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-2021-01232

December 20, 2022

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 King County's Coal Creek Trunk Upgrade Project in Bellevue, Washington (USACE No. NWS-2020-535-WRD, HUC: 171100120400 – Lake Washington)

Dear Mr. Tillinger:

Thank you for the USACE's letter of March 12, 2021, 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 King County Department of Natural Resources and Parks (DNRP), Wastewater Treatment Division (WTD)'s Coal Creek Trunk Upgrade Project in Bellevue, Washington. This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016). Thank you, also, for the USACE's request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)[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, PS steelhead, Puget Sound/Georgia Basin (PS/GB) bocaccio, and PS/GB yelloweye rockfish. The NMFS also concludes that the proposed action is likely to adversely affect designated critical habitat for PS Chinook salmon, PS steelhead, PS/GB bocaccio, PS/GB yelloweye rockfish, and southern resident (SR) killer whales, 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 may affect, but is not likely to adversely affect humpback whales of the Central America and Mexico Distinct Population Segments (DPSs) and SR killer whales.

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 and marine EFH for Pacific Coast Salmon, as well as EFH for Pacific Coast groundfish and coastal pelagic species. Therefore, we have provided 2 conservation recommendations that can be taken by King County and the USACE to avoid, minimize, or otherwise offset potential adverse effects on EFH.

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, 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 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: Andrew Shuckhart, 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

King County DNRP - WTD's Coal Creek Trunk Upgrade Project
Bellevue, King County, Washington
(USACE Number: NWS-2020-535-WRD)

NMFS Consultation Number: WCRO-2021-01232

Action Agency: 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	Yes	No	Yes	No
bocaccio (*Sebastes paucispinis*) Puget Sound /Georgia Basin (PS/GB)	Endangered	Yes	No	Yes	No
yelloweye rockfish (*S. ruberrimus*) PS/GB	Threatened	Yes	No	Yes	No
humpback whales (*Megaptera novaeanglia*)					
Central America	Endangered	No	No	N/A	N/A
Mexico	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	Yes	Yes
Coastal Pelagic Species	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service
West Coast Region

Issued By:

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

Date: December 20, 2022

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LIST OF ABBREIVIATIONS

BE – Biological Evaluation
BMP – Best Management Practices
CFR – Code of Federal Regulations
CBOD5 – Carbanaceous Biochemical Oxygen Demand (5-day)
dB – Decibel (common unit of measure for sound intensity)
dbh – Diameter at Breast Height
DIP – Demographically Independent Population
DPS – Distinct Population Segment
DQA – Data Quality Act
DSPT – Direct Steerable Pipe Thrusting
EF – Essential Feature
EFH – Essential Fish Habitat
ESA – Endangered Species Act
ESU – Evolutionarily Significant Unit
FESL – Fabric Encapsulated Soil Lift
FR – Federal Register
FMP – Fishery Management Plan
HAPC – Habitat Area of Particular Concern
HDPE – High Density Polyethylene
HUC – Hydrologic Unit Code
HPA – Hydraulic Project Approval
ITS – Incidental Take Statement
JARPA – Joint Aquatic Resources Permit Application
MGD – Million Gallons per Day
MLLW – Mean Lower Low Water
MPG – Major Population Group
MSA – Magnuson-Stevens Fishery Conservation and Management Act
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
NPDES – National Pollution Discharge Elimination System
PAH – Polycyclic Aromatic Hydrocarbon
PBF – Physical or Biological Feature
PBDE – Polybrominated Diphenyl Ether
PCB – Polychlorinated Biphenyl
PCE – Primary Constituent Element
PFMC – Pacific Fishery Management Council
PS – Puget Sound
PSTRT – Puget Sound Technical Recovery Team
PSSTRT – Puget Sound Steelhead Technical Recovery Team
PVC – Polyvinyl Chloride
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)
TESC – Temporary Erosion and Sediment Control
TRC – Total Residual Chlorine
USACE – U.S. Army Corps of Engineers
USEPA – U.S. Environmental Protection Agency
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.

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 22, 2020, the NMFS completed formal consultation with the U.S. Army Corps of Engineers' (USACE) for their authorization of King County's installation of temporary streambank protection for Coal Creek Trunk Maintenance Hole R13-25B (NWS-2020-605-WRD; WCRO-2020-01678). That consultation included the county's commitment to remove the temporary protection structures and to conduct stream restoration at the site as part of the project that is the subject of this opinion.

On May 21, 2021, the NMFS received the USACE's formal consultation request for the proposed action (USACE 2021a). The request included King County DNRP's Biological Evaluation (BE; CH2M 2020), their Joint Aquatic Resources Permit Application (JARPA) form and Project Drawings (King County DNRP 2020a; 2020b), and their Fish Passage Crossing Concept for Tributary 2 and Tributary 0272 (CH2M 2019). The NMFS requested additional information on August 5, 2021. On August 12, 2021, a teleconference meeting was held between the NMFS, King County, and some of the County's contractors and agents to discuss the information request. It was agreed to pause the consultation because the project was not developed enough to provide the requested information. King County provided most of the requested information in two emails (King County DNRP 2022a & b). Their January 11, 2022 email provided an addendum to the BE (CH2M 2022a), and their January 21, 2022 email provided revised project drawings for in-water work (Brown and Caldwell, and CH2M 2021). Formal consultation for the proposed action was initiated on January 21, 2022.

In a June 16, 2022 email (King County DNRP 2022c), the County provided the project's Hydraulic Project approval (HPA; WDFW 2022a) and Amended Water Quality Certification Order (WDOE 2022a). On June 29, 2022, the NMFS requested review of their draft proposed action description, and asked for some refined project details. The County responded in 2 emails sent on July 15, 2022 (King County DNRP 2022d & e), which included requested information, a revised drawing for a stream restoration component (Brown and Caldwell, and CH2M. 2021), and suggested edits for the draft proposed action description. On July 21, 2022, the NMFS requested information about the receiving waste water treatment plant (WWTP) and for a copy of its current National Pollution Discharge Elimination System (NPDES) permit. The County responded in 2 emails sent on July 25 & 26, 2022 (King County DNRP 2022f & g), which included the requested information, a copy of the NPDES permit (WDOE 2015), and a copy of a minor modification to the project's HPA (WDFW 2022b).

This opinion is based on the information in the documents identified above; recovery plans, status reviews, and critical habitat designations for ESA-listed PS Chinook salmon, PS steelhead, PS/GB bocaccio, and PS/GB yelloweye rockfish; published and unpublished scientific information on the biology and ecology of those species; and relevant scientific and gray literature (see Literature Cited).

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.

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 (see 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 USACE proposes to authorize King County Department of Natural Resources and Parks, Wastewater Treatment Division (King County) to upgrade its Coal Creek Trunk North sewer pipeline (the existing trunk) in southwestern Bellevue, Washington (Figure 1). Under the ESA, the NMFS considered whether or not the proposed action would cause any other activities and determined that the proposed action would cause the decades-long continuation of municipal effluent flow from the service area to the King County South wastewater treatment plant (WWTP), which discharges effluent to Puget Sound and to a lesser extent to the Green River.

Figure 1. Project location. The Google Earth photograph shows the project site relative to Lake Washington and Puget Sound. The map on the right shows the project area within the City of Bellevue, Washington (The map is adapted from Figure 1 in CH2M 2020).

King County DNRP (2022i) reports that the existing Coal Creek Trunk is a separated system that conveys wastewater (i.e. no stormwater) The existing trunk collects sewage from the City of Bellevue sewer laterals and the Coal Creek Utility District's Olympus Lift Station, and conveys the flow north to the King County Eastside Interceptor (ESI) sewer, which flows to the King County South Treatment Plant in Renton. The existing trunk has a maximum capacity of roughly 9.7 million gallons per day (MGD). The upgraded system would remain separated from stormwater, and would provide a maximum capacity of 18.1 MGD to convey the area's projected 20-year peak sewer wastewater flows through the year 2060 (King County DNRP 2022j).

Within the project area (Figure 2), the existing trunk consists of about 1.41-miles of buried pipe line that tracks closely with the Coal Creek streambed, and crosses the creek and or its tributaries at 11 locations. The project would install about 2.73 miles of new trunk line that would run in an arc east and north of the creek bed. It would also install about 0.37 miles of new lateral sewer line, and convert about 0.16 miles of existing trunk to lateral sewer line. In combination, the new trunk and laterals would cross Coal Creek and or its tributaries at 6 locations. The project would also include the decommissioning in-place of most of the existing trunk, the reuse of some trunk sections, and the removal of about 350 feet of pipe and 6 maintenance hole structures from Coal Creek's streambed and banks. The project would also include wetland and buffer mitigation work. However, because that work would be far enough removed from Coal Creek that it would be extremely unlikely to cause any detectable adverse impacts on or in Coal Creek or any of its tributaries, that work in not described or considered in this opinion.

The project is grouped into 7 activity locations: 1) Spur; 2) South Trunk Connector; 3) Microtunnel; 4) SPU Corridor and Newport Covenant Church Parking Lot (SPU/Newport); 5) 125th Ave. SE (125th Ave.); 6) Woodsong Condominiums (Condos); and 7) ESI Connection. As described in more detail below, the only work expected to impact Coal Creek or its tributaries would occur at the Spur and Condos activity locations, and by workers walking across Coal Creek as needed to access and decommission obsolete sections of the existing trunk. The work at the rest of the activity locations is extremely unlikely to cause detectable adverse impacts on or in Coal Creek or any of its tributaries.

As described in more detail below, all but the very ends of the new trunk would be installed using Direct Steerable Pipe Thrusting (DSPT), which is a trenchless technology that would drill a relatively horizontal underground hole and simultaneously install a 48-inch diameter steel casing pipe as the DSPT tunneling machine moves northward from the Spur location to its opposite end at the ESI Connection location (pipe jacking) (Figure 2). After installation of the steel casing pipe is complete, a 36-inch diameter carrier pipe would be installed inside the casing. A combination of microtunneling, trenched pipe installation, and slip lining of existing pipelines would be used to create new lateral sewer lines, and to connect them to the new trunk. Trenched pipe installation would also be used to connect the new trunk to the existing trunk at the south end of the project area, and to connect to the ESI pipeline at the project's north end.

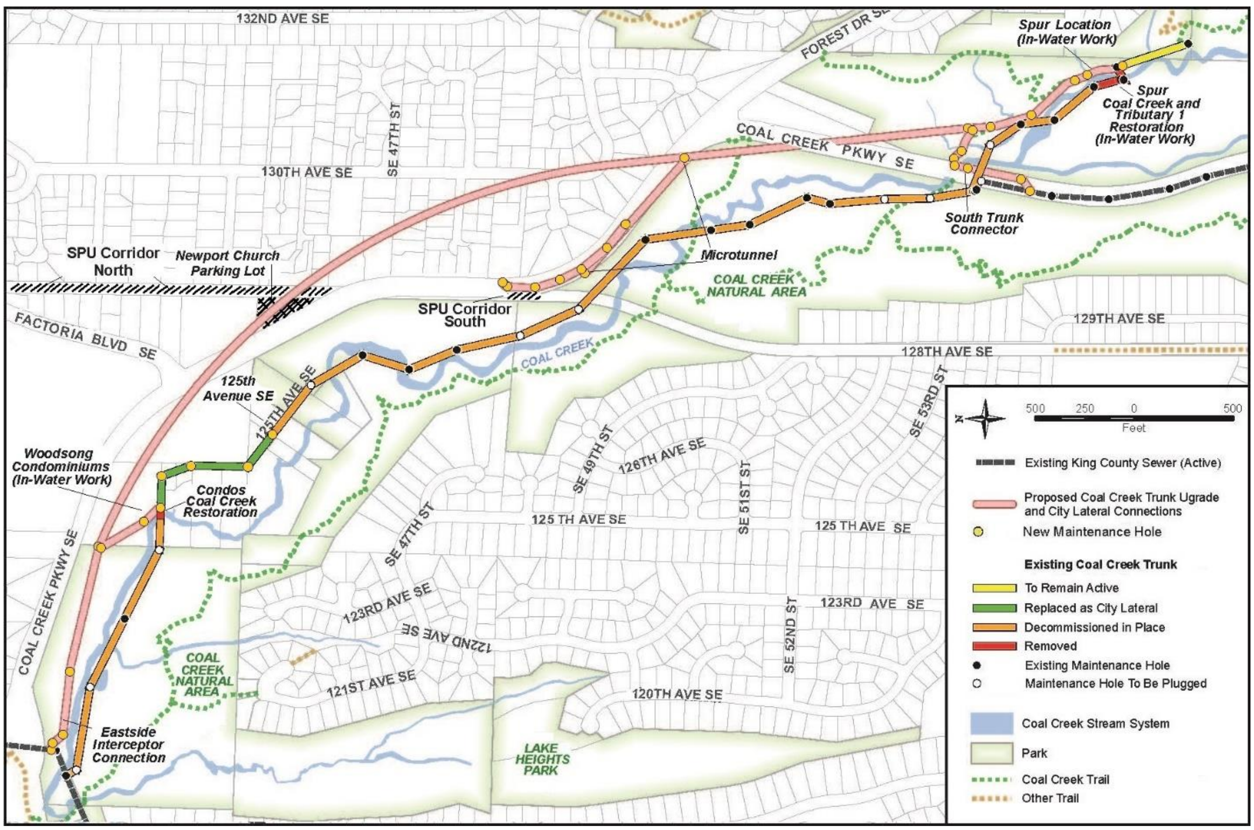

Figure 2. Coal Creek Trunk North project area. The drawing is rotated 90 degrees left to better fit on the page. The proposed trunk and its new lateral lines are shown in pink. The existing trunk within the project area is shown mostly in orange, with a green segment showing where a section would be converted to a lateral line, and 2 red segments showing where trunk segments would be removed from the streambed. The yellow segment at the south end of the trunk is outside of the project area (Adapted from Figure 1A in CH2M 2022a).

Construction is expected to begin in 2024 and to take about 5 years to complete. In-water work would be limited to work at the Condos and Spur activity locations, and to workers walking across Coal Creek as needed to access and decommission the obsolete sections of the existing trunk. All in-water work would be accomplished in years 3 and 4, during the June 16 through September 15 WDFW-authorized in-water work window for the project (King County DNRP 2022d; WDFW 2022a).

All work would be done in compliance with all protective measures and best management practices (BMPs) identified in the Impact Avoidance and Minimization Measures in the applicant's BE (CH2M 2020) (contra IMM 5, as modified in the amended Water Quality Certification for the project), in the Project Water Quality Monitoring and Protection Plan (CH2M 2022b), in the amended Water Quality Certification (WDOE 2022a), and in the provisions identified in the Hydraulic Project Approval for the project (WDFW 2022a). Also, vegetation would be protected and preserved to the greatest extent practicable, and all trees with a 4-inch or greater diameter at breast height (DBH) that would be removed from within the 200-foot WDFW riparian management zone would be replaced with habitat-appropriate native tree species at a 3:1 ratio. Outside of the 200-foot zone, removed trees with an 8-inch or greater DBH would be replaced with habitat-appropriate native tree species at a 1:1 ratio.

Year-1 work would include no in-water work, and would be limited to site-wide mobilization of equipment and supplies, installation of temporary erosion and sediment control (TESC) measures, and some tree protection activities.

Year-2 work would include no in-water work, and would be limited to work at the Spur, Microtunnel, and SPU/Newport locations.

Year-3 work would be done at the Spur, South Trunk Connector, Microtunnel, SPU/Newport, and ESI Connection locations. In-water work would be limited to the Spur location.

Year-4 work would be done at all 7 project activity locations. In-water work would be limited to the Spur and Condos locations and site-wide decommissioning of the replaced section of trunk. Site-wide work to decommission the existing trunk would consist of hand-carrying machinery and walking on foot to plug select maintenance holes and pipes.

Year-5 work would be limited to about 6 months of minor site-wide remedial activities that may be needed to return project locations to pre-construction conditions and or to complete replacement plantings of native vegetation to close-out the project. As such, site-specific Year-5 work is not described below.

The location-specific work descriptions below are organized in location order from south to north.

<u>Spur location:</u> The Spur location is at the south end of the project area (Figures 2 & 3). Work at this location would be done during years 2, 3, and 4, and would occur immediately adjacent to and within Coal Creek and two of its tributaries. In-water work would be limited to years 3 and 4. Year-2 work at the Spur location would consist of installation of TESC measures, closure and demolition of the trailhead parking lot, excavation of the DSPT launch pit, and installation of 48-

inch steel pipe casing into the DSPT borehole (pipe jacking) as it is extended from the Spur location to the ESI location along the new trunk alignment route.

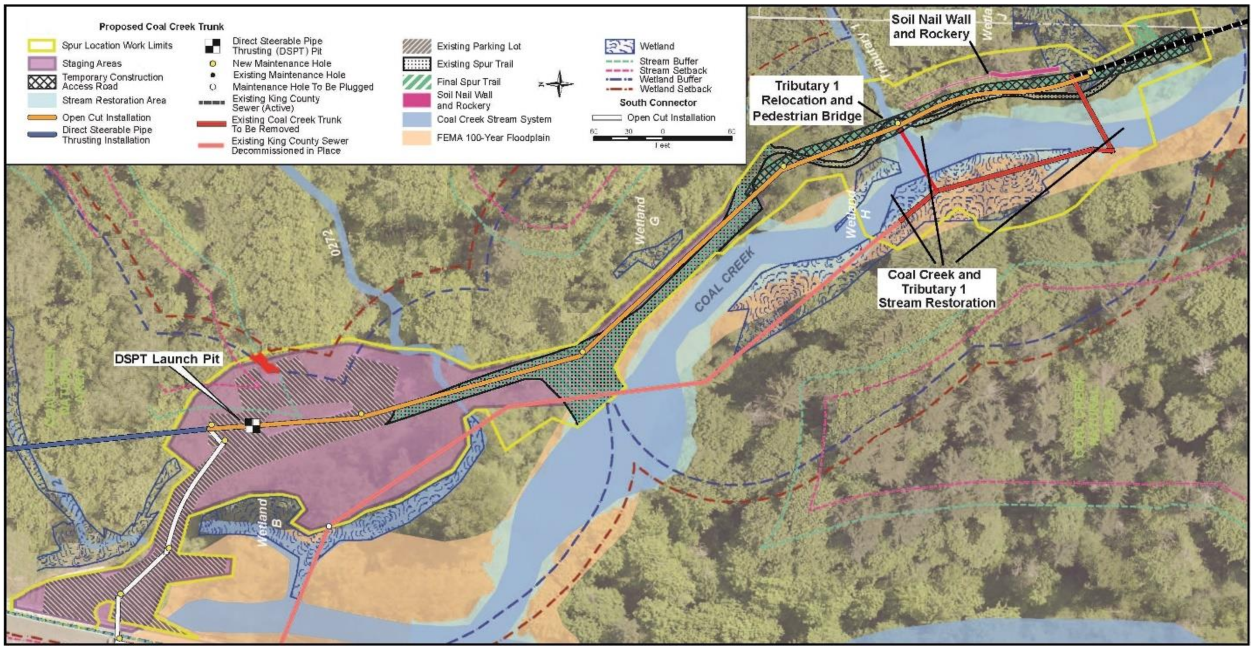

Figure 3. Overhead photograph of the Spur activity location. The photograph is rotated 90 degrees left of true north to better fit on the page. The activity area is outlined in yellow. The DSPT-installed trunk is shown in blue, and the open-trench connection to the existing trunk is shown in orange. The section of the existing trunk and existing City lateral line to be removed is shown in red, and the portion to be decommissioned in-place is shown in pink. (Adapted from Figure 6 in CH2M 2022a).

Year-3 work at the Spur location would include the completion of DSPT pipe jacking of the new trunk casing to the ESI location, the installation of a 36-inch high-density polyethylene (HDPE) carrier pipe within the new trunk casing, and demobilization of the DSPT equipment. It would also include the construction of about 415 feet of 20-foot wide temporary gravel access road along the existing 4-foot-wide gravel trail in the southern portion of the location, the upland excavation and installation of about 845 feet of 24-inch pipe between the DSPT launch pit and the existing trunk at maintenance hole R13-25A, and installation of about 140 feet of permanent upland retaining wall landward of the temporary road south of Tributary 1.

Temporary road construction and trenched pipe installation would cross Tributary 1. Trenched pipe installation would also cross Tributary 0272, but no in-water work would be required for the Tributary 0272 crossing because the tributary flows under the temporary road's proposed route in a pipe culvert that requires no adjustments to accommodate the project. Further, the culvert would be supported in place while the trench is excavated, the pipe is installed about 7 feet below the culvert, and the trench is backfilled. The new pipe would not preclude future culvert replacement. Year-3 in-water work at the trunk location would include installing an extended pipe culvert (bypass culvert) for the current Tributary 1 culvert crossing, and installation of temporary bank stabilization where the temporary road would be close to the right bank of Coal

Creek. This in-water work is discussed in more detail later in this section, under in-water work. The extended bypass culvert for Tributary 1 would be supported in place while the trench is excavated, the pipe is installed about 7 feet below the culvert, and the trench is backfilled. The Tributary 1 bypass culvert would be removed during year 4 as part of this project.

Year-4 work at the Spur location would include the completion of trenched pipe installation between the DSPT launch pit and the existing trunk at maintenance hole R13-25A; the removal from the Coal Creek channel and bank of the temporary streambank protection that was installed in front of maintenance hole R13-25B in 2020, about 252 feet of existing trunk pipe, about 75 feet of existing City lateral sewer pipe, and 4 maintenance holes; channel and bank restoration work in Coal Creek; removal of the Tributary 1 bypass and relocation of its channel; the conversion of the temporary access road to a permanent gravel trail, including the installation of a pedestrian bridge across Tributary 1; and repaving the parking lot. Year-4 in-water work would include the removal of sewer pipes and maintenance holes from the channel and banks of Coal Creek, restoration of Coal Creek, and Tributary 1 relocation, all of which is discussed in more detail under in-water work. After the stream restoration work at the site is complete, the contractors would convert the temporary access road into a permanent 10-foot wide ADA-compliant gravel trail that would also provide maintenance vehicle access. They would also repave the parking lot and restore its associated stormwater facilities, and restore the project area to pre-construction conditions or better.

<u>South Trunk Connector location:</u> The South Trunk Connector location is just north of the Spur location, to which it connects, and with which it shares a staging area (Figures 2 & 4). Work at this location would be done during years 3 and 4. No in-water work would be done at this location, but site preparation and staging would occur adjacent to Coal Creek, Tributary 2, Tributary 0272, and three wetland areas.

Year-3 work would consist of installation of TESC measures, expansion of the staging area, and trench excavation and installation of a 21-inch diameter pipe westward from the DSPT launch pit, across and southward along Coal Creek Parkway SE to the existing King County south trunk sewer line (Figure 4). The trench section and pipeline that would cross Tributary 2 would pass about 3 feet under a section of the tributary that flows through a pipe culvert. The culvert would be supported in-place during trenching and pipe installation. The trench section and pipeline that would cross Coal Creek would do so about 0.5 foot above the Coal Creek culvert that crosses under Coal Creek Parkway SE. Both stream crossing are designed to avoid affecting either stream or interfering with possible future culvert replacements to improve fish passage.

Year-4 work would include the completion of trenched pipe installation, back-filling of the trench, repaving of Coal Creek Parkway SE, and restoration of the area to pre-construction conditions or better.

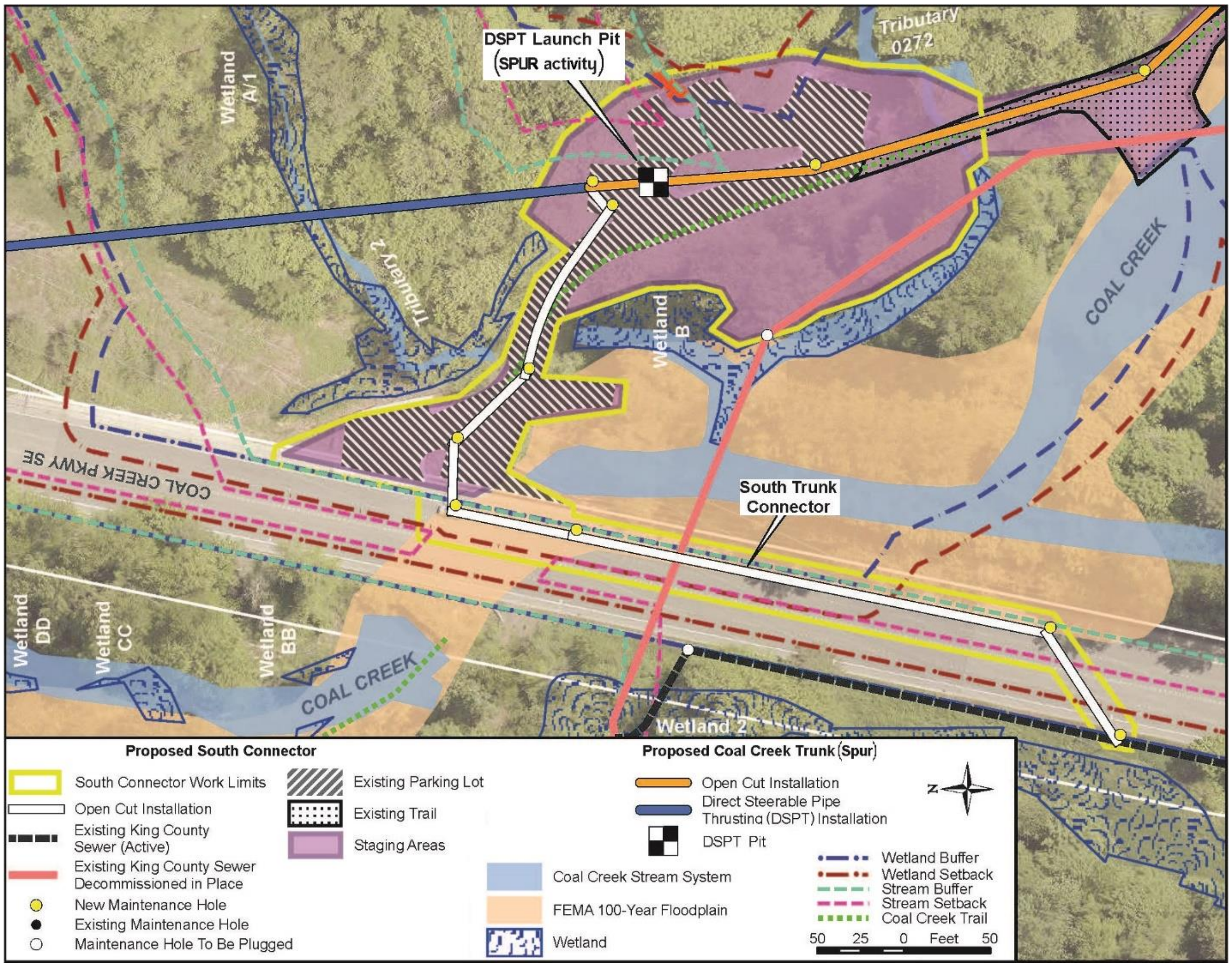

Figure 4. Overhead photograph of the South Trunk Connector activity location. The photograph is rotated 90 degrees left of true north to better fit on the page. The activity area is outlined in yellow, and the trenched installation of the South Connector pipe is shown as a white line. The proposed new trunk is shown in blue and orange (Adapted from Figure 7 in CH2M 2022a).

Microtunnel location: The Microtunnel location is situated along Coal Creek Parkway SE, between 128th Ave. SE and the split between Coal Creek Parkway SE and Forest Drive SE (Figures 2 & 5). Work at this location would be done during years 2, 3, and 4. However, no work at this location would be done within the 100-year floodplain. Small portions of the work at this location would be within 100 feet of Coal Creek, but a densely wooded slope would separate the creek from the work.

Year-2 work would consist of installation of TESC measures, site clearing, installation of temporary access pullouts, and installation of dewatering systems at the north and south ends of the location. It would also include the excavation of a microtunnel receiving pit at the south end of the location where the microtunnel and DSPT pipelines would connect, and installation of a temporary cover over the connection shaft.

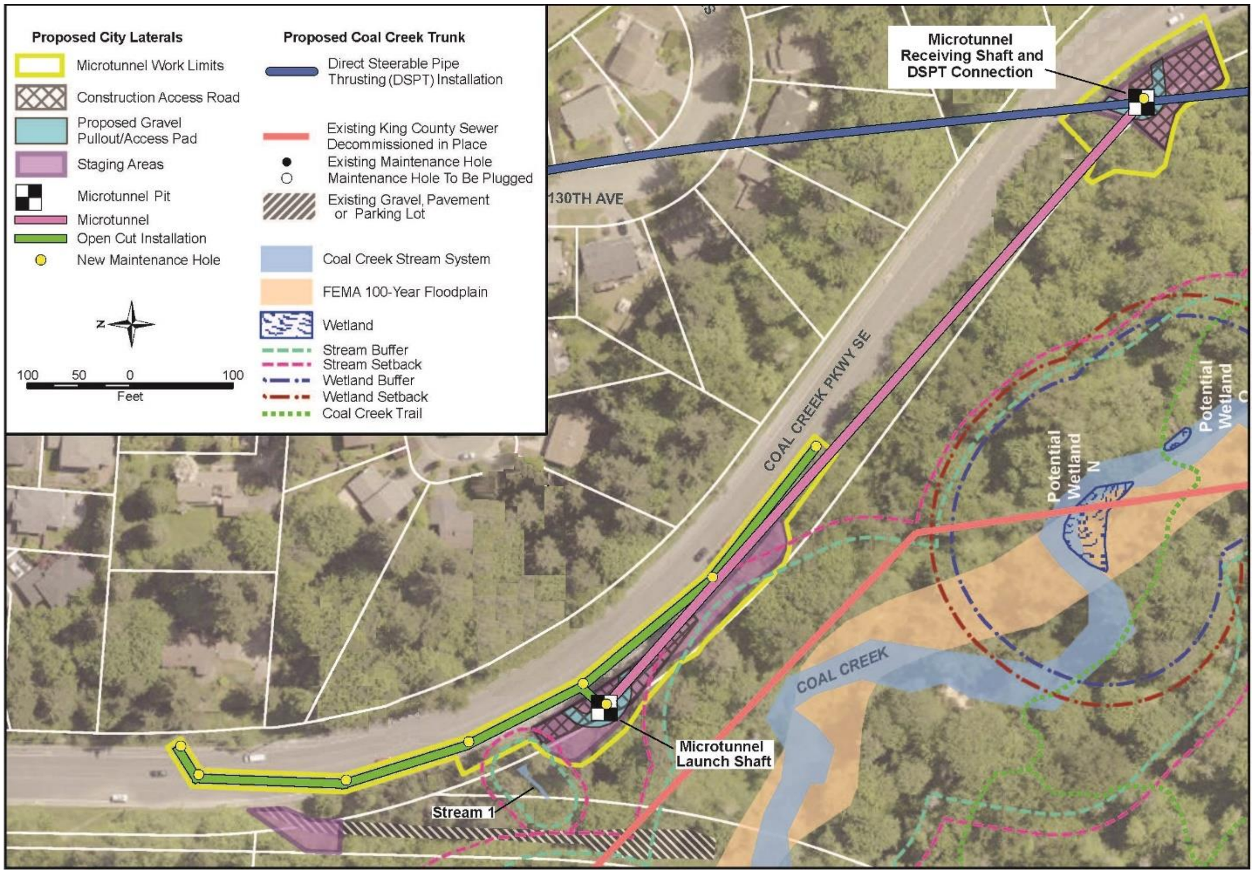

Figure 5. Overhead photograph of the Microtunnel activity locations. The photograph is rotated 90 degrees left of true north to better fit on the page. The activity areas are outlined in yellow. The green line indicates a section trench-installed pipeline, and the pink line indicates a section of microtunnel-installed pipeline that would connect the trenched pipeline to the new DSPT-installed trunk that is shown in blue (Adapted from Figure 6 in CH2M 2022a).

Year-3 work would consist of the installation of two lateral lines to connect the City of Bellevue system to the new trunk (Figure 4). The contractors would excavate a microtunnel launch pit at the north end of the proposed microtunnel pipeline, and use microtunnel equipment to install a 42-inch casing with a 12-inch polyvinyl chloride (PVC) pipe southeastward to the microtunnel receiving pit. To connect the local sewer lines to the new trunk, the contractors would also excavate an open trench and install an 8-inch diameter PVC pipe north and across Coal Creek Parkway SE, and connect the trenched pipe to the microtunnel pipe at the launch pit. They would complete most of the work to return the location to its pre-construction condition, including also backfilling the trench and the microtunnel launch pit, and repaving Coal Creek Parkway SE.

Year-4 work would consist of the disconnection of the City sewers from the existing trunk, connection of the new City lateral lines to the new trunk, backfilling of the microtunnel receiving pit, and completion of site restoration. Site restoration would include a permanent maintenance vehicle pull-out, and vegetation restoration to pre-construction conditions or better.

SPU/Newport locations: The SPU/Newport locations are near the middle of the proposed trunk line, slightly north of the Microtunnel location (Figures 2 & 6). Work at this location would be done during years 2, 3, and 4. No work would be done within the 100-year floodplain, and all work would generally be done more than 100 feet from stream channels. The SPU/Newport locations would be used to provide staging areas and heavy equipment access, and the contractors would excavate a temporary inspection shaft along the DSPT-installed trunk alignment where it would pass under the Newport Covenant Church parking lot. The DSPT-installed trunk would cross about 91 feet below Tributary 268, which is contained in a pipe that extends under the church parking lot and Coal Creek Parkway SE. Tributary 268 would be unaffected by the proposed work at this location.

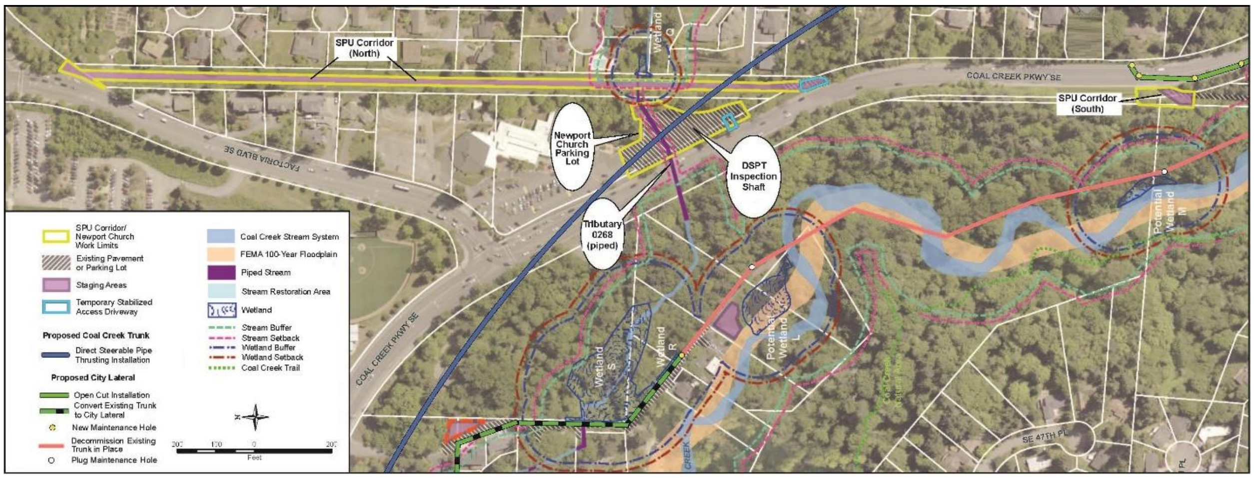

Figure 6. Overhead photograph of the SPU/Newport activity locations. The photograph is rotated 90 degrees left of true north to better fit on the page. The activity areas are outlined in yellow (Adapted from Figure 5 in CH2M 2022a).

Year-2 work at the SPU/Newport locations would include installation of TESC measures, site clearing, construction of a temporary access driveway, installation of a dewatering system, and excavation of an inspection shaft in the church parking lot. Year-3 work would consist of backfilling the DSPT inspection shaft, restoration of church parking lot, and continued use of staging areas and temporary access driveway. Year-4 work would consist of continued use of the staging areas and temporary access driveway, and restoration of the site to pre-construction conditions at the completion of the work.

125th Ave. SE location: The 125th Ave. SE location is situated west of Coal Creek Parkway SE and the Newport Covenant Church Parking Lot, and southwest of the intersection between Coal Creek Parkway SE and Factoria Blvd. SE. (Figures 2 & 7). Work at this location would be done during year 4. No in-water work would be done at this location, but site preparation and staging would occur adjacent to Coal Creek, Tributary 268, and two wetland areas.

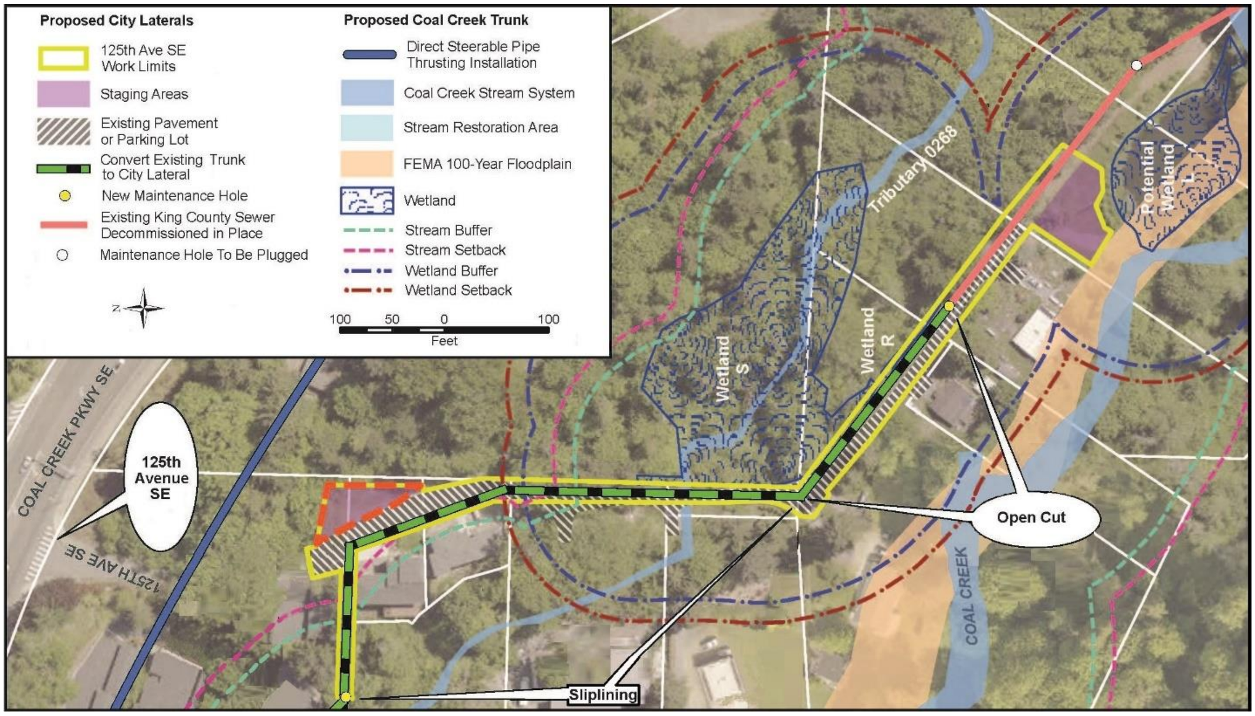

Figure 7. Overhead photograph of the 125th Ave. SE location. The photograph is rotated 90 degrees left of true north to better fit on the page. The activity area is outlined in yellow (Adapted from Figure 4 in CH2M 2022a).

Year-4 work at this location would include the installation of TESC measures, installation of temporary flow diversions for existing side sewers, and the conversion of a section of the existing trunk into a lateral sewer line. Conversion work would include excavation of the southern portion of the existing trunk to install new pipe, and insertion of a liner (slip-lining) into the northern section of the existing trunk line (Figure 7). The slip-lined portion of the existing trunk crosses about 4 feet below Tributary 268, and the proposed work would not affect the tributary. The site would be restored to pre-construction conditions or better at the completion of the work.

Condos location: The Condos location is south of Coal Creek Parkway SE, between the 125th Ave. SE. and the ESI locations. It shares an access road and staging areas with the ESI location (Figures 2 & 8.) Work at this location would be done during year 4, and would include in-water work to remove a section of the existing trunk that crosses Coal Creek, to install bank stabilization along the right bank of the creek, and to perform stream restoration. This in-water work is discussed in more detail later, under in-water work. Upland work at this location would consist of installation of tree protection and TESC measures; clearing; installation of a dewatering system; construction of a temporary 17-space paved parking lot for Condo residents to use while construction activities block access to their existing parking lot; and excavation to remove a city maintenance hole, decommission about 75 feet of existing city sewer line, and to install an 8-inch diameter PVC pipe from the DSPT receiving pit to the existing trunk at the 125th Ave. SE location to connect the new lateral sewer line to the new trunk. The site would be restored to pre-construction conditions or better at the completion of the work.

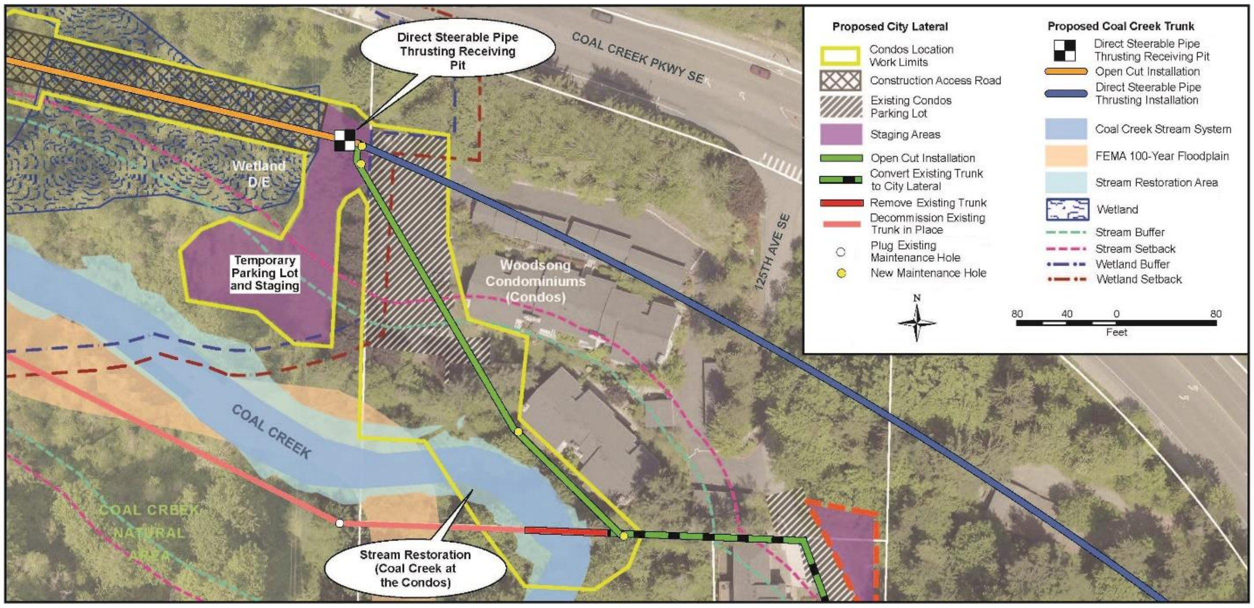

Figure 8. Overhead photograph of the Condos location. The activity area is outlined in yellow, extending off the left side of the image due to the access route that is shared with the ESI location (Adapted from Figure 3 in CH2M 2022a).

ESI Connection location: The ESI Connection location is south of Coal Creek Parkway SE, between 119th Ave. SE and 124th Ave. SE., and northwest of the 125th Ave. SE. location, which it shares an access road and staging areas (Figures 2 & 9.) Work at this location would be done during Years 3 and 4, and would include no work within the Coal Creek 100-year floodplain. At its closest, work would be done about 40 feet away from the creek.

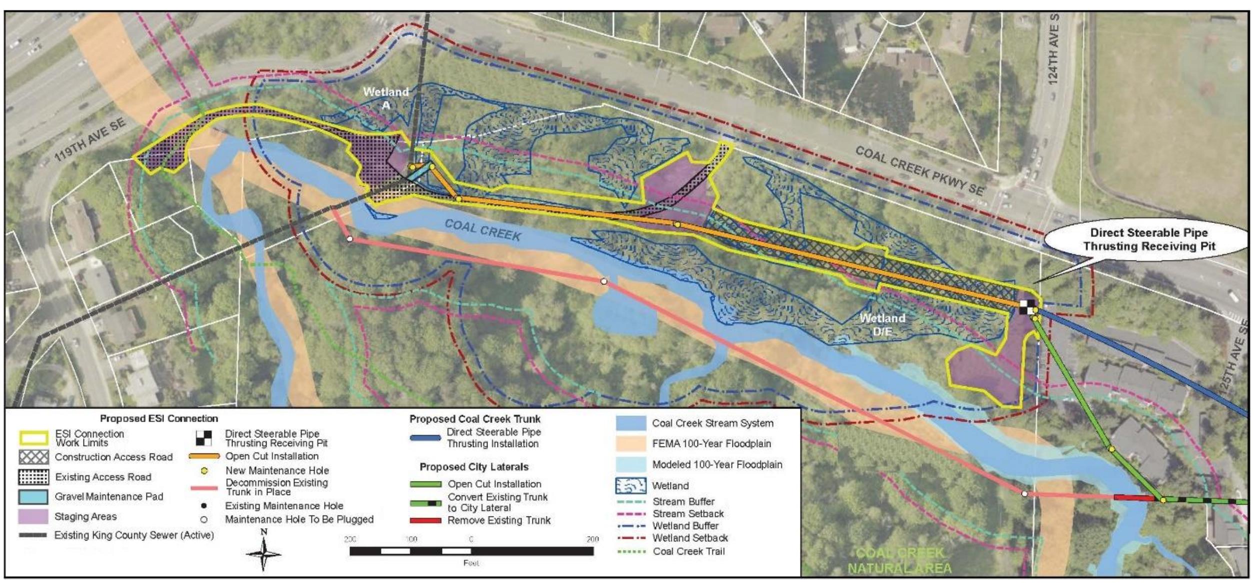

Figure 9. Overhead photograph of the ESI Connection activity location. The activity area is outlined in yellow. The open-trench connection between DSPT-installed trunk and the existing ESI is shown in orange. The section of the existing trunk to be decommissioned in-place is shown in pink (Adapted from Figure 1 in CH2M 2022a).

In-Water Work: As described above, in-water work would be done at the Spur and Condos activity locations. Additionally, work would be done across the whole project area to decommission most of the existing trunk, which would require personnel to walk across Coal Creek at multiple locations in order to access the existing trunk.

Spur location

During year 3, the County's contractors would conduct in-water work to temporarily extend the pipe culvert on Tributary 1. The County estimates that the bypass would impact about 225 square feet, along about 20 linear feet. If needed to protect this component's temporary access road where it would be close to Coal Creek, the County's contractors would install about 85 linear feet of temporary bank stabilization along the right bank of Coal Creek near the confluence of Tributary 1. If needed, the bank stabilization would consist of rip rap or supersacks filled with sand or rounded rock. The County estimates that the temporary bank stabilization would impact about 850 square feet of the right bank of Coal Creek. The work for both components would be completed by heavy equipment such as cranes or excavator and trucks that would be operated from the temporary access road, and by workers on foot. This work would be done during the June 16 through September 15 WDFW-authorized in-water work window for the project, and may require about 12 weeks to complete.

During year 4, the County's contractors would conduct in-water work to remove the temporary Tributary 1 bypass and temporary bank stabilization that were installed during year 3, and to remove temporary bank stabilization structures that were installed along the left bank of Coal Creek in 2020 to temporarily protect maintenance hole R13-25B. They would also remove the existing sewer line that extends across Coal Creek between maintenance holes R33-11 (formerly R13-25A) and R13-25C, the existing sewer line that extends along the left bank of Coal Creek between maintenance holes R13-25C and R13-25, the existing sewer line that extends across Coal Creek between maintenance holes R33-10 and R13-25, and existing maintenance holes R13-25B, R13-25C, R13-25, and the un-numbered maintenance hole that is in-line between maintenance holes R33-10 and R13-25. They would also conduct channel and bank restoration work in Coal Creek, and permanently convert the Tributary 1 culvert to a relocated channel with a pedestrian bridge crossing (Figure 10).

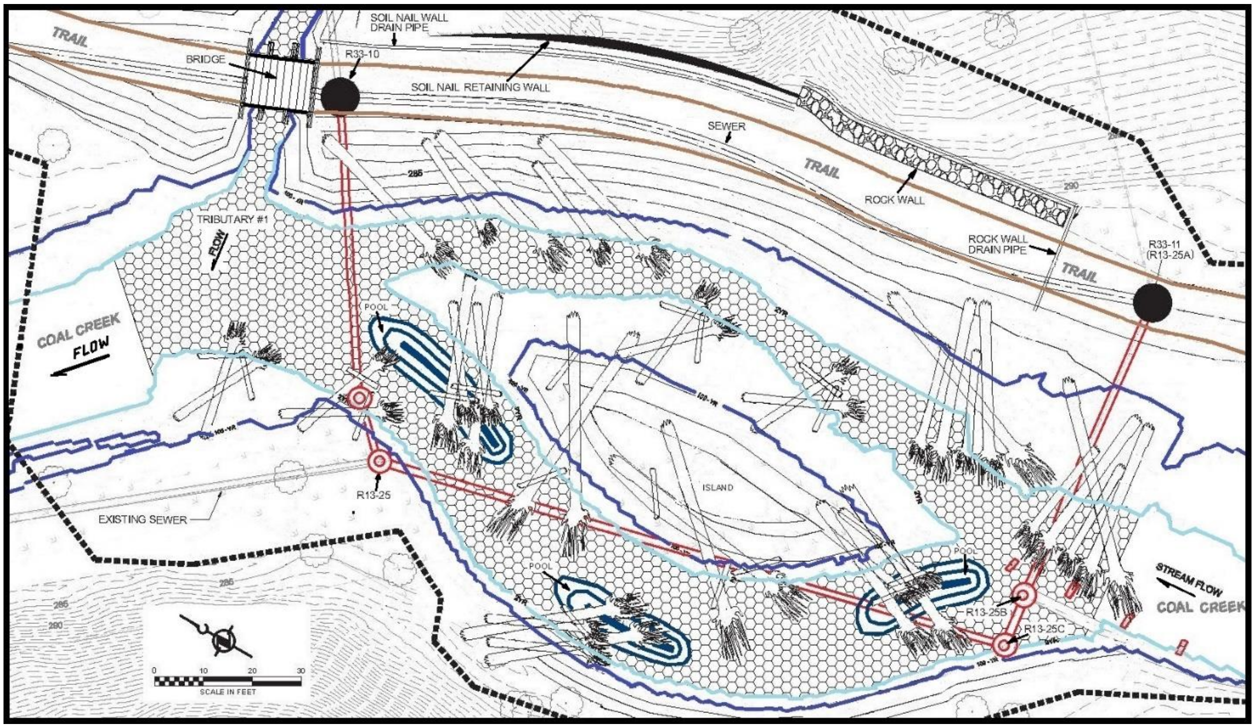

Figure 10. Drawing of the proposed stream restoration work at the Spur activity location. The activity area is outlined with a black dotted line. The planned 2-year and 100-year water levels, and the pools are shown in light, medium, and dark blue, respectively. The existing sewer pipes and maintenance holes to be removed are shown in red. The polygon-patterned area indicates where supplemental streambed substrate material would be installed (Adapted from Drawings CV-453-C-10164, 10166, & 40164 1 in Brown and Caldwell and CH2M 2021).

The County's contractors would operate heavy equipment such as cranes or excavators and trucks primarily from the temporary access road. However, some heavy equipment operation below the OHWM may be required, but would be done so in the dry after the creek is bypassed. Additionally, workers would operate various hand-held tools such as shovels, pickaxes, and chainsaws on foot. This work would be done during the June 16 through September 15 WDFW-authorized in-water work window for the project, and would require about 12 weeks to complete.

Workers would first isolate the project area by installing barrier nets across Coal Creek, then perform fish salvage work, and install a temporary gravity flow bypass to route creek waters around the work area. The exact order of project components that would follow the work area isolation and fish salvage is somewhat uncertain, is likely to overlap in some instances, and is likely prone to coordination-driven adjustments. Therefore, the following description of work is organized in a manner intended to provide project details without implying any strict sequencing of the work.

The contractors would operate heavy equipment with scoop and or clamshell type buckets to remove the temporary bank stabilization structures, to excavate the new Tributary 1 channel about 10 feet north of its current alignment, to expose and remove the existing sewer lines and maintenance hole structures that are to be removed, and to reshape the stream reach, including creating an island and pool and riffle features. As applicable, excavated streambed materials that would be reused would be stockpiled and protected from erosion, whereas concrete debris and pipes would be placed on trucks for removal to appropriate upland disposal facilities. After the maintenance hole and pipe are removed, the contractors would backfill the trench with excavated materials. The contractors would use the heavy equipment to install 59 pieces of LWM in various sizes and habitat structure configurations around the restoration area, and install streambed gravels and cobbles within Coal Creek and Tributary 1 (Figure 10).

As the restoration work moves northward, the contractors would convert the temporary access road to a permanent gravel trail and maintenance vehicle access road that would be about 10 feet wide. The contractors would install a 12-foot long by 10-foot wide pedestrian bridge across the new Tributary 1 channel as part of this work. After the in-channel work is complete in Coal Creek and Tributary 1, water flow would be carefully returned to the channels, and the bypasses would be removed.

The County estimates that the stream restoration work at the Spur location would impact about 5,313 square feet, along about 307 linear feet of Coal Creek, and that removal of the Tributary 1 pipe culvert and realignment of its channel would impact about 681 square feet along 57 linear feet.

Condos location

During year 4, the County's contractors would conduct in-water work to remove a section of the existing trunk that crosses Coal Creek, to install bank stabilization along the right bank of the creek, and to perform stream restoration (Figure 11).

The County's contractors would operate heavy equipment such as an excavator and trucks from the right bank of Coal Creek. However, some heavy equipment operation below the OHWM may be required, but would be done in the dry after the creek is bypassed. Additionally, workers would operate various hand-held tools such as shovels, pickaxes, and chainsaws on foot. This work would be done during the June 16 through September 15 WDFW-authorized in-water work window for the project, and would require about 12 weeks to complete.

Workers would first isolate the project area by installing barrier nets across Coal Creek, then perform fish salvage work, and install a temporary bypass to route creek waters around the work area. The exact order of project components that would follow the work area isolation and fish salvage is somewhat uncertain, is likely to overlap in some instances, and is likely prone to coordination-driven adjustments. Therefore, the following description of work is organized in a manner intended to provide project details without implying any strict sequencing of the work.

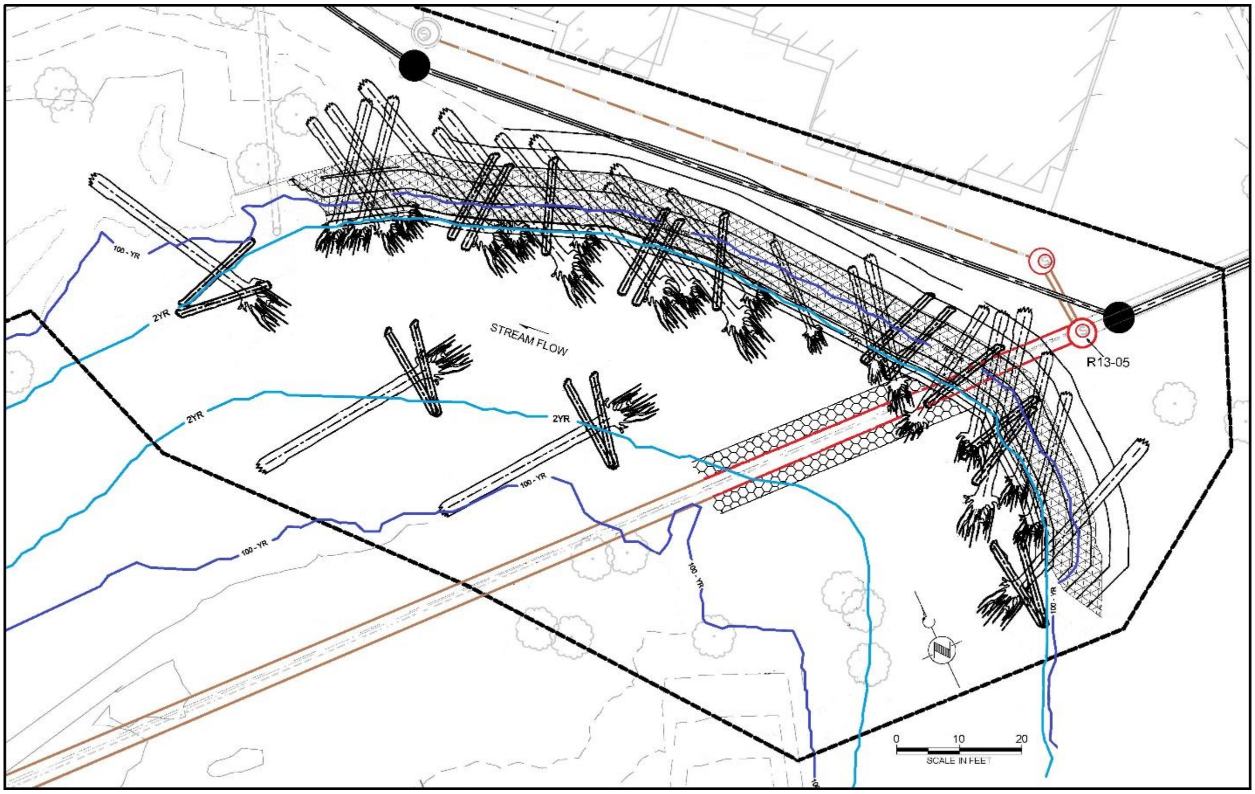

Figure 11. Drawing of the proposed stream restoration work at the Condos activity location. The activity area is outlined with a black dotted line. The planned 2-year and 100-year water levels are shown in light and medium blue, respectively. The sewer pipe section and maintenance hole to be removed are shown in red. The sewer line sections to be decommissioned in-place are shown in brown. The polygon-patterned area indicates where supplemental streambed substrate material would be installed (Adapted from Drawings CV-453-C-40163 in Brown and Caldwell, and CH2M. 2021 and Drawing CV453-C-10164 in Brown and Caldwell, and CH2M 2022).

The contractors would use an excavator or similar equipment with a scoop or clamshell type bucket to expose and remove maintenance hole R13-05 and the existing sewer line that extends from it to cross Coal Creek. The City maintenance hole and sewer line shown in Figure 10 as being removed and decommissioned, respectively, were identified earlier as part of the upland work at this location, and would include no in-water work. As applicable, excavated streambed materials that would be reused would be stockpiled and protected from erosion, whereas concrete debris and pipes would be placed on trucks for removal to appropriate upland disposal facilities. After the maintenance hole and pipe are removed, the contractors would backfill the trench with excavated materials, and install appropriately sized, clean streambed mix over the top of the trenched area.

The contractors would also use the excavator to reshape the right bank, and to install 43 pieces of LWM and Fabric Encapsulated Soil Lifts (FESLs) along about 165 linear feet of the right bank of the creek. The FESLs would be encased in coir fabric. The LWM would be 18 to 24 inches in diameter, 15 to 40 feet long, and have root wads. The LWM would be anchored below the 2-year water surface elevation using toe-key rock, and the FESL would be installed over the anchored upper ends of the LWM, with the root wads extending into the creek channel. Live cuttings would be planted in the FESL above the OHWM of the creek. The contractors would also install about 9 other pieces of LWM on the banks of the creek outside of the bank stabilization structure (Figure 11). After the in-channel work is complete, water flow would be carefully retuned to the creek, and the bypass would be removed.

The County estimates that the stream restoration work at the Condos location would impact about 5,326 square feet, along about 184 linear feet of Coal Creek.

Site-wide Trunk Decommissioning

During year 4, after the new trunk system has been tested and brought online, workers would hand-carry tools and equipment, and walk across Coal Creek where needed to access select maintenance holes and pipes along the existing trunk's route. The workers would plug those maintenance holes and pipes, and in some instances, they would remove the upper portion of maintenance holes. However, they would leave the buried pipeline (decommission in-place). Decommissioning work that requires stream crossings would be completed during the June 16 through September 15 WDFW-authorized in-water work window for the project.

Other activities that could be caused by the proposed action

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that the proposed action would cause no change in the chemical nature of the effluent carried by the trunk line. However, the proposed action would cause the decades-long continuation of municipal effluent flow, and nearly double (~ 87% increase) the maximum flow volume from the service area to the King County South wastewater treatment plant (WWTP), which discharges effluent to Puget Sound, through Outfall 001, and to a lesser extent to the Green River, through Outfall 002. Therefore, we included an analysis of the effects of the continued 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 (LAA) PS Chinook salmon and PS steelhead, not likely to adversely affect (NLAA) designated critical habitat for both species, and would have no effect on Southern Resident (SR) killer whales and their designated critical habitat. Because the NMFS concluded that the proposed action is likely to adversely affect PS Chinook salmon and PS steelhead (Table 1), the NMFS proceeded with formal consultation.

Because the proposed action would cause the continued discharge of municipal effluent from the service area to Puget Sound, and to a lesser extent to the Green River, the NMFS also analyzed the action's potential effects on PS/GB bocaccio, PS/GB yelloweye rockfish, humpback whales (Central America and Mexico DPSs), SR killer whales, and designated critical habitat for PS Chinook salmon, PS steelhead, PS/GB bocaccio, PS/GB yelloweye rockfish, and SR killer whales. Based on that analysis, the NMFS further concluded that the proposed action is likely to adversely affect PS/GB bocaccio, PS/GB yelloweye rockfish, and designated critical habitat for PS Chinook salmon, PS steelhead, PS/GB bocaccio, PS/GB yelloweye rockfish, and SR killer whales. Our conclusion that proposed action is not likely to adversely affect humpback whales (Central America and Mexico DPSs) and SR killer whales is documented 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)
bocaccio (*Sebastes paucispinis*) Puget Sound/Georgia Basin	Endangered	LAA	LAA	04/28/10 (75 FR 22276) / 11/13/14 (79 FR 68041)
yelloweye rockfish (*S. ruberrimus*) PS/GB	Threatened	LAA	LAA	04/28/10 (75 FR 22276) / 11/13/14 (79 FR 68041)
Killer whales (Orcinus orca) Southern resident (SR)	Endangered	NLAA	LAA	11/18/05 (70 FR 57565) / 11/29/06 (71 FR 69054)
ESA-listed species and critical habitat not likely to be adversely affected (NLAA)				
Species	**Status**	**Species**	**Critical Habitat**	**Listed / CH Designated**
Central America humpback whales (*Megaptera novaeanglia*)	Endangered	NLAA	N/A	09/08/16 (81 FR 62259) / N/A
Mexico humpback whales (*Megaptera novaeanglia*)	Threatened	NLAA	N/A	09/08/16 (81 FR 62259) / N/A

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, PS steelhead, PS/GB Bocaccio, PS/GB yelloweye rockfish, and SR killer whales use the terms primary constituent element (PCE) 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 PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

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.

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.

Listed Species

Viable Salmonid Population (VSP) Criteria

For Pacific salmonids, we commonly use four VSP criteria (McElhany et al. 2000) to assess the viability of the populations that constitute the species. These four criteria (spatial structure, diversity, abundance, and productivity) encompass the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. When these parameters are collectively at appropriate levels, they maintain a population's capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment.
"Spatial structure" refers both to the spatial distributions of individuals in the population and the processes that generate that distribution. A population's spatial structure depends on habitat quality and spatial configuration, and the dynamics and dispersal characteristics of individuals in the population.

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

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

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

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

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

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.

<u>Spatial Structure and Diversity:</u> The PS Sound Chinook salmon ESU includes all naturally spawning populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington. The ESU also includes the progeny of numerous artificial propagation programs (NWFSC 2022a). 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 (NWFSC 2022a).

<u>Abundance and Productivity:</u> Available data on total abundance since 1980 indicate that abundance trends have fluctuated between positive and negative for individual populations, but productivity remains low in most populations, and hatchery-origin spawners are present in high fractions in most populations outside of the Skagit watershed. 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 (NWFSC 2022a). 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 (NWFSC 2022a).

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

Table 2. Extant PS Chinook salmon populations in each biogeographic region (Ruckelshaus et al. 2002, NWFSC 2022a).

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

PS Chinook Salmon within the Action Area: The proposed action would affect PS Chinook salmon at 3 separate locations: the Coal Creek project site; the Outfall 001 site in Central Puget Sound; and the Outfall 002 site in the Green River. All of the populations that would be affected by the proposed action belong to the Central/South Puget Sound MPG.

The PS Chinook salmon most likely to occur in Coal Creek would be Fall-run Chinook Salmon that are reported in Coal Creek from Lake Washington to a point above the Coal Creek Parkway SE overpass (WDFW 2021; 2022c; 2022d). Between 2008 and 2021, WDFW reported between 0 and 7 Chinook salmon redds observed annually within Coal Creek. Spawning was reported from upstream of the I-405 overpass to a point above the Coal Creek Parkway SE overpass. WDFW also reported between 0 and 41 live adult Chinook salmon annually in Coal Creek (WDFW 2021; 2022c). More robust information to describe abundance and trends for PS Chinook salmon in Coal Creek is unavailable, but their numbers are much smaller than the two identified fall-run Chinook salmon populations within the Lake Washington watershed; the Cedar and the Sammamish River populations (NWFSC 2022a; WDFW 2022d), which are discussed below. Both stream- and ocean-type Chinook salmon are present in these populations, with the majority being ocean-types. Juvenile Chinook salmon start emigrating from Coal Creek as early as December, with emigration peaking around May. They can be found in Lake Washington, primarily in the littoral zone, until July (Tabor et al. 2006). Some stream-type fish may occur in the creek year-round, but only in very low numbers. Fish surveys conducted with electrofishing in Coal Creek during the summer of 2015 yielded numerous fish species, including juvenile coho salmon, but no juvenile Chinook salmon (HartCrowser 2015), suggesting few if any stream type Chinook salmon in Coal Creek. Returning adult Chinook salmon typically pass through Chittenden Locks mid-June through September, with peak migration occurring in mid-August (City of Seattle 2008). Adult Chinook salmon begin entering Coal Creek in early September. Spawning typically occurs during October and early November (WDFW 2021; 2022c).

The PS Chinook salmon most likely to occur in Puget Sound near Outfall 001 would be an indeterminate mix of spring- and fall-run Chinook salmon from the Cedar, Green/Duwamish, Nisqually, Puyallup, Sammamish, and White River populations (NWFSC 2022a; WDFW 2022d). Juvenile Chinook salmon typically start entering the marine waters of Puget Sound as early as December and are likely to be present in nearshore areas through the end of summer as the majority migrate toward the Pacific Ocean. A small portion of each cohort will likely remain within Puget Sound over their entire life. Depending on the run, adults are typically present in Central Puget Sound from spring through September as they return to their natal streams and rivers.

The PS Chinook salmon that are likely to occur in the Green River near Outfall 002 would be fall-run Chinook salmon from the Green River/Duwamish population (NWFSC 2022a; WDFW 2022d). Those fish are reported from the mouth of the Duwamish waterway to the headwaters of the Green River, with spawning occurring many miles upstream of the outfall. The outfall is located in within a reach with documented juvenile rearing (WDFW 2022d). Juveniles typically migrate out of the river between January and April. Returning adults typically renter the river and migrate upstream mid-June through November (peaking in August), spawning mid-September through November.

The Cedar River PS Chinook salmon population is relatively small, and is a native stock with mostly natural production. The total annual abundance has fluctuated between about 133 and 2,451 individuals since 1965, with an overall slightly negative long term abundance trend. However, the 2022 status review reported that the proportion of natural-origin spawners has stayed between 60 and 90% since the early 2000s, and the 2015-2019 5-year mean fraction of natural-origin spawner abundance was 71%. In 2021, the total number of returning adults was about 963, 62% of which were natural-origin spawners (NWFSC 2022a; WDFW 2022e).

The Green River/Duwamish population is small to moderate in size, and is a native stock with composite (natural and hatchery) production. Total annual abundance has fluctuated between about 688 and 11,512 fish since 1968, with an overall negative long term abundance trend, and the 15-year trend in log natural-origin spawner abundance is also negative. The 2022 status review reported a decreasing fraction of natural-origin spawner abundance in the three most-recent five-year review periods, with the fraction of natural-origin spawners fluctuating between about 21 to 53% since 2003. In 2021, the total number of returning adults was about 3,070, 39% of which were natural-origin spawners (NWFSC 2022a; WDFW 2022e).

The Nisqually River population is relatively small, and is a mixed stock population with a high proportion of mixed-origin hatchery fish. Total annual abundance has fluctuated between about 688 and 11,512 fish between 1968 and 2019, with an overall neutral to slightly positive abundance trend, and the 15-year trend in log natural-origin spawner abundance is also positive. In 2019, 418 natural-origin spawners accounted for about 77% of the total return of 543 spawners (NWFSC 2022a; WDFW 2022e).

The Puyallup River population is moderate in size, and is a mixed stock population with a high proportion of mixed-origin hatchery fish. Total annual abundance has fluctuated between about 11 and 4,218 fish since 1952, with an overall negative long term abundance trend, and the 15-year trend in log natural-origin spawner abundance is also negative. The 2022 status review reported a decreasing fraction of natural-origin spawner abundance in the three most-recent five-year review periods. In 2020, the total number of returning adults was about 1,755, 31% of which were natural-origin spawners (NWFSC 2022a; WDFW 2022e).

The Sammamish River population is relatively small, and is a mixed stock population with a high proportion of mixed-origin hatchery fish. Total annual abundance has fluctuated between about 33 and 2,223 fish since 1983. The overall long term abundance trend is slightly positive, but the 15-year trend in log natural-origin spawner abundance is negative, and the 2022 status review reported a decreasing fraction of natural-origin spawner abundance in the three most-recent five-year review periods. In 2021, the total number of returning adults was about 2,186, 9% of which were natural-origin spawners (NWFSC 2022a; WDFW 2022e).

The White River population is relatively small, is a native stock with composite (natural and hatchery) production. Total annual abundance has fluctuated between about 6 and 6,435 fish since 1978. The overall long term abundance trend is positive, but the 15-year trend in log natural-origin spawner abundance is negative, and the 2022 status review reported a decreasing fraction of natural-origin spawner abundance in the three most-recent five-year review periods. In 2021, the total number of returning adults was about 2,943, 12% of which were natural-origin spawners (NWFSC 2022a; WDFW 2022e).

<u>Puget Sound (PS) steelhead:</u> The PS steelhead distinct population segment (DPS) was listed as threatened on May 11, 2007 (72 FR 26722). The NMFS adopted the recovery plan for this DPS

in December 2019. In 2013, the Puget Sound Steelhead Technical Recovery Team (PSSTRT) identified 32 demographically independent populations (DIPs) within the DPS, based on genetic, environmental, and life history characteristics. Those DIPs are distributed among three geographically-based major population groups (MPGs); Northern Cascades, Central and South Puget Sound; and Hood Canal and Strait de Fuca (Myers et al. 2015) (Table 3).

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

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

In 2015, the PSSTRT concluded that the DPS is at “very low” viability; with most of the 32 DIPs and all three MPGs at “low” viability based on widespread diminished abundance, productivity, diversity, and spatial structure when compared with available historical evidence (Hard et al. 2015). Based on the PSSTRT viability criteria, the DPS would be considered viable when all three component MPG are considered viable. A given MPG would be considered viable when: 1) 40 percent or more of its component 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.

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

Spatial Structure and Diversity: The PS steelhead DPS includes all naturally spawned anadromous steelhead populations in streams in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive). The DPS also includes six hatchery stocks that are considered no more than moderately diverged from their associated natural-origin counterparts (USDC 2014). PS steelhead are the anadromous form of *O. mykiss* that occur below natural barriers to migration in northwestern Washington State (NWFSC 2022a). 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 (NWFSC 2022a). 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 (NWFSC 2022a). Over the time series examined, the over-all abundance trends, especially for natural spawners, remain predominantly negative or flat across the DPS, and general steelhead abundance across the DPS remains well below the level needed to sustain natural production into the future (NWFSC 2022a). 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 (NWFSC 2022a).

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 proposed action would affect PS Steelhead at 3 separate locations: the Coal Creek project site; the Outfall 001 site in Central Puget Sound; and the Outfall 002 site in the Green River. All of the DIPs that would be affected by the proposed action belong to the Central/South Puget Sound MPG.

The PS Steelhead most likely to occur in Coal Creek would be winter-run steelhead. They are reported in Coal Creek from its mouth to a point above the Coal Creek Parkway SE overpass (WDFW 2022d). However, no individuals have been observed in the creek during any of the salmon spawner surveys conducted between 2008 and 2021 (WDFW 2021; 2022c), nor were any observed during fish presence surveys conducted with electrofishing during the summer of 2015 (HartCrowser 2015). Specific abundance and trend data for PS steelhead in Coal Creek is unavailable, but their numbers are much smaller than the two identified winter-run steelhead DIPs within the watershed; the Cedar River and the North Lake Washington / Lake Sammamish DIPs (NWFSC 2015; WDFW 2022f), which are discussed below. Both DIPs are among the smallest within the PS steelhead DPS. Juvenile steelhead of these 2 DIPs typically leave their natal streams and enter Lake Washington in April, and migrate through the ship canal and the through Chittenden Locks (aka Ballard Locks) between April and May (Seattle 2008), but because juvenile steelhead rear in freshwater for 1 to 3 years, juveniles could be present in Coal Creek year-round. Returning adults typically pass through the locks and the Lake Washington Ship Canal between January and May, and may remain within Lake Washington through June

(Seattle 2008). The timing of steelhead spawning across the basin is uncertain, but no steelhead spawning is reported in Coal Creek.

The PS Steelhead most likely to occur in Puget Sound near Outfall 001 would be an indeterminate mix of winter-run steelhead from the Cedar River, East Kitsap Peninsula Tributaries, Green River/Duwamish, Nisqually River, Puyallup River, North Lake Washington / Lake Sammamish, South Sound Tributaries, and White River DIPs, and summer-run steelhead from the Green River DIP (NWFSC 2022a; WDFW 2022d). Steelhead smolt of both runs typically migrate to marine waters between April and mid-May (Myers et al. 2015). In watersheds with summer-run steelhead, such as the Green River, returning summer-run adult steelhead typically enter their natal rivers from May to October. In watersheds with winter run steelhead, such as all of the DIPs considered here, adults typically enter their natal waters from early November to the end of April.

The PS steelhead that are likely to occur in the Green River near Outfall 002 would be summer- and winter-run steelhead from the Green River DIP (NWFSC 2022a; WDFW 2022d). The winter-run fish are reported from the mouth of the Duwamish Waterway to the headwaters of the Green River, and summer-run fish are reported from the mouth of the Duwamish Waterway to slightly below Chester Morse Lake on the Green River (WDFW 2022d). Steelhead smolt typically migrate to marine waters between April and mid-May (Myers et al. 2015), but because juvenile steelhead rear in freshwater for 1 to 3 years, juveniles may be present in the river year-round. Returning summer-run adult steelhead typically enter their natal rivers from May to October, whereas winter-run adults typically enter their rivers between early November and the end of April. The nearest documents steelhead spawning is several upstream of Outfall 002.

The Cedar River PS steelhead DIP is small, and is of unknown stock with natural production. The total annual abundance has fluctuated between 0 and about 900 individuals between 1984 and 2021, with a strong negative trend, such no more than 10 retuning adults are believed to have retuned annually since 2007. The estimated total number of returning adults in 2021 was only 4 fish (NWFSC 2022a; WDFW 2022e).

The East Kitsap Peninsula Tributaries DIP is considered a native stock with wild production, but no abundance or trend data are available (NWFSC 2022a; WDFW 2022e).

The Green River/Duwamish DIP is small to medium sized, and is a native stock with natural and hatchery production. The total annual abundance has fluctuated between 304 and about 2,778 individuals between 1978 and 2021. The most recent long-term (15-year) abundance trend was neutral. The estimated total number of returning adults in 2021 was about 402 fish (NWFSC 2022a; WDFW 2022e).

The Nisqually River DIP is small to medium sized, and is a native stock with natural production. The total annual abundance has fluctuated between 0 and about 1,257 individuals between 1980 and 2020. The most recent long-term (15-year) abundance trend has been positive. The estimated total number of returning adults in 2020 was about 402 fish, all of which were considered natural-origin spawners (NWFSC 2022a; WDFW 2022e).

The North Lake Washington and Lake Sammamish DIP is extremely small, and of unknown stock origin. The total annual abundance has fluctuated between 0 and about 916 individuals between 1984 and 1999, with a steep negative trend until 1994, after which it flattened no more than 10 retuning adults. Abundance was only 4 adults during the last survey, which was done in 1999 (NWFSC 2022a; WDFW 2022e).

The Puyallup River DIP is small to medium sized, and is a native stock with natural production. The total annual abundance has fluctuated between 162 and about 2,880 individuals between 1983 and 2019. The most recent long-term (15-year) abundance trend has been positive. The estimated total number of returning adults in 2019 was about 847 fish, all of which were considered natural-origin spawners (NWFSC 2022a; WDFW 2022e).

The South Sound Tributaries DIP has no available stock, abundance, or trend data (NWFSC 2022a; WDFW 2022e).

The White River DIP is small to medium sized, and is a native stock with natural and hatchery production. The total annual abundance has fluctuated between about 186 and 1,762 individuals between 1980 and 2018. The most recent long-term (15-year) abundance trend has been positive. The estimated total number of returning adults in 2018 was about 963 fish (NWFSC 2022a; WDFW 2022e).

Puget Sound/Georgia Basin (PS/GB) Bocaccio and Yelloweye Rockfish

On April 28, 2010, the PS/GB bocaccio distinct population segment (DPS) was listed as endangered, and the PS/GB yelloweye rockfish DPS was listed as threatened (75 FR 22276). In April 2016, we completed a 5-year status review that recommended the DPSs retain their endangered and threatened classifications (Tonnes et al. 2016), and we released a recovery plan in October 2017 (NMFS 2017).

The waters of Puget Sound and Straits of Georgia can be divided into five interconnected basins that are largely hydrologically isolated from each other by relatively shallow sills (Burns 1985; Drake et al. 2010). The basins within US waters are: (1) San Juan, (2) Main, (4) South Sound, and (4) Hood Canal. The fifth basin consists of Canadian waters west and north of the San Juan Basin into the Straights of Georgia (Tonnes et al. 2016). Most individuals of the PS/GB bocaccio and PS/GB yelloweye rockfish DPSs are believed to remain within the basin of their origin, including larvae and pelagic juveniles. However, some movement between basins occurs, and both DPSs are currently considered single populations.

There are no estimates of historic or present-day DPS-wide abundance for either species across the full range of their respective DPSs. However, available data suggest that total rockfish abundance declined across the area at a rate of 3.1 to 3.8 percent per year from 1977 to 2014, representing a 69 to 76 percent total decline over that period, and the population growth rates for PS/GB bocaccio and PS/GB yelloweye rockfish over that period are believed to have been more negative. Additionally, there is little to no evidence of any recovery in total rockfish abundance in response to recent protective measures. In 2013, the Washington State Department of Fish and Wildlife (WDFW) published abundance estimates for both species in the San Juan basin based on a remotely operated vehicle (ROV) survey conducted in 2008. The survey estimated abundances of about 47,000 yelloweye rockfish, and 4,600 bocaccio in the San Juan basin (Tonnes et al. 2016).

The VSP criteria described by McElhaney et al. (2000), and summarize at the beginning of Section 2.2, identified spatial structure, diversity, abundance, and productivity as criteria to assess the viability of salmonid species because these criteria encompass a species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. These viability criteria reflect concepts that are well founded in conservation biology and are generally applicable to a wide variety of species because they describe demographic factors that individually and collectively provide strong indicators of extinction risk for a given species (Drake et al. 2010), and are therefore applied here for PS/GB bocaccio and PS/GB yelloweye rockfish.

General Rockfish Life History: To reduce redundant common text for both species, common general life history information is discussed here, with important species-specific discussed for each species below.

Rockfish are long-lived species, with life histories that include a larval to pelagic juvenile stage that is followed by largely benthic juvenile, subadult, and adult stages. Rockfish eggs are fertilized internally, and the young are extruded as larvae that are about 4 to 5 mm in length. In general, embryo production increases with the age and or size of the female rockfish. For example, 20-cm long female copper rockfish produce about 5,000 eggs while 50-cm long females can produce about 700,000 eggs (Palsson et al. 2009). Based on observations of other rockfish species, mature female bocaccio and yelloweye rockfish are believed to produce from several thousand to over a million eggs annually, depending on their size and or maturity (Love et al. 2002).

Rockfish larvae tend to occur in two peaks in Puget Sound (early spring and late summer) that coincide with the main primary production peaks in Puget Sound, and they essentially disappear by the beginning of November. Additionally, larval densities tended to be lower in the more northerly basins (Whidbey and Rosario) than in the Central and South Sound basins (Greene and Godersky 2012).

Rockfish larvae are distributed by prevailing currents until they are large enough to actively swim toward preferred habitats, but they can pursue food within short distances immediately after birth (Tagal et al. 2002). Rockfish larvae are typically pelagic, distributed throughout the water column. They are often observed in the upper water layers, under detached floating algae, seagrass, and kelp (Love et al. 2002; Shaffer et al. 1995). The oceanographic conditions within Puget Sound likely result in most larvae staying within the basin where they are released rather than their being broadly dispersed (Drake et al. 2010). Natural mortality is believed to be quite high (up to about 70%) during early life stages (Green and Godersky 2012). At about 3 to 6 months old and 1.2 to 3.6 inches (3 to 9 cm) long, juvenile rockfish swim toward their preferred habitats (described in species-specific detail below).

PS/GB Bocaccio

General Life History: Bocaccio are a long-lived fish species with a maximum recorded age of 46 years in Alaskan waters, typically mature between 6 and 11 years old, and have a maximum size of about 36 inches (91 cm) (Palsson et al. 2009). They tend to school above the bottom or off of steep slopes, and some have large home ranges and move long distances (NMFS 2017).

The timing of larval parturition in PS/GB bocaccio is uncertain, but based on coastal bocaccio, parturition likely occurs between January and April (NMFS 2017). At about 5 to 6 months old and 1.2 to 3.6 inches (3 to 9 cm) long, juvenile bocaccio move to shallow nearshore habitats, most typically with rocky or cobble substrates with kelp, but they also utilize sandy areas with eelgrass (NMFS 2017).

Juvenile bocaccio may spend months or more in shallow nearshore rearing habitats before transitioning to deeper water habitats (Palsson et al. 2009). As they grow, their habitat preference shifts toward increasingly deep waters. Sub-adult to adult bocaccio are most commonly found between 131 to 820 feet (40 to 250 m) deep, typically in areas with high relief rocky substrates, but they also utilize sand, mud, and other unconsolidated sediment substrates (NMFS 2017).

Spatial Structure and Diversity: The PS/GB bocaccio DPS includes all bocaccio from inland marine waters east of the central Strait of Juan de Fuca and south of the northern Strait of Georgia. As described above, within US waters, the PS/GB is subdivided into the San Juan, Main, South Sound, and Hood Canal basins with limited exchange of individuals occurring between the basins, and the DPS is currently considered a single population. The available data indicate that the historical distribution of PS/GB bocaccio was likely spatially limited, being most abundant in the Main and South Sound basins, but never a predominant segment of the total rockfish abundance within the region (Drake et al. 2010). There were no documented occurrences in the San Juan Basin until 2008 (Pacunski et al.2013).

Abundance and Productivity: Because bocaccio are long-lived, slow to mature, and their episodes of successful reproduction are sporadic, they are considered to have generally low levels of inherent productivity. Yelloweye rockfish productivity may be further negatively impacted by the situation where the low density of reproductive aged adults reduces the likelihood of locating mates, which may further reduce population density. However, there is insufficient information to determine that this is currently occurring.

No reliable range-wide historical or current population estimates are available for the PS/GB bocaccio DPS. However, their abundance is very low, and observations of the species are relatively rare. Bocaccio were always infrequent in recreational fisheries, with low occurrences in localized areas of the Main and South Sound basins, and a few erratic occurrences in the North Sound. However, they have not appeared in recent research or recreational catches (Palsson et al. 2009).

The best available information indicates that total rockfish populations in the Puget Sound region have declined by about 70 percent, and that bocaccio have declined by an even greater extent (NMFS 2017). The apparent decrease in PS/GB bocaccio population size in the Main Basin and South Sound could result in further reduction in the historically limited distribution of PS/GB bocaccio, and adds significant risk to long-term viability of the DPS.

Limiting Factors: Factors limiting recovery for PS/GB bocaccio include:

- Degraded Habitat (water quality, derelict fishing gear, climate change);
- Overutilization (commercial and recreational bycatch); and
- Inadequacy of existing regulatory mechanisms.

PS/GB Bocaccio within the Action Area: Very little specific information is available to describe PS/GB bocaccio presence and habitat use close to Outfall 001, with the exception that they are likely to be uncommon to rare. Larvae that may episodically pass through the area would occupy the water column, likely tending toward the upper layers where productivity would be typically be highest.

The area under and around the outfall consists of relatively flat unconsolidated sediments at depths of about -620 to -630 feet, with steeper substrate rising about 4,000 feet east of the outfall. Because bocaccio are known to range widely, and to utilize low-profile habitats with unconsolidated sediments in addition their typically preferred steeper rocky substrates, it is possible that some adult bocaccio may utilize the area around outfall for migration, feeding, and breeding.

PS/GB Yelloweye Rockfish

General Life History: Yelloweye rockfish are a long-lived fish species with a maximum recorded age of 118 years in Alaskan waters, 90 years in North Puget Sound, and 55 years in South Puget Sound. They typically mature between 19 and 22 years old, and can reach a maximum size of about 36 inches (91 cm) (Palsson et al. 2009). They tend to remain near the substrate at depths from 90 to 1,640 feet (30 to 500 m) deep, and to remain within relatively small home ranges (NMFS 2017).

The available information suggests that larval parturition in PS/GB yelloweye rockfish occurs from April to September, with the highest abundances in June and July (Palsson 2006). Juvenile and adult yelloweye rockfish typically occur in similar habitats, with juveniles tending to inhabit the shallower end of the shared deepwater range. At about 4 months old and 1.2 to 3.6 inches (3 to 9 cm) long, juvenile yelloweye rockfish typically settle in areas at depths greater than 98 feet (30 m) with complex rocky/boulder habitats with cloud sponges or with cobble substrates. They are not typically found in shallow nearshore waters (NMFS 2017). As they grow, their habitat preference shifts toward increasingly deep waters. Adult yelloweye rockfish prefer areas with moderate to extreme steepness, and substrates consisting of fractured bedrock, and or boulder-cobble complexes. They are most commonly found in highly rugose rocky areas and pinnacles that are between 164 and 1,640 feet (50 to 500 m) deep (NMFS 2017; Palsson et al. 2009).

Spatial Structure and Diversity: The PS/GB yelloweye rockfish DPS includes all yelloweye rockfish from inland marine waters east of the central Strait of Juan de Fuca and south of the northern Strait of Georgia. As described above, within US waters, the PS/GB is subdivided into the San Juan, Main, South Sound, and Hood Canal basins with limited exchange of individuals occurring between the basins, and the DPS is currently considered a single population. However, recent research has found evidence that may support separating Hood Canal yelloweye rockfish from the rest of the PS/GB DPS. Within U.S. waters, PS/GB yelloweye rockfish are believed to be most abundant within the San Juan Basin. However, Hood Canal has the greatest frequency of yelloweye rockfish observations in both trawl and scuba surveys. Yelloweye rockfish are considered rare in Central and Southern Puget Sound.

Abundance and Productivity: Because yelloweye rockfish are long-lived, slow to mature, and their episodes of successful reproduction are sporadic, they are considered to have generally low levels of inherent productivity. Yelloweye rockfish productivity may be further negatively impacted by the situation where the low density of reproductive aged adults reduces the likelihood of locating mates, which may further reduce population density. However, there is insufficient information to determine that this is currently occurring.

No reliable range-wide historical or current population estimates are available for the PS/GB yelloweye rockfish DPS. However, their abundance is low. The best available information indicates that total rockfish populations in the Puget Sound region have declined by about 70 percent, and that yelloweye rockfish have declined by an even greater extent (NMFS 2017).

Limiting Factors: Factors limiting recovery for PS/GB yelloweye rockfish include:

- Degraded Habitat (water quality, derelict fishing gear, climate change);
- Overutilization (commercial and recreational bycatch); and
- Inadequacy of existing regulatory mechanisms.

PS/GB Yelloweye Rockfish within the Action Area: Very little specific information is available to describe PS/GB yelloweye rockfish presence and habitat use close to Outfall 001, with the exception that they are likely to be rare. Larvae that may episodically pass through the area would occupy the water column, likely tending toward the upper layers where productivity would be typically be highest.

The area under and around the outfall consists of relatively flat unconsolidated sediments at depths of about -620 to -630 feet. The preference of juvenile and adult yelloweye rockfish for steep rocky substrates, combined with their tendency to remain within relatively small home ranges suggests that most of the juvenile and adult yelloweye rockfish that may be in the area would most likely occupy the steep substrate that begins about 4,000 feet east of the outfall, and that they would utilize the area for feeding, growth, and breeding.

Critical Habitat

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

Critical Habitat within the Action Area

No critical habitat has been designated within Coal Creek.

Critical habitat has been designated for PS/GB bocaccio, PS/GB yelloweye rockfish, and SR killer whales in Central Puget Sound where the King County South WWTP's primary outfall (Outfall 001) discharges.

Critical habitat has been designated for PS Chinook salmon and PS steelhead in the Green River where the King County South WWTP's emergency outfall (Outfall 002) discharges.

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. 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. No marine waters were designated as critical habitat for PS steelhead.

The PBFs of salmonid critical habitat include: (1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development; (2) Freshwater rearing sites with: (i) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) Water quality and forage supporting juvenile development; and (iii) Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks; (3) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival; (4) Estuarine areas free of obstruction and excessive predation with: (i) Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation; (5) Nearshore marine areas free of obstruction and excessive predation with: (i) Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and (6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation. The PBF for PS Chinook salmon 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.

Table 4. Physical or biological features (PBFs) of designated critical habitat for PS Chinook salmon and PS steelhead, and 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

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).

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 critical habitat in the Green River adjacent to Outfall 002 provides the Freshwater Migration PBF for both species, and the Freshwater Rearing PBF for PS Chinook salmon (NOAA 2022; WDFW 2022d).

Puget Sound/Georgia Basin Bocaccio and Yelloweye Rockfish Critical Habitat

The NMFS designated critical habitat for PS/GB bocaccio and PS/GB yelloweye rockfish on November 13, 2014 (79 FR 68042). That critical habitat includes marine waters and substrates of the US in Puget Sound east of Green Point in the Strait of Juan de Fuca. Nearshore critical habitat is defined as areas that are contiguous with the shoreline from the line of extreme high water out to a depth no greater than 98 feet (30 m) relative to mean lower low water. The PBF of nearshore critical habitat includes settlement habitats with sand, rock, and/or cobble substrates that also support kelp. Important site attributes include: (1) Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; and (2) Water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities. The PBF of Deepwater critical habitat is defined as areas at depths greater than 98 feet (30 m) that possess or are adjacent to complex bathymetry consisting of rock and/or highly rugose habitat. Important site attributes include: (1) Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; (2) Water quality and sufficient levels of DO to support growth, survival, reproduction, and feeding opportunities; and (3) The type and amount of structure and rugosity that supports feeding opportunities and predator avoidance. Both nearshore and deepwater critical habitat include the entire water column above those substrates. Table 5 lists the PBFs and corresponding life history events for PS/GB bocaccio critical habitat.

Table 5. Physical or biological features of designated critical habitat for PS/GB bocaccio and PS/GB yelloweye rockfish, and their corresponding life history events.

Physical or Biological Features		
Site Type	**Site Attributes**	**Species Life History Event**
Nearshore habitats with substrate that supports kelp	Prey quantity, quality, and availability Water quality and sufficient dissolved oxygen	Juvenile bocaccio settlement, growth, and development
Deepwater habitats with Complex bathymetry	Prey quantity, quality, and availability Water quality and sufficient dissolved oxygen	Juvenile yelloweye rockfish settlement, growth, and development Adult bocaccio and yelloweye rockfish growth and reproduction

Designated critical habitat for PS/GB bocaccio encompasses a total of about 1,083 square miles (1,743 sq. km) of marine habitat in Puget Sound, comprised of about 645 square miles (1,037 sq. km) of nearshore habitat, and about 438 square miles (706 sq. km) of deepwater habitat. Overall, nearshore critical habitat has been degraded in many areas by shoreline development. Both nearshore and deepwater critical habitat has been degraded by the presence of derelict fishing gear and reduced water quality that is widespread throughout Puget Sound.

Over 25 percent of the shoreline within Puget Sound has been impacted by development and armoring (Broadhurst 1998, WDOE 2010a). Shoreline armoring has been linked to reductions in invertebrate abundance and diversity, reduced forage fish reproduction, and reductions in eelgrass and kelp (Dethier et al. 2016; Heerhartz and Toft 2015; Rice 2006; Sobocinski et al. 2010).

Thousands of lost fishing nets and shrimp and crab pots (derelict fishing gear) have been documented within Puget Sound. Most derelict gear is found in waters less than 100 feet deep, but several hundred derelict nets have also been documented in waters deeper than 100 feet (NRC 2014). Derelict fishing gear degrades rocky habitat by altering bottom composition and killing encrusting organisms. It also kills rockfish, salmon, and marine mammals, as well as numerous species of fish and invertebrates that are rockfish prey resources (Good et al. 2010).

Over the last century, human activities have impacted the water quality in Puget Sound predominantly though the introduction of a variety of pollutants. Pollutants enter via direct and indirect pathways, including surface runoff; inflow from fresh and salt water, aerial deposition, discharges from wastewater treatment plants, oil spills, and migrating biota. In addition to shoreline activities, fourteen major river basins flow into Puget Sound and deliver contaminants that originated from upland activities such as industry, agriculture, and urbanization. Pollutants include oil and grease, heavy metals such as zinc, copper, and lead, organometallic compounds, chlorinated hydrocarbons, phenols, polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), and polycyclic aromatic hydrocarbons (PAHs) (USACE 2015; WDOE 2010b). Some of these contaminants are considered persistent bioaccumulative toxics (PBTs) that persist in the environment and can accumulate in animal tissues or fat. The WDOE estimates that Puget Sound receives between 14 and 94 million pounds of toxic pollutants annually (WDOE 2010b).

The deep water critical habitat for PS/GB bocaccio and PS/GB yelloweye rockfish adjacent to Outfall 001 provides the Deepwater Habitats with Complex Bathymetry PBF that supports juvenile yelloweye rockfish settlement, growth, and development, as well as adult bocaccio and yelloweye rockfish growth and reproduction (NOAA 2022).

Southern Resident (SR) Killer Whale Critical Habitat

The NMFS designated critical habitat for the SR killer whale DPS on November 29, 2006 (71 FR 69054), and then revised the designation on August 2, 2021 to expand the range of the designated critical habitat (86 FR 41668). SR killer whale critical habitat currently includes approximately 2,560 square miles of inland waters of Washington in three specific areas: 1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; 2) Puget Sound; and 3) the Strait of Juan de Fuca. It also includes 15,910 square miles of coastal marine waters from the U.S./Canada border with to Point Sur, California, with the exclusion of the Quinault Range Site off the coast of Washington.

Within the inland waters of Washington State, SR killer whale critical habitat includes all waters waterward of a line at a depth of 20 feet (6.1 m) relative to extreme high water. Along the coast, SR killer whale critical habitat includes all waters waterward of a line at a depth of 20 feet (6.1 m) relative to extreme high water out to the 656-ft (200-m) depth contour.
The NMFS identified the following physical or biological features that are essential to SR killer whale conservation: (1) Water quality to support growth and development; (2) Prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth; and (3) Passage conditions to allow for migration, resting, and foraging.

Water Quality: Waters that are free of contaminants or other agents at concentrations that would inhibit reproduction, impair immune function, result in mortalities, or otherwise impede the growth of SR killer whales is a habitat feature that is essential for the species' recovery. Good water quality is especially important in high-use areas where foraging behaviors occur and contaminants can enter the food chain.

As described in the Puget Sound Partnership's 2022-2026 Action Agenda for Puget Sound, the water quality in Puget Sound is degraded and continues to decline (Puget Sound Partnership 2022). Despite bans of some harmful substances in the 1970s, and subsequent cleanup efforts, several toxicants persist in Puget Sound and build up in marine organisms including SR killer whales and their prey resources. High levels of maritime activity discharge pollutants into the sound, and hundreds of outfalls continuously discharge stormwater and wastewater treatment plant effluents into Puget Sound. Water quality varies in the coastal waters from Washington to California. For example, high levels of DDTs have been found in SR killer whales, especially in K and L pods, which spend time during the winter in California where DDTs still persist in the marine ecosystem (Sericano et al. 2014).

Exposure to oil spills poses additional direct threats and long-term population level impacts. Oil spills can also have long-lasting impacts on other habitat features. Oil spill risk exists throughout the SR killer whales' coastal and inland range. For example, off the California coast, 463,848 gallons of crude oil was released in 2008, 141,680 gallons in 2015, and 44,755 gallons in 2016 (Stephens 2015 and 2017). Non-crude oil spills into the marine environment also occurred off California, Oregon, and Washington in 2015 and 2016 (Stephens 2015 and 2017).

Prey Quantity, Quality, and Availability: Access to adequate numbers of uncontaminated Chinook salmon and other fish species is essential to support individual SR killer whale growth and reproduction, and to support the recovery of the SR killer whale DPS. However, most wild salmon stocks throughout the geographic range of the SR killer whale DPS are at fractions of their historic levels. Beginning in the early 1990s, 28 ESUs and DPSs of salmon and steelhead in Washington, Oregon, Idaho, and California were listed as threatened or endangered under the ESA, and many wild salmon stocks continue to decline. Some of these losses have been partially offset hatchery production.

Pollution also affects the quality and availability of SR killer whale prey across the range of the DPS. Contaminants enter marine waters and sediment from numerous sources, but are typically concentrated near areas of high human population and industrialization. Once in the environment these substances migrate across the food web, and accumulate in in long-lived top predators like SR killer whales. Despite the increasing implementation of modern pollution controls in recent decades, those measures only reduce the presence of targeted contaminants in the environment. They don't completely eliminate them, and they often do little to reduce the presence of non-targeted substances, many of which becoming of increasing concern as new science comes to light. In addition to potentially accumulating in SR killer whale prey species, pollutants can directly and indirectly reduce the long-term survival of those prey species, which can reduce the amount of available prey resources for SR killer whales.

Passage: Southern Residents are highly mobile and use a variety of areas for foraging and other activities, as well as for traveling between these areas. Human activities and in-water structures can impede SR killer whale movement across their range. In particular, vessel operation and mod-frequency military sonars are believed to present obstacles to whale passage, often causing whales to change direction, and potentially having to swim further, which can increase energy expenditure and reduce foraging efficiency.

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 southwestern Bellevue, Washington, and extends along and across Coal Creek, from slightly upstream of the I-405 overpass to slightly upstream of the Coal Creek Parkway SE overpass (Figures 1 & 2), and includes significant in-water work at the Spur and Condos activity locations, as well as workers crossing the creek on foot to access pipeline sections for decommissioning, which could occur anywhere along the length of the project area.

The project would also cause the decades-long continuation of municipal effluent discharge from the project's service area to Central Puget Sound, and to a lesser extent to the Green River, through the King County South WWTP's Outfall 001 and Outfall 002, respectively. Outfall 001 is located about in Central Puget Sound, about 10,000 feet west/northwest of Duwamish Head. Outfall 002 is located near the center of the Green River, a bit over 10 miles upstream from the mouth of the Duwamish Waterway and Puget Sound (Figure 12).

Figure 12. Google Earth image showing the Coal Creek Trunk North's project location relative to the King County South wastewater treatment plant and its outfall diffuser locations in Puget Sound and the Green River.

As described in the "Effects of the Action" section (2.5) in this opinion, construction-related effects would be limited to the in-water area within about 50 feet upstream and 300 feet downstream of the in-water project activities, and hydrological impacts may extend to the bends in the creek nearest to the in-water work sites at the Spur and Condos activity locations. Based on the stream map presented in WDFW's SalmonScape website (WDFW 2022d) and on the project drawings provided by the County, a relatively sharp bend exists about 43 yards downstream of the in-water work at the Condos activity site. The same resources indicate that a very sharp bend exists in Coal Creek about 63 yards past the upstream end of the in-water work at the Spur activity location, and a sharp bend exists about 50 yards upstream of the in-water work in Tributary 1. To be conservative, the NMFS estimates that detectable construction-related direct and indirect effects would be limited to the waters and substrates of Coal Creek from about 300 feet downstream of the downstream end of pipe decommissioning work at the ESI Connection activity location (under the I-405 overpass) to about 63 yards past the upstream end of the in-water work at the Spur activity location, and waters and substrates of Tributary 1 from its confluence with Coal Creek to about 50 yards upstream of the proposed foot bridge across the tributary.

Additionally, the action area includes the marine waters and substrates of Central Puget Sound that are within about 2,475 feet around both Outfall 001 diffusers, as well as the waters and substrates of the Green River and the Duwamish Waterway that are between about 300 feet upstream of Outfall 002 and the mouth of the Duwamish Waterway.

The described areas overlap 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).

Environmental conditions at and surrounding the project site and the related outfalls: The project site is located in southwestern Bellevue, Washington, and extends along and across Coal Creek, from slightly upstream of the I-405 overpass to slightly upstream of the Coal Creek Parkway SE overpass (Figures 1 & 2). Outfall 001 is located in Central Puget Sound, about 10,000 feet west/northwest of Duwamish Head, and Outfall 002 is near the center of the Green River, a bit over 10 miles upstream from the mouth of the Duwamish Waterway and Puget Sound.
The Coal Creek basin includes about 18.4 miles of open channel and drains about 3,978 acres. Coal Creek originates in Cougar Mountain Park and flows 7 miles to the East Channel of Lake Washington (Bellevue 2022).

The geography and ecosystems within the Lake Washington watershed, including the Coal Creek basin have been dramatically altered by human activity since Euro-American settlement began in the 1800s. Heavy timber harvests from the 1870s through the early twentieth century removed almost all of the area's forests. Development since then has converted most of the lowland areas to urban, agricultural, and industrial uses, and forestry and agricultural practices continue to impact the upper portions of the watershed. Today, tree canopy accounts for about 59 percent of the land cover within the Coal Creek basin. Impervious surfaces account for about 21 percent. Tree canopy cover within the 100-foot stream buffer is 86 percent. Open space or parks accounts for about 41 percent of the land use within the basin. The remaining 59 percent consists of a mix of residences, roads, commercial and government offices, industrial facilities, and other miscellaneous users (Bellevue 2022). The project area is located within the Coal Creek Natural Area, which includes wooded areas, open space, and trails. Sediment removal ponds and several access roads are also located within the natural area.

Urban land use within the basin has caused Coal Creek's hydrologic regime to become flashy, with increased peak flows, stream bank erosion, and streambed sedimentation (Kerwin 2001 in CH2M 2020). The City of Bellevue has installed two sediment retention ponds in the creek to combat this issue, one of which is immediately adjacent to the action area. The sediment retention ponds collect larger sediments. However, the finer particles remain suspended and are carried downstream. The creek is also on Washington State Department of Ecology's (WDOE) 303(d) list for impaired dissolved oxygen and degraded benthic biologic integrity (Category 5). Other listings include mercury, temperature, and pH (Category 2), as well as selenium, copper, zinc, ammonia-N, arsenic, and bacteria (Category 1) (WDOE 2022b).

The past and ongoing anthropogenic impacts described above have reduced Coal Creek's ability to support PS Chinook salmon and PS steelhead. However, barriers to fish passage are limited to a few man-made partial barriers, and the creek and its associated tributaries, including within the project area, are all fish bearing or potentially fish bearing streams. In addition to Chinook salmon, coho and sockeye salmon, cutthroat trout, sculpin, lamprey, and largescale suckers have all been recently documented within the project area (HartCrowser 2015; WDFW 2021; 2022b). In addition to these species, steelhead have been previously documented in the creek (CH2M 2020; WDFW 2022a). Further, the project area continues to provide spawning, rearing and migratory habitat for PS Chinook salmon and other salmonid species.

Outfall 001 is located in Central Puget Sound, about 10,000 feet west/northwest west of Duwamish Head. The diffusers rest on relatively flat unconsolidated sediments at depths of about -620 to -630 feet. The substrate steepens and likely becomes increasingly rocky about 4,000 east of the diffusers, rising more than 200 feet in the first 3,000 feet of eastward travel, then rising more than 300 feet over the next eastward 1,000 feet.

The waters have an average salinity of about 28.5 parts per thousand, compared to about 34 parts per thousand for the waters off the west coast of the state. However, they are considered marine for designated critical habitat purposes. The area receives freshwater from numerous freshwater rivers and streams, as well as discharges from numerous WWTP and stormwater outfalls. The area also supports high levels of commercial and recreational vessel traffic. The WDOE rates the general water quality in the area around Outfall 001 as extraordinary for aquatic life use, and as primary contact for recreational use. However, the area is also identified as having 1 Category 2 listing for low dissolved oxygen, and 3 Category 1 listings for elevated water temperature, and 2 types of bacteria. The area also has 47 Category 1 listings for sediments that include Arsenic, Cadmium, Chromium, Copper, Dichlorobenzenes, Trichlorobenzines, PAHs, and numerous other chemicals and heavy metals (WDOE 2022x).

The past and ongoing anthropogenic impacts described above have reduced the ability of the waters at and adjacent to Outfall 001 to support PS Chinook salmon, PS steelhead, PS/GB bocaccio, and PS/GB yelloweye rockfish. However, those waters continue to provide some combination of spawning, rearing, growth, and migratory habitat for all of these listed species.

Outfall 002 is located in the freshwaters of the Green River, a bit more than 10 miles inland from Puget Sound. At the Outfall 002 location, the Green River is about 98 feet wide, and tidally influenced such that water levels fluctuate from about 3 feet deep at low tide to about 6 to 8 feet deep at high tide, and flow rates decrease or increase depending on whether the tide is rising or falling. The surrounding area is highly urbanized, the river has been highly channelized, and it receives numerous point and not point stormwater discharges along its length.

The Green River/Duwamish Waterway is on the WDOE's 303(d) list for impaired waters, starting well upstream of Outfall 002, and extending north to just south of the Boeing field (at about South 102nd Street). At the outfall site, the Green River has 2 Category 5 listings (dissolved oxygen, and fecal coliform bacteria); 1 Category 4A listing (elevated water temperatures); 4 Category 2 listings (E-coli bacteria, mercury, Polychlorinated Biphenyls (PCBs),and Bis(2-ethylhexyl) phthalate); and 2 Category 1 listings (Ammonia-N and pH) (WDOE 2022b).

The past and ongoing anthropogenic impacts described above have reduced the Green River/Duwamish Waterway's ability to support PS Chinook salmon and PS steelhead. However, those waters continue to provide some combination of rearing and migratory habitat for both of these listed species.

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

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

The combined effects of increasing air temperatures and decreasing spring through fall flows are expected to cause increasing stream temperatures; in 2015, this resulted in 3.5-5.3°C increases in Columbia Basin streams and a peak temperature of 26°C in the Willamette (NWFSC 2015). Overall, about one-third of the current cold-water salmonid habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua et al. 2009).

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

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

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

2.5 Effects of the Action

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, the USACE proposes to authorize King County to conduct a 5-year project to install about 2.73 miles of replacement sewer trunk line. In-water work would be limited to 2 of 7 project areas, with foot crossings of Coal Creek and its tributaries also occurring across the project area. All in-water work would be accomplished in years 3 and 4, during the June 16 through September 15 WDFW-authorized in-water work window for the project.

Based on the best available information, as described in this section, the planned construction is likely to cause direct and indirect effects on listed fish at the project site. Project site direct effects would include exposure to fish salvage, construction-related noise, and construction-related water contamination. Project site indirect effects would occur through exposure to construction-related habitat impacts such as construction-related forage and shelter diminishment, construction-related reduced riparian vegetation, and the proposed in-stream artificial structures. Additionally, although the proposed action would cause no change in the chemical nature of the effluent carried by the trunk line, the proposed action would cause several decades of continued municipal effluent flow, and nearly double (~ 87% increase) the maximum flow volume from the service area to the King County South WWTP, which discharges effluent to Central Puget Sound and to a lesser extent to the Green River. Therefore, project would also cause indirect effects on listed fish and the PBFs of designated critical habitat from effluent-related impacts at the two outfall locations.

In Coal Creek, PS Chinook salmon inhabit the project area. PS steelhead are also reported within the project area, but have not been observed there during recent surveys. The proposed timing of the work avoids the typical migration and spawning seasons for adult PS Chinook salmon, as well as the typical seasons for egg incubation, juvenile emergence, rearing, and emigration, but very low numbers of juvenile stream-type Chinook salmon, that rear in freshwater for multiple years, are expected to be present at the site year-round. Conversely, PS steelhead are considered rare in the watershed, and they haven't been observed in any recent surveys of Coal Creek. Therefore, it is reasonably likely that some juvenile stream-type Chinook salmon would be exposed to the direct effects of the proposed action, but very unlikely that any PS steelhead would be exposed. However, this assessment assumes that over the years-long duration of some of this projects' indirect effects in Coal Creek, some PS steelhead would be exposed to project-related indirect effects along with PS Chinook salmon.

In Central Puget Sound, habitat features that would be supportive of PS/GB bocaccio and PS/GB yelloweye rockfish exist at and or adjacent to Outfall 001, and outfall 001 is located within designated critical habitat for PS/GB rock fish. Based on the proximity of those habitat features to the outfall, and on the expectation that WWTP effluent would be discharged through the outfall for several decades, it is reasonably likely that some PS/GB bocaccio, PS/GB yelloweye rockfish, and the PBFs of deep water rockfish critical habitat would be exposed to WWTP effluent. Additionally, outfall 001 is located within designated critical habitat for SR killer whales. Therefore, the PBFs of designated critical habitat for SR killer whales would be exposed to WWTP effluent.

In the Green River at Outfall 002, both PS Chinook salmon and PS steelhead utilize the river for freshwater migration, and juvenile rearing is documented in the area for PS Chinook salmon. Further, the area had been designated as freshwater critical habitat for both species. Therefore, it is reasonably likely that some PS Chinook salmon and PS steelhead, and the PBFs of their designated critical habitats would be exposed to WWTP effluent discharges into the Green River.

2.5.1 Effects on Listed Species

Fish Salvage

Exposure to fish salvage is likely to adversely affect juvenile PS Chinook salmon. Fish that are within the in-water isolation areas would be exposed to removal by nets and to electrofishing if they are not readily spotted and removed.

Handling and transfer processes can cause physical trauma and physiological stress responses in exposed fish (Moberg 2000; Shreck 2000). Contact with nets can cause scale and skin damage, and overcrowding of small fish in traps can cause stress and injury. The primary factors that contribute to stress and mortality from handling are: (1) Difference in water temperatures between the creek and the holding buckets; (2) dissolved oxygen levels; (3) the amount of time that fish are held out of the water; and (4) physical trauma. Stress from handling increases rapidly if water temperature exceeds 18ºC (64ºF), or if dissolved oxygen is below saturation.

Electrofishing and capture can cause stress, physical trauma, and mortality in exposed fish. Dalbey et al. (1996), Emery (1984), and Snyder (2003) describe responses that range from muscular contractions to mortality from exposure to electrofishing. Depending on the pulse train used, and the intensity and duration of exposure, muscular contractions may cause a lactic acid load and oxygen debt in muscle tissues (Emery 1984), it can cause internal hemorrhage and spinal fractures in 12 to 54% of the exposed fish, and acute mortality in about 2% (Dalbey et al. 1996). Severe interruption of motor function can stop respiration, and combinations of lactic acid load and oxygen debt may be irreversible, causing delayed mortality in apparently healthy fish. Obvious physical injuries often reduce long-term growth and survival, whereas uninjured to slightly injured fish showed long-term growth and survival rates similar to unexposed fish of similar age (Dalbey et al. 1996).

Based on the timing and location of the work, very few juvenile Chinook salmon are expected to be present within the action area during the proposed work period (HartCrowser 2015). However, because low numbers of juveniles are known to remain in the watershed year-round, the County and the NMFS believe that some juveniles could be present during the proposed construction.

Based on the best available information for the region, the 2013 biological opinion completed for restoration activities in the Pacific Northwest Region (NMFS 2013) estimated that projects that included fish salvage captured an average of 132 ESA-listed salmon and steelhead per project, and that up to 5% of the captured fish are seriously injured or killed by the activity.

However, the PS Chinook salmon populations within the Lake Washington watershed are very small, and the June 16 through September 15 in-water work window for the project is well outside of the expected presence of adults and ocean-type juveniles in the creek. Additionally, although many individuals of several fish species were captured and identified at the project site during fish salvage activity that was conducted for the Coal Creek Trunk Maintenance Hole 25B project in 2020, including juvenile coho salmon, they captured no Chinook salmon or steelhead (King County DNRP 2020c).

Therefore, it is extremely likely that the estimated regional average far exceeds any reasonable expectations for the number of juvenile Chinook salmon that may be captured during this project's fish salvage activities. Based on the available information, and on the need to avoid underestimating the potential take for this activity, the County and the NMFS estimate that no more than 30 juvenile Chinook salmon would be captured for the entire project (King County DNRP 2022d), and that no more than 3 of those individuals would be seriously injured or killed. The remaining fish would likely experience sub-lethal effects that are unlikely to affect their fitness or survival. Because the fish that may be injured or killed by this stressor would comprise such a small subset of their cohorts, their potential loss would cause no detectable population-level effects.

<u>Construction-related Noise</u>

Exposure to construction-related noise is likely to adversely affect juvenile PS Chinook salmon. Elevated in-water noise at levels capable of causing detectable effects in exposed fish would be caused by excavation and installation of rock during streambed and bank restoration work.

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 or 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 or 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 construction-related noise.

The estimated in-water source levels (SL, sound level at 1 meter from the source) used in this assessment are based on the best available information, as described in a recent consultation for a similar project (NMFS 2016), and in other sources (Dickerson et al. 2001; Reine et al. 2012 & 2014; Richardson et al. 1995). The best available information supports the understanding that the loudest construction related noise source would be caused by excavation and installation of rock that could cause in-water noise levels up to about 194 dB_{peak} (below the 206 dB_{peak} threshold for the onset of instantaneous injury in fish) and 169 dB_{SEL}.

It is impossible to estimate the number of impulsive events that may occur from a workday's worth of excavation and rock installation, but the number is likely to be enormous. Therefore, the SEL_{cum} threshold would likely exceed that of effective quiet. If not, the use of effective quiet would over-estimate the area of effect. Therefore, use of effective quiet would be conservative to estimate the range of acoustic effects for this project.

In the absence of location-specific transmission loss data, variations of the equation RL = SL – #Log(R) are 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 SEL SL suggests that noise levels above the 150 dB_{SEL} threshold could extend to about 62 feet (19 m) around the excavation and rock installation work.

The juvenile Chinook salmon that are within about 62 feet of project-related excavation and rock placement are likely to experience behavioral disturbance, such as acoustic masking, startle responses, altered swimming patterns, avoidance, and increased risk of predation. Further, 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, but some individuals may 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, the best available information about the sizes of the affected populations, the small size of the affected area, and the timing of the work relative to expected Chinook salmon presence at the project site supports the understanding that the subset of the annual juvenile Chinook salmon cohort that might be present during construction would be very small. Therefore, the number of PS Chinook salmon that would be exposed to construction-related noise would represent an extremely small subset of their cohort, and the numbers of exposed fish that would be meaningfully affected would be too low to cause detectable population-level effects.

Construction-related Water Contamination

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

Turbidity: Installation and removal of the stream bypass would briefly mobilize small amounts of streambed sediments. Revetment construction would loosen a large amount of streambank and streambed sediments, and runoff from the construction area could transport sediments to the creek.

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

The effects on fish exposed to suspended sediments are somewhat species and size dependent. In general, severity typically increases with sediment concentration and duration of exposure, and decreases with the increasing size of the fish. At concentration levels of about 700 to 1,100 mg/l, minor physiological stress is reported in juvenile salmon only after about three hours of continuous exposure (Newcombe and Jensen 1996). 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).

During construction, the work area would be dewatered by the stream bypass and pumps as needed to prevent its exposure to flowing water, and most upland erosion-mobilized sediments would be contained within upland sediment barriers. Upon completion of work, the disturbed streambank and streambed fine sediments would be covered by large wood structures and a layer of appropriately sized, clean streambed cobbles and gravel that would greatly diminish the exposure of fine sediments to moving water after the bypass is removed. Further, the County's turbidity monitoring plan requires that turbidity be limited to 5 NTU over background levels of 50 NTU or less, or 10% over background levels of turbidity levels above 50 NTU, with a maximum point of compliance 300 feet downstream for stream flow above 100 cubic feet per second (CH2M 2022b).

Based on the available information, project-related turbidity in the creek would consist of TSS concentrations well below those described by Berg and Northcote (1985) and Robertson et al. (2006), and would be largely undetectable beyond 300 feet downstream of the project site, and last no more than one or two hours after work stops each day (Bloch 2010). If any PS Chinook salmon are exposed to project-related turbidity, the duration of their exposure would likely be measured in minutes, and the plume concentrations would most likely be too low to cause more than temporary, non-injurious behavioral effects such as avoidance of the plume and mild gill flaring. None of the potential responses, individually, or in combination would affect the fitness of exposed fish nor meaningfully affect their normal behaviors. Further, the timing of the work would prevent exposure of eggs and interstitial juveniles to the effects of sedimentation, and the TSS concentrations would be too low to measurably increase substrate embeddedness that could affect future spawning.

Dissolved Oxygen: Mobilization of anaerobic sediments can decrease dissolved oxygen levels (Hicks *et al*. 1991; Morton 1976). The impact on dissolved oxygen is a function of the oxygen demand of the sediments, the amount of material suspended in the water, the duration of suspension, and the water temperature (Lunz and LaSalle 1986; Lunz *et al*. 1988).

Reduced dissolved oxygen can affect salmonid swimming performance (Bjornn and Reiser 1991), as well as cause avoidance of water with low dissolved oxygen levels (Hicks 1999). However, as described above, very little sediment would be mobilized in the creek. Further, it is very unlikely that the mobilized sediments would be anaerobic, and the well-oxygenated water in the stream flow beyond the project sites would quickly oxygenate the small volumes of affected water. This supports the expectation that any dissolved oxygen reductions would be too small and short-lived to cause detectable effects on the fitness or normal behaviors of any fish that may be exposed to the affected water.

Toxic Materials: Construction related spills and discharges may introduce toxic materials to the water. PS Chinook salmon and other 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).

Some of the petroleum-based fuels, lubricants, and other fluids used by construction-related equipment contain Polycyclic Aromatic Hydrocarbons (PAHs). Depending on the pollutant, its concentration, and or the duration of exposure, exposed fish may experience effects that can range from avoidance of an affected area, to reduced growth, altered immune function, and mortality (Brette *et al*. 2014; Feist *et al*. 2011; Gobel *et al*. 2007; Incardona *et al*. 2004, 2005, and 2006; McIntyre *et al*. 2012; Meadore *et al*. 2006; Sandahl *et al*. 2007; Spromberg *et al*. 2015).

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

Construction-related Habitat Impacts

Indirect habitat impacts would adversely affect PS Chinook salmon, PS steelhead, PS/GB bocaccio, and PS/GB yelloweye rockfish. The proposed action would cause indirect effects on PS Chinook salmon and PS steelhead in Coal Creek through construction-related forage and shelter diminishment, construction-related reduced riparian vegetation, and in-stream artificial structures.

Construction-related Forage and Shelter Diminishment: The proposed in-water work at the Spur and Condos activity locations is likely to indirectly adversely affect juvenile PS Chinook salmon through substrate impacts that would diminish forage and shelter availability.

At the Spur activity location, the County's in-water work would include temporary dewatering of the work area, and the excavation and backfilling of nearly 6,000 square feet of in-stream and bank habitat to remove obsolete sewer pipes and maintenance holes, and to reshape about 364 linear feet of creek bed in Coal Creek and Tributary 1 (Figure 10). At the Condos activity location, the County's in-water work would include temporary dewatering of the work area, and the excavation and backfilling of about 5,326 square feet of in-stream and bank habitat to remove an obsolete sewer pipe and a maintenance hole, and to install about 165 linear feet of bank stabilization (Figure 11).

Juvenile salmonids primarily prey on water-dependent aquatic organisms such as copepods, euphausiids, and larvae of many benthic species and fish, and on terrestrial-origin insects that fall into the water (NMFS 1997; NMFS 2006). They also utilize submerged aquatic vegetation (SAV), leaf litter, small branches, and large wood as shelter from predators.

Dewatering the in-water work areas would kill many of the aquatic infaunal and epifaunal invertebrate organisms and SAV within those areas through desiccation and or asphyxiation, especially those that are on or near the surface of the substrate. Excavation of the stream substrates would kill both surface and deeper aquatic invertebrates and SAV by some combination of mechanical injury, desiccation, asphyxiation, and or burial.

The available information about ecosystem responses to excavation and dredging indicates that little recovery would occur during the first seven months after the excavation, with early successional fauna increasing in abundance over the next six months (Jones and Stokes 1998). Full recovery of a site could take years. Therefore, the in-stream work would reduce forage and shelter availability within the affected stream reaches for a year or more, which would be exacerbated by construction-related removal of riparian vegetation (discussed below). The greatest impacts are not expected last much beyond a year or two due to the small size of the affected areas and the close proximity of unaffected habitat in the stream immediately upstream of the affected areas that would help repopulate the affected areas. However small reductions in forage and shelter availability would persist for several years to decades, until the replacement riparian vegetation recovers to pre-construction levels of organic material input to the creek.

Over at least the first 1 to 2 years after construction, construction-related reduced forage and shelter availability within the affected areas is likely to cause some juvenile Chinook salmon to avoid or abandon the affected areas in favor of less disturbed and or more productive habitat, whereas others may remain within the affected areas. The displaced juvenile Chinook salmon would increase inter- and intraspecific competition in the areas that they move to, while the individuals that remain within the degraded areas are likely to experience reduced forage and cover availability. The displacement and the reduced availability of shelter resources may also increase the risk of predation for some individuals. The intensity of effects that any individual may experience due to these exposures is uncertain and likely to be quite variable. However, to be conservative, this assessment assumes that some subset of the exposed juvenile Chinook salmon are likely to experience reduced fitness and reduced long term survival due reduced forage and cover availability that would be attributable the proposed project's in-water construction. Due to the relatively short expected recovery period for the disturbed substrate (1 to 2 years) and current rarity of PS steelhead in Coal Creek, it is unlikely that any PS steelhead would be detectably affected by forage and shelter diminishment related to the proposed in-water work.

<u>Construction-related Riparian Vegetation Removal:</u> The project would require the removal of riparian vegetation to access and perform streambed and streambank work at the Spur and Condos activity locations. At the Spur activity location, riparian trees and shrubs would be removed as needed along about 307 feet of both banks of Coal Creek, and about 57 feet of both banks of Tributary 1. Riparian trees and shrubs would also be removed as needed along about 184 feet of the right bank of Coal Creek at the Condos activity location (CH2M 2022).

The county would replant the affected areas after construction is complete. Within 200 feet of the bank, all impacted trees with a 4-inch or greater diameter at breast height (dbh) would be replaced at a 3:1 ratio with appropriate native trees. Outside of 200 feet, all impacted trees with an 8-inch or greater dbh would be replaced at a 1:1 ratio. Additionally, live cuttings would be planted in the FESL of the bank stabilization structure at the Condos activity location. However, the replacement vegetation would take several years to decades before it would provide ecological functions equitable to pre-construction levels.

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

Removal of riparian vegetation from the project area would slightly increase summer-time input of solar energy (insolation) to Coal Creek. However, the relatively small size of the affected area compared to the large amount of existing riparian vegetation both up and downstream from the project area, combined with the continuous water flows from the upstream reaches of the creek's watershed that are largely shaded by riparian forest canopy supports the expectation that any action-related temperature increases would be very small, and unlikely to meaningfully increase water temperatures in Coal Creek. Additionally, project-related increased insolation would diminish over time as the replacement vegetation matures. However, until the riparian vegetation has fully recovered, the increased insolation is likely to cause some juvenile Chinook salmon and or steelhead to avoid the affected areas, which could increase inter- and intraspecific competition in the adjacent areas.

Removal of streambank vegetation from the project area would reduce the input of terrestrial-origin organic matter, such as insects, leaf litter, small branches and large wood to Coal Creek. Terrestrial insects that fall into streams are a forage resource for salmonids, and the decay of dead insects and leaf litter add to the in-stream nutrient cycle that supports the growth of aquatic algae and invertebrates that provide important shelter and forage resources for juvenile salmonids. Large wood that falls into streams provides shelter and also drives stream forming processes that are important to salmonids. The planned installation of large wood structures may partially offset some to effects of reduced large wood input to the affected stream reaches. However, it would not offset the reduction in terrestrial-origin insect and leaf litter input. Therefore, the reduced input of terrestrial-origin insects and leaf litter would exacerbate the construction-related forage and shelter diminishment within the affected stream reaches (discussed immediately above).

Over the years-long vegetation recovery period, reduced riparian vegetation at the Spur and Condos activity locations would slightly reduce forage and shelter availability in and slightly downstream of the areas with reduced input of terrestrial-origin organic matter, and increased in-water illumination would cause some avoidance or abandonment of unshaded areas. These impacts would be similar and additive to, but would last longer than those that would be caused by construction-related forage and shelter diminishment discussed above. Due to the expected long recovery period for the replacement vegetation, this assessment assumes that some PS steelhead in Coal Creek could be detectably affected by these impacts. To be conservative, this assessment assumes that some subset of the exposed Chinook salmon and steelhead are likely to experience reduced fitness and reduced long term survival due to increased insolation, reduced forage and cover availability, and increased exposure to predators that would be attributable the proposed project's removal of riparian vegetation.

In-stream Artificial Structures: In addition to the construction-related impacts discussed above, the proposed bank stabilization structure at the Condos location is likely to adversely affect PS Chinook salmon and PS steelhead through altered hydrological, chemical, and biological processes within the affected stream reach, which may be lessened slightly by the proposed additional LWM that would be installed at that location. The proposed habitat improvement features at the Spur location are unlikely to adversely PS Chinook salmon and PS steelhead, and may provide long-term beneficial effects though improved hydrological and biological processes within the affected stream reach.

At the Condos location, the project would reshape about 165 feet of streambed and bank to install a bank stabilization structure that would consist of FESLs with 43 pieces of imbedded LWM, as well as live stake plantings. Outside of the stabilization structure, the project would also install about 9 other pieces of LWM on both banks (Figure 11). The project would impact about 5,326 square feet of in-stream and bank habitat along about 184 feet of Coal Creek at the Condos location. At the Spur location, the project would remove obsolete in-stream pipe and maintenance holes, reshape about 6,000 square feet of streambed and bank substrate, and install stream-appropriate sediments and 59 pieces of LWM to mimic natural conditions along about 364 feet of Coal Creek and Tributary 1 (Figure 10).

Riverine habitats are the product of physical, chemical, and biological processes that interact together to form and maintain the streams (Fischenich 2003). Physical processes involve the interaction of hydrological forces with the substrate and objects in the streambed that drive geomorphic adjustments in the channel, floodplain, and riparian habitats. Chemical processes involve inputs of organic matter, retention and export of nutrients and thermal energy, nutrient cycling in the aquatic food web, linkages to terrestrial food webs, and gas exchange (Beechie *et al*. 2010). Biological processes include aquatic and riparian plant and animal growth, and community development and succession, which establish the biodiversity and influence the life histories of aquatic and riparian organisms (Harman *et al*. 2012).

Hydrological Impacts

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

By design, bank stabilization structures replace dynamic natural processes with a set of semi-permanent conditions that prevent natural channel migration past the structure and alter fundamental channel and aquatic habitat formation processes (Cramer 2012). Many bank stabilization structures, especially older-style rip rap revetments and vertical bulkheads, redirect water flows and often cause unexpected changes in the stream-forming processes upstream and downstream from the stabilization structure, such as increased erosion, altered sediment recruitment and transport, and reduced formation of complex off-channel and edge habitat features such as undercut banks and alcove habitats (Fischenich 2003; Pracheil 2010). Also, most bank stabilization structures require periodic maintenance and repair to prevent their failure. The process often leads to ever-steepening banks, with reduced velocity diversity, depth diversity, substrate diversity, large wood recruitment and retention, and stream bank roughness along its length, which can exacerbate the effects identified above.

Due to the complex relationships between the processes that are involved, it is virtually impossible to predict and quantify the exact effects the proposed bank stabilization structure would have on stream hydrology, geomorphology, and habitat forming processes. However, the proposed bank stabilization structure is designed to cause fewer and less intense negative effects than those that are common with harder bank stabilization structures such as rip-rap armoring and vertical bulkheads.

At the Condos location, the sloped bank and inclusion of LWM and live plantings in the proposed structure is expected to provide some velocity diversity and stream bank roughness that could encourage some natural processes to occur at the site, such as large wood recruitment and retention and relatively natural sediment distribution, which may increase depth and substrate diversity within the affected stream reach. However, it would still alter water flows, which could impede natural stream-forming processes in adjacent parts of the creek, which could reduce the affected area's ability to support salmonid spawning and rearing. However, these effects are expected to be relatively small, especially as compared to harder bank protection structures.

Bank stabilization structures often reduce or eliminate the input of LWM along the protected banks because the structures are designed to prevent bank failure. Reduced input of LWM typically negatively affects natural streambed and bank formation processes. However, although the proposed structure would prevent channel migration into the right bank into the foreseeable future, its relatively small size and the narrowness of the land (about 20 feet) between it and the apartment building immediately inland from it support the understanding that the structure is unlikely to measurably reduce the future availability of LWM in Coal Creek.

The best available information supports the expectation that the proposed bank stabilization structure could slightly reduce the affected area's ability to support salmonid spawning and rearing through slightly altered habitat forming processes. However, these effects are expected to be relatively small, and the structure's influence on those processes would likely decrease with distance from the structure and with increasing size of flood events. Because the potential impacts related to bank stabilization structures are typically limited to the stream reach within the nearest bends in the stream, the area of affect is estimated to be between about 135 feet upstream to about 160 feet downstream from the ends of the structure.

At the Spur location, the proposed removal of the cross stream pipes and the maintenance holes, the reshaping of the creek bed, and the installation of stream-appropriate sediments and 59 pieces of LWM are likely to improve stream forming processes over the existing conditions, including improved velocity and depth diversity, and improved roughness. Further, the removal of the cross stream pipes and the maintenance holes at both sites would eliminate the need for future in-water work to maintain or protect those structures. The installation of the LWM at the Condos location may act to lessen some of the hydrological effects of the bank stabilization structure, but the degree to which they would do so is uncertain.

Chemical and Biological Impacts: In addition to the construction-related forage and shelter diminishment and loss of riparian vegetation at the Condos and Spur locations (discussed earlier), the proposed bank stabilization structure at the Condos location is likely to reduce juvenile salmonid use the affected bank. The habitat improvement features at the Spur location are unlikely to cause any meaningful additional impacts on in-stream chemical and biological processes.

The proposed bank stabilization structure would consist of 165 feet of artificial bank, the features of which may cause deleterious behavioral impacts on juvenile salmonid that avoid the affected bank. Juvenile salmonids tend to aggregate more densely in edge habitats than in the center of rivers where adult salmonids occur in greater numbers (Washington Trout 2006). Studies also show that juvenile salmonids tend to select natural banks over hardened ones, and that the habitat provided by armored banks is typically degraded as compared to natural banks. Juvenile Chinook salmon are consistently more abundant along natural banks with wood, cobble, boulder, aquatic plants, and or undercut bank cover compared than they are along rip rap banks (Beamer and Henderson 1998; Peters et al. 1998). In a study of 667 bank stabilization structures of various designs in Washington State, fish densities were generally positively correlated with increased amounts of large woody debris and overhead vegetation within 30 cm of the water surface. Fish densities under those conditions were also consistently higher than those at the control sites. Conversely, fish densities at sites that were stabilized by rip rap alone were consistently lower than at control sites (Peters et al. 1998).

Based on the available information, the inclusion of LWM into the proposed stabilization structure would provide some of the features preferred by juvenile Chinook salmon. However, the absence of over-hanging riparian vegetation is likely to reduce the structure's acceptability for juvenile salmon until the structure's planted vegetation provides adequate functions.

Therefore, it is likely that some rearing and migrating juvenile Chinook salmonid will selectively avoid the habitat along the bank stabilization structure in favor of more suitable habitat. As described earlier, displaced individuals may experience decreased fitness from increased competition, which may reduce their likelihood of survival. They may also experience increased exposure to predators. To be protective, the NMFS assumes that for the first 10 years after construction, very low numbers of juvenile PS Chinook salmon and PS steelhead would annually experience behavioral effects that would be attributable to avoidance of the proposed stabilization structure, and that those effects would lead to increased completion that would reduce the fitness and long-term survival for some of the exposed individuals.

Conversely, the project's habitat improvement features are unlikely to cause any detectable negative impacts on the biological processes in Coal Creek, and over time, they are likely to improve habitat-forming processes that would enhance the growth of native aquatic organisms and SAV, such that the availability of forage and shelter resources for PS Chinook salmon and

PS steelhead would be improved over existing conditions. They may also act to improve the availability and quality of spawning habitat within the affected reach.

To be protective, the NMFS assumes that over the life of the proposed bank stabilization structure, a very low number of juvenile PS Chinook salmon and juvenile PS steelhead would annually experience behavioral effects caused by slightly altered hydrology and stream morphology that would be attributable to the bank stabilization structure, and that some subset of the exposed individuals would experience reduced fitness and reduced long-term survival from the exposure.

In Summary: Project-related in-water work, removal of riparian vegetation, and installation of the proposed in-stream artificial structures at the Spur and Condos locations is likely to annually expose very low numbers of PS Chinook salmon and PS steelhead to some combination of diminished forage and shelter availability, and to increased illumination, at and slightly downstream of both construction areas. It would also expose very low numbers of PS Chinook salmon and PS steelhead to a bank stabilization structure and altered stream morphology at and slightly downstream of the Condos location. The exact duration of these impacts is uncertain, but forage and shelter availability is expected to return to very close to existing levels in less than 5 years, whereas the effects of increased illumination and of the bank stabilization structure may persist for several years to low numbers of decades.

The responses that these exposures would cause in Chinook salmon and steelhead would be highly variable, but are likely to include some combination of areal avoidance, reduced forage efficiency, increased inter- and intra-specific completion, and increased exposure to predators. The intensity of the effects that any exposed individuals would be likely to experience would also be highly variable, such that some individuals would experience no meaningful fitness or behavioral effects, while others would experience reduced fitness and reduced long-term survival, including low levels of mortality related to increased exposure to predators.

The number of individuals that would be annually exposed to these stressors is unquantifiable with any degree of certainty. However, based on the very small affected areas, the low levels of utilization of this creek by PS Chinook salmon and PS steelhead, and the expectation that only a subset of the exposed individuals would be meaningfully affected, the annual numbers of individuals of either species that would be meaningfully affected by these stressors would comprise such small subsets of their respective cohorts, that their loss would cause no detectable population-level effects.

Effluent-related Impacts

The discharge of wastewater effluent transported from the service area through the upgraded trunk line would adversely affect PS Chinook salmon, PS steelhead, PS/GB bocaccio, and PS/GB yelloweye rockfish.

The proposed action would replace a sewer trunk line that connects its service area to King County's South wastewater treatment plant (WWTP) in Renton, which discharges effluent into Puget Sound (outfall 001), and to the Green River for emergencies, and for brief (4-hour maximum) scheduled maintenance periods (outfall 002) (Figure 12). Consequently, the proposed action would result in the decades-long continuation of the service area's discharge of residential and light commercial wastewater to Puget Sound and the Green River via the South Treatment Plant.

Background: The existing Coal Creek Trunk is a separated system that conveys only wastewater (i.e. no stormwater) (King County DNRP 2022i), and its maximum capacity is roughly 9.7 MGD (King County DNRP 2022j). The County estimates that during peak flows, the existing Trunk contributes about 2 percent of the flow processed by the King County South WWTP (King County DNRP 2022g). The upgraded system would remain separated from stormwater, and would provide a maximum capacity of 18.1 MGD (King County DNRP 2022j).

The King County South WWTP provides secondary treatment of municipal wastewater using activated sludge with chlorine disinfection to remove about 85 percent of the influent's suspended and dissolved solids. King County DNRP (2022i) reports that Outfall 001 consists of two pipelines that extend about 10,000 feet into the marine waters of Central Puget Sound, west/northwest off Duwamish Head. Each of the pipelines has a 500-foot long diffuser on the end. The diffusers are separated by about 1000 feet, and both rest on relatively level substrate at depths of about -620 to -630 feet relative to mean lower low water (MLLW) (Figure 13).

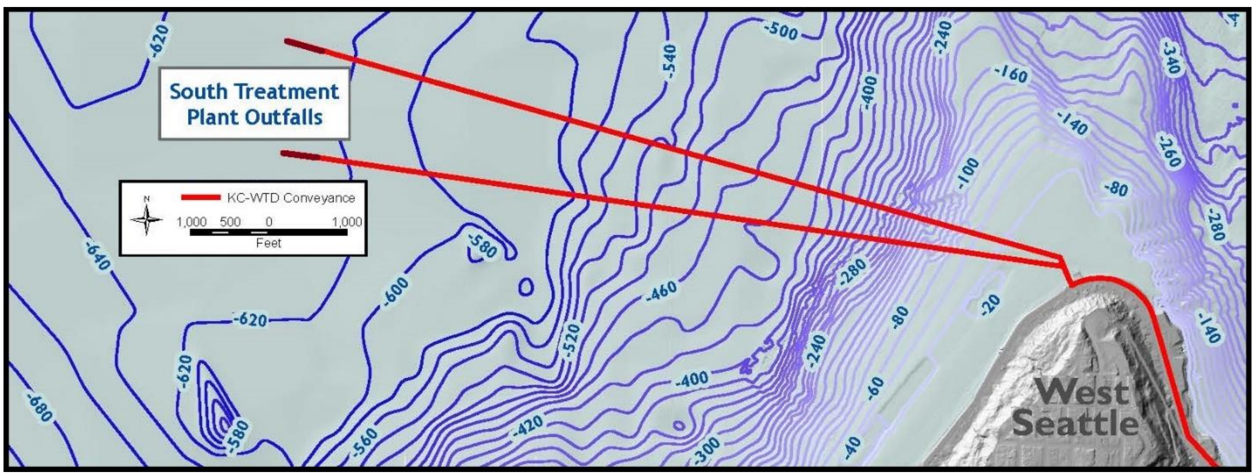

Figure 13. Computer-generated image showing the location of the King County South wastewater treatment plant's outfall 001 in Central Puget Sound, west of Duwamish Head. The 500-foot long diffusers are indicated by the dark brick red sections at the end of the red pipelines (Adapted from an image attached to King County DNRP 2022h).

Outfall 002 consists of single pipeline with 33-foot long, 8-port diffuser situated near the center of the Green River. Outfall 002 is intended for emergency use (for example, to allow effluent discharge during a catastrophic malfunction of the offshore effluent transfer system). Episodic discharges to maintain the functionality of the outfall's systems and diffuser are also allowed under the NPDES permit, with maintenance discharges limited to 4 hours. The County reports that the most recent maintenance discharge occurred in June 2020, and the event prior to it was in June 2014 (King County DNRP 2022i). Further, maintenance discharge events are coordinated with WDOE and WDFW to schedule the events in a way that would reduce a the overlap of a discharge event with ecologically sensitive times in the river, yet also to occur when river flows would be adequate to provide appropriate dilution. Maintenance discharges through outfall 002 also target high-slack tide in the river to discharge as river outflow begins to increase due to the reversal of tidal inflows (King County DNRP 2022i).

The King County South WWTP currently discharges its effluent under National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit No. WA0029581, which was issued by the WDOE on July 1, 2015 (WDOE 2015), and has been administratively extended past its July 31, 2020 expiration date while the County's renewal application is being processed (King County DNRP 2022g). 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). This assessment assumes that the NPDES permit will be renewed with similar limitations as the 2015 permit.

The King County South WWTP is permitted for a maximum month design flow of 144 MGD. At 2 percent of the total, the existing system contributes about 2.9 MGD of effluent. It is important to note here that final effluent discharge volumes are lower than inflow to WWTPs due to sludge removal, evaporation, and other processes, but there is no definitive ratio to describe the reduction. Working from the understanding that the service area's current 9.7 MGD maximum inflow is reduced to about 2.9 MGD of effluent outflow, the effluent volume is about 30 percent as large as the inflow. Therefore, the new 18.1 MGD maximum inflow from the service area would likely generate about 5.4 MGD of effluent.

The NPDES permit limits the marine discharge of carbanaceous biochemical oxygen demand (5-day; $CBOD_5$) to a weekly average of 48,000 pounds per day, total suspended solids (TSS) to a weekly average of 54,000 pounds per day, total residual chlorine (TRC) to a daily maximum of 750 µg/L, pH to 6.0 to 9.0 standard units, and fecal coliform bacteria to a weekly geometric mean of 400 cfu/100ml. The permit includes no Acute Toxicity limits, nor does it expresses limits for metals such as cadmium, copper, nickel, lead, silver, zinc, or compounds such as nitrogen, phosphorus, oil, and grease that are common in most municipal wastewater effluents. The permitted marine chronic and acute mixing zones are cylinders that extend from the seafloor to the top of the water column around the diffuser ports with respective radii of 825 and 82 feet (70.4 and 7.04 meters) (WDOE 2015).

The permit limits the freshwater discharge to a maximum flow that is less than or equal to 25 percent of the Green River's flow. It limits $CBOD_5$ to 20 mg/L, TSS to 20 mg/L, TRC to a daily maximum of 95 µg/L, pH to 6.0 to 9.0 standard units, and fecal coliform bacteria to 200 cfu/100ml. The permit includes no Acute Toxicity limits. The permit includes no freshwater chronic mixing zone because permitted maintenance discharges are infrequent and limited to 4 hours or less. The freshwater acute mixing zone is allowed to encompass 25% of the river flow, and to extend from the bottom to the top of the water column within 100 feet upstream and 300 feet downstream of the outfall.

Based on the best available information, we have identified acute toxicity, chronic toxicity, and exposure to altered environmental conditions as potential effects associated with the discharge of wastewater from the King County South WWTP.

Acute Toxicity and Chronic Accumulation of Contaminants

Contaminants and Potential Effects: As described under Construction-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 in exposed individuals. The intensity of effects depends largely on the pollutant, its concentration, the duration of exposure, and the lifestage of the exposed individual.

In addition to the $CBOD_5$, TSS, TRC, fecal coliform bacteria, metals, nitrogen, phosphorus, oil, and grease 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 2022b & c; 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 like the Anacortes WWTP 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 2022b).

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 2022b)

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 in within an affected waterbody, on 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 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 most 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 2022b).

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 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 2022c). 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 deposit 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 2022b). Coho juveniles appear to be similarly susceptible to the acutely lethal toxicity of 6PPD/6PPD-q (Chow 2021; 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 (McIntyre and Scholz, unpublished results, 2020). 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 2022b). Because the sewer system within the service area for the Coal Creek Trunk is a separated system that includes no stormwater input, the effluent for the service area is unlikely to carry many of the roadway-related chemicals, but some automotive-related pollutants are likely to be occasionally present in the effluent due to their improper disposal directly into the area's sanitary sewer system.

Exposure: 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 beyond 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 beyond 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, in Central Puget Sound, marine organisms that are within the 82-foot wide acute mixing zones around the two outfall 001 diffusers may be exposed to lethal effluent concentrations, and organisms that are within the overlapping 825-foot wide chronic mixing zones may be exposed to contaminants at concentrations that would cause chronic effects. Similarly, during maintenance discharges into the Green River, aquatic organisms that are within the acute mixing zone around the outfall 002 diffuser during a maintenance discharge, which includes one quarter of the river's flow between 100 feet upstream to 300 feet downstream of the outfall, may be exposed to potentially lethal effluent concentrations.

As described earlier, Outfall 001 is located in Puget Sound, about 2 miles from shore, and at a depth of about 620 to 630 feet below the surface. Given the typical shoreline-obligated behaviors of emigrating juvenile Chinook salmon, it is extremely unlikely, that any juvenile Chinook salmon would swim close enough to the outfall to be detectably affected by its discharge. Conversely, adult Chinook salmon and both juvenile and adult steelhead could be reasonably expected to swim through water with detectable levels of effluent from the outfall.

Outfall 001 is located within an area that has been designated as deepwater critical habitat for adult bocaccio and juvenile and adult yelloweye rockfish. It is uncertain how far away the closest suitable habitat is from the outfall, but it is very likely that some suitable habitat would be at least be episodically exposed to detectable levels of effluent from the outfall. Additionally, the outfall itself provides structure that may be attractive to adult bocaccio, juvenile and adult yelloweye, and other rockfish. Therefore, to be protective, the NMFS assumes that over the decades of discharge, some adult bocaccio and juvenile and adult yelloweye rockfish are reasonably likely to be exposed to detectable levels of effluent from the outfall. Additionally, over the decades of discharge, some pelagic larval bocaccio and yelloweye rockfish that are carried by the currents are reasonably likely to pass through the mixing zones.

It is reasonably likely that some subset of exposed individuals would experience strong avoidance behaviors when they detect the effluent-altered water quality at the outer edges of the plume (Beitinger and Freeman 1983). The avoidance of the area around Outfall 001 is unlikely to cause any harmful effects in any of the fish species considered here. However, not all individuals will avoid the affected area, and those that enter the plume area around Outfall 001 would be exposed to varying concentrations of some combination of the contaminants discussed above. The annual numbers of individuals that would be directly exposed to the effluent from Outfall 001 is uncertain and likely to be highly variable over time, as are the likely effects that exposed individuals are likely to experience.

The increasing effluent concentrations, diminishing salinity, and increasing temperature within the chronic mixing zone likely cause fish to avoid the acute mixing zone. Therefore, few, if any, adult Chinook salmon, and or juvenile and adult steelhead, bocaccio, and yelloweye rockfish are likely to experience acute mortality from effluent exposure. However, over the decades-long discharge through the outfall, it is very likely that some pelagic bocaccio and yelloweye rockfish larvae would be carried by currents through the acute mixing zone where some are reasonably likely to experience acute mortality.

Some adult Chinook salmon, and juvenile and adult steelhead, bocaccio, and yelloweye rockfish are likely to enter the effluent plume, including parts of the chronic mixing zone, and some of those individuals are likely ingest and or absorb contaminants from the water. Based on the best available information, as described above, some of the exposed individuals are likely to experience non-lethal fitness impacts that may reduce their long-term survival and or cause negative reproductive effects.

Outfall 002 is located within occupied freshwater critical habitat for both PS Chinook salmon and PS steelhead, and the affected reach is documented as rearing habitat for PS Chinook salmon. Discharges through Outfall 002 occur infrequently, typically only once every few years. The discharges are timed to avoid the typical emigration seasons for juveniles and immigration seasons for returning adults, and they are limited to 4 hours or less. However, low numbers of stream-type juvenile PS Chinook salmon and juvenile PS steelhead are likely to present in the river year-round.

As stated earlier, the outfall is located near the middle of the river, and the permitted freshwater acute mixing zone encompasses 25% of the river flow, and extends from the bottom to the top of the water column within 100 feet upstream to 300 feet downstream of the outfall. Therefore, the acute mixing zone is likely to remain relatively close to the center of the river, whereas most juvenile Chinook salmon and steelhead are more likely to occupy bankside habitats. Given the infrequency and short duration of the maintenance discharges, the relatively centralized acute mixing zone, and the expected low density of rearing and migrating juveniles that are likely to be present during maintenance discharges, it is unlikely that any juvenile Chinook salmon and or juvenile steelhead would experience acute mortality from effluent exposure from Outfall 002. However, over time, it is reasonably likely that at least some juveniles of both species would be exposed to detectable concentrations of the effluent as the plume spreads out and moves downstream. Based on the best available information, some of the exposed individuals are likely to experience avoidance behaviors that may cause fitness impacts through increased competition, and or increased exposure to predators, and some individuals may also experience non-lethal fitness impacts from exposure to effluent-borne contaminants that may reduce their long-term survival and or cause future negative reproductive effects.

Altered Environmental Conditions

In addition to directly exposing fish to the numerous contaminants discussed above, the continued effluent discharge would maintain altered habitat conditions within the mixing zones and in adjacent areas that are within the detectable effluent plume. Because the vast majority of the effluent would discharge into Puget Sound through Outfall 001, the first part of this discussion is focused on that outfall. The effects of discharge through Outfall 002 are discussed afterward.

The effluent plume would create temperature, salinity, contaminant, and dissolved oxygen gradients that would increase in intensity with movement toward the diffusers. Also, effluent-borne nitrogen and other nutrients likely affect local productivity, which alters forage quality and availability, and potentially creates conditions that are favorable to certain harmful algae. Further, the settlement of suspended solids from the effluent likely alters the benthic habitat around the outfall. The exact extent of detectable effluent as well as the maximum settlement distance of sediments is unknown. However, to avoid underestimating potential impacts, this assessment assumes that detectable effluent-borne contaminants and sediments could extend about three times the width of the chronic mixing zone (2,475 feet) around both Outfall 001 diffusers.

How the listed fish under consideration here would respond to the effluent-altered environmental conditions are likely to be highly variable even within a given species at the same life stage. Depending on the conditions of the exposure, some fish are likely to experience avoidance behaviors soon after detecting chemical changes in the water, 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.

Avoidance: Based on the location of Outfall 001's diffusers and mixing zones, avoidance of the plume area is unlikely to limit migration or prevent access to important habitat resources for any of the fish considered here. Therefore, avoidance of the plume area is extremely unlikely to cause any detectable adverse effects on the normal behaviors or fitness of any listed fish consideration in this opinion.

Altered forage availability and quality: The effluent's nutrient load likely increases productivity for planktonic organisms and SAV within the detectable plume, creating an area of increased forage availability. However, as discussed earlier, organisms that are exposed to the plume are likely to uptake contaminants, and those 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 through the directly from the water column and from the planktonic food web (West et al. 2008).

Therefore, fish 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 the listed fish under consideration here may preferentially remain within the affected area. Those fish that delay their migration past the 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.

Harmful Algae: As described in the NMFS biological opinion for the reissuance of the NPDES permit for the Hyperion WWTP in Los Angeles, CA (NMFS 2018); nitrogen is the primary nutrient that limits phytoplankton production in coastal waters, the addition of nitrogen increases phytoplankton production, and reduced forms of nitrogen that are present in WWTP effluents can tilt phytoplankton communities toward the development of harmful diatom and dinoflagellate species and lead to harmful algal blooms.

Harmful diatoms such as the Pseudo-nitzschia delicatissima group and the P. seriata group produce domoic acid, which is a water soluble neurotoxin that accumulates in shellfish and planktivorous fish. It is responsible for toxic events in marine mammals and birds, as well as amnesiac shellfish poisoning in humans, but its impacts on schooling fish are believed to be less intense. Under laboratory conditions, fish that ingested domoic acid producing diatoms seemed able to isolate and eventually excrete the domoic acid. However, it is unknown if there is a metabolic cost to this process for the fish.

Harmful dinoflagellates such as the Alexandrium tamarense complex produce saxitoxins, which have been implicated in numerous fish kills, and Paralytic Shellfish Poisoning (PSP) in humans. Studies have documented paralysis, morphological impacts, and heavy mortality in larval and juvenile fish that were exposed to direct saxitoxin intoxication and through the food web. The effects of saxitoxin on crustacean larvae ranged from lethality in brine shrimp to sublethal effects in crab larvae. The dinoflagellate Lingulodinium polyedrum produces a yessotoxin, which is a large family of toxins. Yessotoxins have been identified as the major causative agent in an invertebrate mass mortality event, but its potential impacts on fish are still unclear and under research.

Settlement of Suspended Solids: Although the suspended solids that are discharged through Outfall 001 are initially carried up in the rising effluent plume, and carried laterally by the currents, most of the solids eventually settle out onto the seafloor nearby. In general, the greatest amount of deposition occurs near the diffusers, with decreasing levels of deposition with increasing distance from the diffusers.

The settlement of solids alters the availability and quality of SAV and forage within the affected area. Where deposition rates are high, the solid material that settles out of the effluent may smother SAV and other sessile organisms. Additionally, many heavy metals and persistent organic compounds, such as pesticides and PCBs, tend to adhere to solid particles discharged from outfalls. Therefore, the layer of settled solids very likely contains a low but steady load of heavy metals and persistent organic compounds that would be taken up by the benthic organisms within the affected area, and those contaminants likely bioaccumulate in the local food web at higher rates than in unaffected areas.

Dissolved Oxygen: The effluent is authorized to discharge a weekly average of 48,000 pounds per day of carbonaceous biochemical oxygen demand (CBOD) and a weekly average of 54,000 pounds per day of total suspended solids (TSS), both of which reduce dissolved oxygen levels in the receiving water. Respiration related to the biological breakdown of the effluent's carbonaceous components reduces the dissolved oxygen concentration within the plume. TSS typically reduces dissolved oxygen through decreased photosynthesis due to turbidity-related reduced light. Also, the increased water temperature within the effluent plume reduces the water's ability to hold oxygen. Additionally, algal blooms that may be triggered by the increased availability of nutrients within the plume can reduce dissolved oxygen in the water column due to respiration by the algae and or by increased respiration by bacteria during the decomposition of dead algae.

Reduced dissolved oxygen may 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. Further, the impacts of reduced dissolved oxygen tend to be more severe lower in the water column (LaSalle 1988).

Outfall 002: Outfall 002's effluent plume would create water quality gradients that would increase in intensity with movement toward the diffuser during a discharge event. Also, effluent-borne nitrogen, other nutrients, and suspended solids may increase local productivity and forage availability, but also diminish forage quality. The exact extent of detectable effluent and sediments that would be discharged from Outfall 002 is unknown. However, to avoid underestimating potential impacts, this assessment assumes that detectable effluent and sediments could extend the full distance downstream from the outfall to the mouth of the Duwamish Waterway.

Due to the infrequency, short duration, and relatively low volume of the discharges that are expected through Outfall 002, its effects on altered environmental conditions would be episodic, small-scale, and temporary in nature. Additionally, maintenance discharges through outfall 002 would be timed to maximize the river's outflow (King County DNRP 2022i). Further, based on the requirement to coordinate with natural resource agencies to schedule maintenance discharges, and on the timing of recent maintenance discharges, exposed listed fish would most likely be limited to low numbers of stream-type juvenile Chinook salmon and juvenile steelhead that could be rearing or migrating through the affected stream reach at the time of a discharge. How juvenile Chinook salmon and steelhead would respond to effluent-altered environmental conditions are likely to be highly variable and context driven.

Avoidance: The potential for avoidance of Outfall 002's effluent plume would depend largely on how and where a given effluent plume would overlay occupied habitat resources. Where the overlay occurs close to the outfall and effluent concentrations are high, the likelihood and intensity of avoidance would likely 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. Plume avoidance would reduce direct exposure to water-born contaminants, but the displacement from preferred habitat could result in increased competition and increase vulnerability to predators.

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 very slight and temporary increase in forage availability within the affected area. Dissolved nutrients would likely become undetectable very 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. In both cases, any increased productivity is expected to be short-lived (hours to days). As discussed earlier, organisms that are exposed to the plume and its settled-out solids are likely to uptake contaminants, and those that are consumed by other organisms will connect the effluent-related contaminants to the food web. Therefore, for some brief period following a discharge event, fish that forage in the affected area may consume contaminated prey that would be attributable to the discharge. However, as with the productivity increase, the contaminant concentrations would likely be very low.

In summary: Almost all effluent discharge would occur through Outfall 001, with very short maintenance discharges episodically occurring through Outfall 002. Over the decades of discharge through Outfall 001, some adult Chinook salmon; juvenile and adult steelhead; larval, juvenile, and adult bocaccio and yelloweye rockfish are likely to be exposed directly and indirectly to the discharge. During the episodic maintenance discharges through Outfall 002, extremely low numbers of juvenile Chinook salmon and steelhead are likely to be exposed directly and indirectly to the discharge.

Adult Chinook salmon and juvenile and adult steelhead that enter Outfall 001'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 large size and state of maturity of the adult fish, and the expectation that their exposures would be relatively brief and outside of the acute mixing zones, no direct mortality of adults is expected, but some individuals are likely to experience fitness impacts that could reduce their spawning success. Due to the expectation that their exposures would also be relatively brief and outside of the acute mixing zones, no direct mortality is expected for juvenile steelhead. However, their small size and state of immaturity increases the likelihood that they would experience fitness impacts that could reduce their likelihood of survival to adulthood and or reduce their future reproductive success, both of which would be exacerbated by repeated exposures to other effluent discharges, especially while within Puget Sound. The exact numbers of individuals that would be annually exposed to the effluent is unpredictable and likely to be highly variable over time. However, Outfall 001's location and the small size of its mixing zones relative to the surrounding shorelines and to the mouths of the rivers that support the potentially affected populations suggest that the routes taken by most retuning adults and emigrating juvenile steelhead are unlikely to intersect with the affected area, and that exposed individuals would comprise variably sized small subsets of their cohorts.

During maintenance discharges in the Green River, low numbers of juvenile Chinook salmon and steelhead are likely to be briefly exposed to Outfall 002's effluent plume or to resulting contaminated prey in the affected stream reach downstream of the diffuser. Like the fish discussed above, the intensity of juvenile Chinook salmon and steelhead's exposures and responses to the effluent are likely to be highly variable. However, due to the small size and state of immaturity of the juvenile fish in the river, combined with the expectation that some individuals may be suddenly enveloped within the acute mixing zone, some direct mortality is possible. Further, their small size and state of immaturity increases the likelihood that nonlethal exposures would result in reduced likelihood of survival to adulthood and or reduced reproductive success, which would be exacerbated by repeated exposure to other effluent discharges, especially when they migrate within Puget Sound. The exact numbers of juveniles that would be exposed to the effluent during a maintenance discharge is unpredictable and likely to be highly variable over time. However, based on the multi-year periodicity, short-duration (~ 4 hours), and timing of maintenance discharges though Outfall 002, combined with the expectation that the window for indirect exposures following a discharge would be very short (days to weeks) it is most likely that extremely few individuals of either species are likely to be directly or indirectly exposed to a discharge event.

Given the expectation that the total discharge is likely to detectably affect only small subsets of the annual cohorts of the affected PS Chinook salmon and PS steelhead populations', and that the proposed action would only contribute about 2% of the total discharge, it is extremely unlikely that the proposed action would cause any detectable population-level effects on PS Chinook salmon and PS steelhead.

Larval, juvenile, and adult bocaccio and yelloweye rockfish that enter Outfall 001'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 their small size and inability to effectively avoid the acute mixing zone as they are carried on the currents, some larval bocaccio and yelloweye rockfish are likely to experience direct mortality due to exposure to Outfall 001's effluent plume. Larvae that experience non-lethal exposures are likely to experience fitness impacts that could reduce their likelihood of survival to adulthood and or reduce their future reproductive success, both of which are likely to be exacerbated by exposures to other effluent discharges as the larvae are carried on the currents within Puget Sound. Due to their larger sizes and their ability to remain outside of the acute mixing zones, no direct mortality of juvenile or adult bocaccio and or yelloweye rockfish is expected. However, some exposed individuals are likely to experience fitness impacts that could reduce their likelihood of survival to adulthood and or reduce their reproductive success, especially for those individuals that habituate to the conditions and remain the affected area for extended periods of time.

The exact numbers of individuals of either species that would be exposed to the effluent is unpredictable and likely to be highly variable over time. However, based on the rarity of both rockfish species, and on the location of Outfall 001's mixing zones relative to habitat features that are likely to provide supportive deepwater rockfish habitat, the numbers of exposed individuals would be extremely small. Given the expectation that the total discharge is likely to detectably affect extremely small numbers of bocaccio and or yelloweye rockfish, and that the proposed action would only contribute about 2% of the total discharge, it is extremely unlikely that the proposed action would cause any detectable population-level effects on PS/GB bocaccio and or PS/GB yelloweye rockfish.

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.

Effluent discharge is likely to adversely affect critical habitat for PS Chinook salmon, PS steelhead, PS/GB bocaccio, PS/GB yelloweye rockfish, and SR killer whales.

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: None in the action area.

2. Freshwater rearing sites:
   a. Water quantity – The proposed action would cause no meaningful effect on this attribute. During episodic WWTP maintenance discharges, the effluent would briefly (~4 hours) and virtually imperceptibly increase water quantity in the Green River downstream of the diffuser.
   b. Floodplain Connectivity – The proposed action caused no effect on this attribute.

c. Water quality – The proposed action would cause long-term but episodic minor adverse effects on this attribute. The proposed action would be responsible for the continuation of about 2% of the King County South WWTP's effluent discharge to the Green River. As described above under Effluent-related Effects, the effluent that would be discharged into the Green River during maintenance discharges would contain numerous pollutants that are known to be harmful to listed salmonids and to other aquatic organisms. Within the acute mixing zone around the diffuser, some pollutant concentrations are reasonably likely to be acutely toxic to exposed juvenile Chinook salmon and to other aquatic organisms. Outside of the acute mixing zone, some of the contaminants are likely to be of high enough concentrations to contribute to chronic adverse effects in exposed juvenile Chinook salmon that are repeatedly exposed to pollutants over their lives. The exact temporal duration and spatial extent of impacted water quality is uncertain. However, water quality in the river would be reduced during the entire duration of a discharge (about 4 hours) plus the time it would take for the last of the plume to flow to Puget Sound. Additionally, because some of the pollutants are known to be persistent and to float, this assessment assumes that detectable water quality impacts would extend the length of the river between the diffuser and Puget Sound.

d. Natural Cover – The proposed action would cause no meaningful effect on this attribute. The brief and episodic WWTP maintenance discharges of effluent is unlikely to cause any change in SAV or other sources of natural cover within the river.

3. Freshwater migration corridors free of obstruction and excessive predation:
   a. Obstruction and excessive predation – The proposed action would cause long-term but episodic minor adverse effects on this attribute. The proposed action would be responsible for the continuation of about 2% of the King County South WWTP's effluent discharge to the Green River. During maintenance discharges, the effluent plume would briefly (~ 4 hours) cause water quality conditions that are likely to cause some rearing juvenile Chinook salmon to abandon preferred shelter and foraging habitat to avoid the effluent plume. This, in turn may increase the risk of predation for some of the exposed juvenile Chinook salmon.
   b. Water quantity – Same as above.
   c. Water quality – Same as above.
   d. Natural Cover – Same as above.

4. Estuarine areas free of obstruction and excessive predation: – Outside of the expected range of detectable effects.

5. Nearshore marine areas from the shoreline to a depth of 98 feet (30 m) that are free of obstruction and excessive predation: – Outside of the expected range of detectable effects.

6. Offshore marine areas: – Outside of the expected range of detectable effects.

Critical Habitat for PS/GB bocaccio and PS/GB yelloweye rockfish: The proposed action, including full application of the planned conservation measures and BMPs, is likely to adversely affect designated critical habitat for PS/GB Bocaccio and PS/GB Yelloweye Rockfish as described below.

1. Nearshore marine areas from the shoreline to a depth of 98 feet (30 m) with substrates such as sand, rock, and/or cobble compositions that support kelp: – Outside of the expected range of detectable effects.

2. Deepwater marine areas at depths greater than 98 feet (30 m) that possess or are adjacent to complex bathymetry consisting of rock and/or highly rugose habitat:
   a. Prey quantity, quality, and availability – The proposed action would cause long-term minor adverse effects on this attribute. The proposed action would be responsible for the continuation of about 2% of the King County South WWTP's effluent discharge to Puget Sound. As described earlier, in the discussion about altered forage availability and quality, the effluent's nutrient load is likely to slightly increase productivity and create an area of slightly increased forage availability around Outfall 001. However, some contaminants from the effluent would enter the food web and bioaccumulate in rockfish forage organisms that are directly exposed to the effluent and or consume contaminated forage organisms. However, given the very small portion of the effluent that would be attributable to the proposed action, action attributable effects on forage quantity, quality, and availability would be minor.
   b. Water quality and sufficient dissolved oxygen – The proposed action would cause long-term minor adverse effects on this attribute. The proposed action would be responsible for the continuation of about 2% of the King County South WWTP's effluent discharge to Puget Sound. As discussed earlier, under Effluent-related Effects, the discharged effluent would contain numerous pollutants that are known to be harmful to fish and to other aquatic organisms. Within the acute mixing zone around the diffusers, some pollutant concentrations are reasonably likely to be acutely toxic to exposed rockfish, rockfish larvae, and to other aquatic organisms. Outside of the acute mixing zone, some of the contaminants are likely to be of high enough concentrations to contribute to chronic adverse effects in exposed rockfish that would be exposed to more pollutants over their lives. Additionally, the effluent would contain large amounts of material that would create a biological oxygen demand, which would reduce the dissolved oxygen concentration in the water. The exact spatial extent of impacted water quality is uncertain. However, to avoid underestimating potential impacts, this assessment assumes that detectable effluent-borne contaminants and sediments could extend about three times the width of the chronic mixing zone (2,475 feet) around both Outfall 001 diffusers.

Critical Habitat for SR Killer Whales: The proposed action, including full application of the planned conservation measures and BMPs, is likely to adversely affect designated critical habitat for SR Killer Whales as described below.

Inland waters of Puget Sound waterward of a line at a depth of 20 feet (6.1 m) relative to extreme high water:

a. Water quality to support growth and development – The proposed action would cause long-term minor adverse effects on this attribute. The proposed action would be responsible for the continuation of about 2% of the King County South WWTP's effluent discharge to Puget Sound. As discussed earlier, under Effluent-related Effects, the discharged effluent would contain numerous pollutants that are known to be harmful to fish and to other aquatic organisms. As discussed in more detail in Section 2.12, exposure to the proposed action's portion of the effluent is not likely to adversely affect SR killer whales. However, the continued discharge of the service area's effluent would contribute to maintaining water quality within about 2,475 feet around both Outfall 001 diffusers at a state where its ability to support growth and development of SR killer whales would be degraded as compared to non-impacted waters.
b. 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 minor effects on this attribute. The proposed action would be responsible for the continuation of about 2% of the King County South WWTP's effluent discharge to Puget Sound. As described earlier, in the final summary under Effluent-related Effects, very low numbers of Chinook salmon, steelhead, and rockfish are likely to uptake contaminants directly from the water column within Outfall 001's plume, and or through the consumption of effluent-contaminated forage. Additionally, some individuals may experience some degree of effluent-related reduced reproductive success. Therefore, some of the SR killer whale's available prey species within the affected area may be contaminated, but the numbers that would be attributable to the proposed action would be very low. Due to the naturally high attrition rates of larval and juvenile fish, it is very unlikely that any proposed action-attributable reduced reproductive success would detectably reduce the available prey for SR killer whales.
c. Passage conditions to allow for migration, resting, and foraging – The proposed action would cause no detectable effects on passage conditions.

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 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. Non-federal activities in and upstream of the action area that have contributed to those conditions include past and on-going bankside development, vessel activities, upland urbanization, along with stormwater and wastewater discharges. They also include 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 low-level inputs of non-point source pollutants will likely continue 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 within many of the watersheds that flow into the action area. However, the implementation of plans, initiatives, and specific restoration projects are often subject to political, legislative, and fiscal challenges that increase the uncertainty of their success.

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in 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 PBF 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 the opinion well into the foreseeable future. However, the action's effects on water quality, substrate, and the biological environment are expected to be of such a small scale that no detectable effects on ESA-listed species or critical habitat through synergistic interactions with the impacts of climate change are expected.

2.7.1 ESA Listed Species

PS Chinook salmon, PS steelhead, and PS/GB yelloweye rockfish are all listed as threatened. PS/GB bocaccio are listed as endangered. All four listings are 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. All four 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, that escapement levels remain well below the PSTRT planning ranges for recovery for all MPGs, concluded that the PS Chinook salmon ESU remains at "moderate" risk of extinction (NWFSC 2022).

The proposed action would affect PS Chinook salmon at 3 separate locations: the Coal Creek project site; the Outfall 001 site in Central Puget Sound; and the Outfall 002 site in the Green River. All of the populations that would be affected by the proposed action belong to the Central/South Puget Sound MPG. The PS Chinook salmon most likely to occur at the Coal Creek project site would be fall-run Chinook salmon from the Cedar River and or the Sammamish River populations. The PS Chinook salmon most likely to occur in Puget Sound near Outfall 001 would be an indeterminate mix of spring- and fall-run Chinook salmon from the Cedar, Green/Duwamish, Nisqually, Puyallup, Sammamish, and White River populations. The PS Chinook salmon most likely to occur in the Green River near Outfall 002 would be fall-run Chinook salmon from the Green River/Duwamish population.

The Cedar River PS Chinook salmon population is relatively small, with a slightly negative long-term abundance trend, but a stable and relatively high proportion of natural-origin spawners. The Green River/Duwamish PS Chinook salmon population is small to moderate in size, with a relatively high proportion of hatchery-origin spawners, and negative trends in long-term abundance and natural-origin spawners. The Nisqually River population is relatively small, with a high proportion of mixed-origin hatchery fish, but positive trends in long term abundance and natural-origin spawners. The Puyallup River population is moderate in size, with a high proportion of mixed-origin hatchery fish, and negative trends in long term abundance and natural-origin spawners. The Sammamish River population is relatively small, has a high proportion of mixed-origin hatchery fish, a negative trend in natural-origin spawners, but a slightly positive long-term abundance trend. The White River population is relatively small, with a relatively high proportion of hatchery-origin spawners, a positive trend in long term abundance, but a negative trend in natural-origin spawners.

The environmental baseline within the affected area of the Coal Creek project site has been degraded by more than 100 years of nearby urbanization, agriculture, industry, and road building and maintenance. However, the affected reach supports freshwater migration, spawning, and juvenile rearing for PS Chinook salmon. The environmental baseline within the affected area around Outfall 001 has been degraded by more than 100 years of maritime activity, point and non-point stormwater and sewer discharges related to upland development and urbanization around Central Puget Sound, and WWTP effluent discharge from Outfall 001. However, the affected area supports marine migration and growth for adult PS Chinook salmon. The environmental baseline within the affected area around Outfall 002 has been degraded by more than 100 years of nearby urbanization, agriculture, industry, road building and maintenance, and upstream agriculture and forestry. However, the affected reach supports freshwater migration and juvenile rearing for PS Chinook salmon.

In Coal Creek, up to 30 juvenile Chinook salmon may be captured during fish salvage operations, with up to 3 mortalities. Indirect habitat impacts are likely to cause a range of effects that both individually and collectively would cause altered behaviors and possible mortality in very low numbers of juveniles annually for several years following the completion of the project. For several decades to come at Outfall 001, exposure to WWTP effluent is likely to cause non-lethal fitness impacts that may cause negative reproductive effects in low annual numbers of adult Chinook salmon. At Outfall 002, brief (hours long) effluent discharges every few years, is likely to cause some combination of non-lethal behavioral and fitness impacts that may reduce the long-term survival and or cause future negative reproductive effects in very low numbers of juvenile Chinook salmon.

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, it is assumed that abundances are 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 NWFSC 2022.

The proposed action would affect PS steelhead at 3 separate locations: the Coal Creek project site; the Outfall 001 site in Central Puget Sound; and the Outfall 002 site in the Green River. All of the DIPs that would be affected by the proposed action belong to the Central/South Puget Sound MPG. The PS steelhead most likely to occur at the Coal Creek project site would be winter-run fish from the Cedar River DIP and or the North Lake Washington and Lake Sammamish DIP. The PS steelhead most likely to occur in Puget Sound near Outfall 001 would be an indeterminate mix of summer- and winter-run fish from the Cedar, East Kitsap Peninsula Tributaries, Green/Duwamish, Nisqually, Puyallup, North Lake Washington and Lake Sammamish, Puyallup River, South Sound Tributaries, and White River DIPs. The PS steelhead most likely to occur in the Green River near Outfall 002 would be summer- and winter-run fish from the Green River/Duwamish population.

The Cedar River PS DIP is small, of unknown stock with natural production, but with a strongly negative long-term abundance trend. The East Kitsap Peninsula Tributaries DIP is a native stock with wild production, but no abundance or trend data are available. The Green River/Duwamish DIP is small to medium sized, of native stock with natural and hatchery production, with a neutral long-term abundance trend. The Nisqually River DIP is small to medium sized, of native stock with natural production, and a positive long-term abundance. The North Lake Washington and Lake Sammamish DIP is extremely small, of unknown stock origin, with less than 10 adults retuning annually since 1994. The Puyallup River DIP is small to medium sized, of native stock with natural production, and a positive long-term abundance trend. The South Sound Tributaries DIP has no available stock, abundance, or trend data. The White River DIP is small to medium sized, of native stock with natural and hatchery production, and a positive long-term abundance trend.

The environmental baseline within the affected area of the Coal Creek project site has been degraded by more than 100 years of nearby urbanization, agriculture, industry, and road building and maintenance. However, the affected reach would likely support freshwater migration and juvenile rearing for PS steelhead. The environmental baseline within the affected area around Outfall 001 has been degraded by more than 100 years of maritime activity, point and non-point stormwater and sewer discharges related to upland development and urbanization around Central Puget Sound, and WWTP effluent discharge from Outfall 001. However, the affected area supports marine migration and growth for juvenile and adult PS steelhead. The environmental baseline within the affected area around Outfall 002 has been degraded by more than 100 years of nearby urbanization, agriculture, industry, road building and maintenance, and upstream agriculture and forestry. However, the affected reach supports freshwater migration and possibly juvenile rearing for PS steelhead.

In Coal Creek, indirect habitat impacts are likely to cause a range of effects that both individually and collectively would cause altered behaviors and possible mortality in very low numbers of juveniles annually for several years following the completion of the project. For several decades to come at Outfall 001, exposure to WWTP effluent that would be attributable to the proposed action is likely to cause non-lethal behavioral and fitness impacts that may that may reduce the long-term survival and or cause future negative reproductive effects in very low annual numbers of juvenile steelhead. It is also is likely to annually cause negative reproductive effects in low annual numbers of adult steelhead. At Outfall 002, brief (hours long) effluent discharges every few years, is likely to cause some combination of non-lethal behavioral and fitness impacts that may reduce the long-term survival and or cause future negative reproductive effects in very low numbers of juvenile steelhead.

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.

<u>PS/GB bocaccio</u>

No reliable population estimates are available for PS/GB bocaccio. The best available information indicates that they were never a predominant segment of the total rockfish abundance in Puget Sound, and that abundance has declined by more than 70 percent since 1965. They are considered rare in the action area, and it is uncertain whether they currently utilize the habitat within the action area. Fishing removals and derelict fishing gear, combined with degraded water quality appear to be the greatest threats to the recovery of the DPS.

Outfall 001 is located in Central Puget Sound, about 10,000 feet west/northwest west of Duwamish Head, West Seattle, Washington (Figures 12 & 13). The environmental baseline within the action area has been degraded by more than 100 years of development, maritime activity, upland urbanization, and wastewater discharge.

Based on the rarity of bocaccio in the action area, and the distance between Outfall 001 and habitat with characteristics that are typically preferred by bocaccio, very low numbers of individuals may be directly and indirectly exposed to contaminants related to WWTP effluent discharged through Outfall 001. Exposure to those contaminants is likely to cause some combination of altered behaviors, reduced fitness, and mortality in some exposed individuals. However, the annual numbers of individuals that are likely to be impacted by this stressor is expected to be extremely low.

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 population (abundance, productivity, distribution, or genetic diversity) for the PS/GB bocaccio DPS. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

PS/GB yelloweye rockfish

No reliable population estimates are available for PS/GB yelloweye rockfish. The best available information indicates that they were never a predominant segment of the total rockfish abundance in Puget Sound, and that abundance has declined by more than 70 percent since 1965. They are considered rare in the action area, and it is uncertain whether they currently utilize the habitat within the action area. Fishing removals and derelict fishing gear, combined with degraded water quality appear to be the greatest threats to the recovery of the DPS.

Outfall 001 is located in Central Puget Sound, about 10,000 feet west/northwest west of Duwamish Head, West Seattle, Washington (Figures 12 & 13). The environmental baseline within the action area has been degraded by more than 100 years of development, maritime activity, upland urbanization, and wastewater discharge.

Based on the rarity of yelloweye rockfish in the action area, and the distance between Outfall 001 and habitat with characteristics that are typically preferred by yelloweye rockfish, very low numbers of individuals may be directly and indirectly exposed to contaminants related to WWTP effluent discharged through Outfall 001. Exposure to those contaminants is likely to cause some combination of altered behaviors, reduced fitness, and mortality in some exposed individuals. However, the annual numbers of individuals that are likely to be impacted by this stressor is expected to be extremely low.

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 population (abundance, productivity, distribution, or genetic diversity) for the PS/GB yelloweye rockfish DPS. 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, PS steelhead, PS/GB bocaccio, PS/GB yelloweye rockfish, and SR killer whales 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 habitat 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 for PS Chinook salmon and PS steelhead critical habitat at and adjacent to the King County South WWTP's emergency outfall (Outfall 002) are limited to freshwater rearing and freshwater migration corridors free of obstruction and excessive predation. The site attributes of those PBFs that would be affected by the action are obstruction and excessive predation, and water quality. As described in the environmental baseline section, the outfall site is located along a heavily impacted waterway, and both of these site attributes currently function at reduced levels as compared to an undisturbed river. As described in the effects section, over the long term, the proposed action would episodically cause minor adverse effects on the identified site attributes.

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 PBFs of freshwater rearing and freshwater migration corridors 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.

Critical Habitat for PS/GB Bocaccio and PS/GB Yelloweye Rockfish

Nearshore rockfish critical habitat has been degraded by past and ongoing shoreline development that has altered shoreline substrates, and reduced eelgrass and kelp habitats in many areas of Puget Sound. Agriculture, industry, urbanization, and maritime activities have reduced water quality throughout Puget Sound, and the widespread presence of derelict fishing gear in both nearshore and deep-water critical habitat areas has altered bottom composition, reduced prey availability, and directly kills rockfish.

Rising sea levels, caused by climate change, are expected to increase coastal erosion and alter the composition of nearshore critical habitat for PS/GB bocaccio. Elevated sea surface temperatures and increased ocean acidification may also reduce the quality of nearshore marine habitats, and reduce prey availability by reducing ocean productivity.

Future non-federal actions and climate change are likely to increase and continue acting against the quality of rockfish critical habitat. The intensity of those influences is uncertain, as is the degree to which those impacts may be tempered by adoption of more environmentally acceptable practices, by restoration activities such as efforts to remove derelict fishing gear and to improve water quality, and by efforts to address the effects of climate change.

The PBF for PS/GB bocaccio and PS/GB yelloweye rockfish critical habitat in the action area is limited to deep water critical habitat with complex bathymetry. The site attributes of that PBF that would be affected by the action are prey quantity, quality, and availability; and water quality and dissolved oxygen. As described in the effects section, the proposed action would cause long term minor adverse effects on all of those attributes.

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 deep water rockfish critical habitat in the action area. Therefore, this critical habitat will maintain its current level of functionality, and retain its current ability for PBF to become functionally established, to serve the intended conservation role for PS/GB bocaccio and PS/GB yelloweye rockfish.

Critical Habitat for SR Killer Whales

Past and ongoing land and water use practices have degraded SR killer whale critical habitat throughout the Puget Sound basin. Urbanization, shoreline development, and point and non-point stormwater and wastewater discharges have reduced water quality across the region. Shoreline industries and high levels of vessel traffic have increase ambient noise levels, and anthropogenic impacts on Chinook salmon and other fish species have reduced the availability and quality of forage resources for SR killer whales.

In the future, non-federal land and water use practices and climate change are likely to increase. The intensity of those influences on SR killer whale 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 SR killer whales and their primary prey species (Chinook salmon), and by efforts to address the effects of climate change.

The PBF for SR killer whale critical habitat that exists at and adjacent to the King County South WWTP's primary outfall (Outfall 001) is that of inland waters of Puget Sound deeper than 20 feet at extreme high water. The attributes of that PBF that would be affected by the proposed action include water quality to support growth and development, and prey species of sufficient quantity, quality, and availability. As described in the effects section, the proposed action would cause long term minor adverse effects on both of these attributes.

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 Inland Waters of Puget Sound PBF. 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 SR killer whales.

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, PS steelhead, PS/GB bocaccio, and PS/GB yelloweye rockfish. It is also the NMFS' biological opinion that the proposed action is not likely to destroy or adversely modify designated critical habitat for PS Chinook salmon, PS steelhead, PS/GB bocaccio, PS/GB yelloweye rockfish, and SR killer whales.

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 from exposure to:
- Fish Salvage
- Construction-related Noise,
- Construction-related Habitat Impacts, and
- Effluent-related Impacts.

Harm of PS steelhead from exposure to:
- Construction-related Habitat Impacts, and
- Effluent-related Impacts.

Harm of PS/GB bocaccio and PS/GB yelloweye rockfish from exposure to:
- Effluent-related Impacts.

The King County predicts that a maximum of 30 juvenile Chinook salmon may be captured during fish salvage activities for the entire project, and that up to 3 of those fish would be seriously injured or killed.
The NMFS cannot predict with meaningful accuracy the number of PS Chinook salmon, PS steelhead, PS/GB bocaccio, and PS/GB yelloweye rockfish that are reasonably certain to be injured or killed by exposure to construction-related noise, construction-related habitat impacts, and effluent-related impacts. 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 of the in-water work is applicable for exposure of PS Chinook salmon to construction-related noise because the proposed in-water work window avoids the expected presence of adult PS Chinook salmon, and greatly reduces the potential for juvenile PS Chinook salmon in the project area. Therefore, working outside of the proposed work window would increase the potential that more PS Chinook salmon would be exposed to construction-related noise than would be exposed working within it.

The size and design of the proposed bank stabilization structure and in-stream restoration features are the best available surrogates for the extent of take of juvenile PS Chinook salmon and juvenile PS steelhead from exposure to construction-related habitat impacts. The size and design of these installations is appropriate for construction-related habitat impacts because the resulting fitness impacts would be positively correlated with the amount of degraded aquatic habitat and with the intensity of the degradation. As the size of impacted habitat increases, the number of fish that are likely to be exposed would increase as would the duration of their exposure. As the bank stabilization structure and the in-stream restoration features diverge from similarity to natural streambank and streambed conditions, the intensity of those installations' impacts on the fitness of exposed fish would increase.

The nature of wastewater flow from the service area, and the maximum flow volume through the trunk line are the best available surrogates for the extent of take of PS Chinook salmon, PS steelhead, PS/GB bocaccio, and PS/GB yelloweye rockfish from exposure to effluent-related impacts. The nature of wastewater flow is appropriate because the resulting fitness and behavioral impacts would be positively correlated with the pollutants that would be in the effluent. The inclusion of stormwater to the proposed separated sewer system would introduce roadway pollutants that were not considered in the biological opinion, and would likely increase the intensity of adverse effect experienced by fish that would be exposed to the discharged effluent. The maximum flow volume through the trunk line is appropriate because, without changing the treatment system, the amount of pollutants discharged to the receiving waters would increase as the volume of the wastewater that is delivered to the WWTP increases. As the amount of discharged pollutants increases in the receiving waters, the number of exposed fish and or the intensity of fitness and behavioral effects that exposed fish would experience would also increase.

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

- A total of 30 juvenile PS Chinook salmon captured during fish salvage, with a maximum of 3 individuals being seriously injured or killed;
- In-water work to be completed between June 16 and September; and
- The size and design of the proposed bank stabilization structure and in-stream restoration features as described in the proposed action section of this biological opinion.
- The size and design of the proposed upgraded trunk line with a maximum design flow volume of 18.1 MGD for the service area's separated sewer system 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 reinitiation triggers. If any of these take surrogates exceed the proposal, it could still meaningfully trigger reinitiation 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 or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. 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 fish salvage activities. The applicant or their contractor shall maintain and submit fish salvage logs to verify that all take indicators are monitored and reported. Minimally, the logs should include:
                a. The identity (name, title, organization), qualification, and contact information of the persons conducting fish salvage, and the person completing the report;
                b. The date, time, and air and water temperatures during salvage work;
                c. The method(s) of capture and handling procedures that were used; and

d. The species and quantities of captured fish, and their disposition at release (i.e. alive with no apparent injuries, alive with apparent minor/serious injuries, dead with/without apparent injuries).

2. Documentation of the timing of in-water work to ensure that all in-water work is accomplished between June 16 and September 15; and
3. Documentation of the size and design of the proposed bank stabilization structure and in-stream restoration features to confirm that they conform with the characteristics described in this opinion. Minimally, the documentation should include:
   a. The location, linear and areal extent, and design features of the bank stabilization structure;
   b. The location, linear and areal extent, and design features of the in-stream restoration features;
   c. Identification of the fill layers and materials that are installed; and
   d. Construction photographs with locations of photo points and direction of view for photographs.

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-2021-01232 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 in Central Puget Sound and in the Green River through continued discharge of wastewater from the project's service area:

1. King County 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 state-issued NPDES permits within the Puget Sound Basin, 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 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 Reinitiation of Consultation

This concludes formal consultation for the U.S. Army Corps of Engineers' authorization of King County DNRP - WTD's Coal Creek Trunk Upgrade Project in Bellevue, 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 humpback whales of the Central America and Mexico DPSs, and southern resident (SR) killer whales. Detailed information about the biology, habitat, and conservation status and trends of these whale species 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, and are incorporated here by reference.

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. 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 effects analyses presented in Section 2.5.

2.12.1 Effects on Listed Species

The proposed action will cause no direct effects on humpback whales and SR killer whales because all construction and its direct effects would be limited to freshwater, and both whale species live in marine waters, far beyond the range of direct effects. However, the project may indirectly affect humpback whales and SR killer whales through direct exposure to WWTP effluent and through impacts on the quantity and quality of forage availability for both whale species (trophic impacts) that would occur as a result of the proposed action.

Direct Exposure to WWTP Effluent

It is extremely unlikely that direct exposure to action-attributable effluent would cause any meaningful fitness or behavioral impacts on either whale species considered here.

As described in Section 2.5, the proposed trunk line upgrade would cause several decades of continued municipal effluent flow from the service area to the King County South WWTP, which almost exclusively discharges to Central Puget Sound. As described in subsection 2.5.1, under effluent-related impacts, the discharged effluent contains substances that are known to be harmful to fish, especially to small and or developing juvenile fish. Some of those substances are also known or expected to be harmful to marine mammals (NMFS 2018).

The NMFS biological opinion for the reissuance of the NPDES permit for the Hyperion WWTP in Los Angeles, CA (NMFS 2018) concluded that the effluent from that WWTP would adversely affect numerous whale species, and this biological opinion determined that fish would be adversely affected by direct exposure to effluent that would be attributable to the proposed action considered in this opinion.

However, the volume of action-attributable effluent is very small, especially when compared to large WWTPs like Hyperion, which is permitted to discharge a maximum of 850 MGD. The proposed action’s maximum effluent contribution of about 5.4 MGD, is less that 1 percent (0.64 percent) as large as the maximum Hyperion discharge.

Additionally, due to their much larger mass, the whales must absorb much more contamination than would fish to elicit detectable effects, and being air breathers, instead of drawing oxygen from the water through gills like fish, whales likely absorb contaminants directly from the water at lower rates than do fish. Therefore, far more direct exposure to the effluent would be required to elicit detectable effects in whales than would be required for the fish considered in Section 2.5.1. Further, both whale species are unlikely to remain within the detectable plume for extended lengths of time because they are observed relatively infrequently in the Central Puget Sound, and only for brief periods, and they typically range widely during any given day. Based on this, on the relatively small size of the detectable effluent plume, and on the very small volume of action attributable effluent, it is most likely that individuals of either whale species would be exposed to action-attributable effluent very infrequently, and only for very brief periods of time, likely measured in low numbers of hours.

Based on the very small action-attributable effluent volume and area of effect, the whales’ large size and low expected rates of absorption, and the expectation that exposures would be infrequent and very brief, it is extremely unlikely that any exposed whales would absorb enough contaminants from action-attributable effluent to cause any meaningful fitness or behavioral effects, including with multiple exposures to the effluent over any given whale’s lifetime.

Trophic Impacts

It is extremely unlikely that action-attributable trophic impacts would cause any meaningful fitness or behavioral impacts on either whale species considered here.

As described in Section 2.5, the proposed construction in Coal Creek is likely to result in the annual loss of extremely low numbers of juvenile Chinook salmon, which are the primary forage resource for SR killer whales. Additionally, the routine discharge of the service area's effluent to Puget Sound, and episodic brief maintenance discharges to the Green River, is likely to cause some uptake of pollutants by very low numbers of Chinook salmon, as well as forage fish and planktonic invertebrate organisms that are forage resources for humpback whales. The uptake of pollutants by forage resources may affect humpback whales and SR killer whales by reducing the availability of forage due to direct mortality or reduced fecundity in forage organisms that are exposed to the effluent. Additionally, the whales may be indirectly exposed to pollutants if they consume prey organisms that were contaminated by exposure to the effluent.

Humpback Whales

Action-attributable loss of humpback forage organisms, and any trophic link to action-attributable contaminants would be too small to cause any meaningful effects on the fitness and normal behaviors of humpback whales.

As described above, the volume of action-attributable effluent and the size of the affected area in Central Puget Sound are both very small. Therefore, only a very small proportion of the prey organisms in the Central Puget Sound are likely to be exposed to action-attributable effluent; exposures are likely to be very brief as the prey organisms swim, or are carried by the prevailing currents, through the small affected area; and the pollutant concentrations from action-attributable effluent would be very low. Based on the best available information, the subset of forage organisms in Central Puget Sound that would be lost or experience reduced fecundity would be too small to cause any detectable reduction in forage availability for humpback whales that forage in Central Puget Sound. Similarly, it is extremely unlikely that the numbers of forage organisms that are likely to be contaminated by, and the concentrations of contaminants that would be attributable to the proposed action would be high enough to cause any meaningful effect on humpback whales that forage in Central Puget Sound.

SR Killer Whales

Action-attributable loss of SR killer whale forage and any trophic link to action-attributable contaminants would be too small to cause any meaningful effects on the fitness and normal behaviors of SR killer whales.

As described in Section 2.5, the proposed action would annually affect an extremely low number of juvenile Chinook salmon. In Coal Creek, the project's detectable effects on fish would be limited to a relatively short stretch of the creek where very small subsets of each year's juvenile PS Chinook salmon cohort would be exposed to construction-related impacts, and only very small subsets of the individuals that occur within the affected area are likely to be detectably affected by the exposure. Similarly, during the episodic and very brief effluent discharges to the Green River, extremely low number of juvenile Chinook salmon would be exposed to WWTP effluent. Again, only very small subsets of the individuals that are within the affected reach during a discharge are likely to be detectably affected by the exposure.

The exact Chinook salmon smolt 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.

It is extremely unlikely that the numbers of Chinook salmon that may be contaminated by action-attributable pollutants, and or that the attributable pollutant concentrations would be high enough to cause any meaningful effect on SR killer whales. The adult Chinook salmon that would be exposed to action-attributable effluent would mostly likely be a small subset of any year's cohort of returning adults. Additionally, those adults would most likely be exposed to the effluent plume and effluent-contaminated forage when they would mostly be in the terminal phase of their oceanic life stage, and in route to their natal streams.

The duration of exposure to the effluent that adult Chinook salmon may experience, and or the amount of action-attributable contaminated forage that any adult Chinook salmon may consume before entering their natal stream would be highly variable over time, but both are expected to be very 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.

In summary, based on the best available information, the proposed action is not likely to adversely affect humpback whales of the Central America and Mexico DPSs and or SR killer whales.

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 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 COE and the descriptions of EFH for Pacific Coast Salmon (Pacific Fishery Management Council [PFMC] 2014), Pacific Coast Groundfish (PFMC 2005), and Coastal Pelagic Species (PFMC 1998) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

The project site is located in Coal Creek, in southwestern Bellevue, Washington (Figure 1). The waters and substrate of Coal Creek are designated as freshwater EFH for various life-history stages of Pacific Coast Salmon, which within the Lake Washington watershed include Chinook and coho salmon. Due to action-related effluent discharges, the project's action area also overlaps with freshwater EFH for various life-history stages of Pacific Coast Salmon in the Green River (Chinook, coho, and pink salmon), and with marine waters that have been designated, under the MSA, as EFH for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species.

Freshwater and marine EFH for Pacific salmon is identified and described in Appendix A to the Pacific Coast salmon fishery management plan (PFMC 1998). The major components of freshwater EFH for Pacific Coast salmon are: Spawning and incubation; Juvenile rearing; Juvenile migration corridors; and Adult migration corridors and holding habitat. The important habitat features of this EFH are: 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.

The major components of marine EFH for Pacific Coast Salmon are: Estuarine rearing; Ocean rearing; and juvenile and adult migration. The important habitat features of this EFH are: 1 good water quality; 2 cool water temperatures; 3 abundant prey species and forage base; 4 connectivity with terrestrial ecosystems; and 5 adequate depth and habitat complexity including marine vegetation and algae in estuarine and near-shore habitats.

Pacific Coast Groundfish EFH is identified as: All marine waters and substrate from mean higher high water (MHHW) or the upriver extent of saltwater intrusion out to depths less than or equal to 11,484 feet (3,500 m); Certain specifically identified seamounts in depths greater than 11,484 feet; and Areas designated as HAPCs not already identified by the above criteria (PFMC 2005). Pacific Coast Groundfish HAPC includes: Estuaries; Canopy Kelp; Seagrass; Rocky Reefs; and Areas of interest.

For Coastal Pelagic Species, EFH is identified as all marine and estuarine waters from the shoreline to the offshore limits of the exclusive economic zone (EEZ) and above the thermocline where sea surface temperatures range between 10°C to 26°C (PFMC 1998).

Succinct identification of specific habitat features that are necessary to support the full life cycles of Groundfish and Pelagic Species are absent from their respective EFH descriptions. However, the important features identified for Salmon EFH effectively address the habitat features that are necessary to support the full life cycle for all three species groups that may be affected by the proposed action. Therefore, the important features of marine Salmon EFH are used below to assess the impacts on EFH for all three species groups.

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 Coal Creek project area provides the spawning habitat HAPC, and Central Puget Sound at Outfall 001 provides the estuaries HAPC.

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 habitat, and is relevant to the effects on EFH for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species. 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 and marine EFH for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species as summarized below.

Freshwater EFH for Pacific Coast Salmon

1. Water quality: Within Coal Creek, in-water work would cause short-term minor adverse effects on this attribute. As described in section 2.5, in-water excavation and other work would cause elevated turbidity, and very small pollutant discharges from construction equipment are also possible. The impacts on water quality are unlikely to be detectable beyond about 300 feet downstream of the in-water construction areas, and they would persist no more than a low number of hours after work stops.

   Within the Green River, the project would episodically (once every few years) cause minor short-term (about 4 hours) adverse effects on this attribute through the continued practice of performing short maintenance discharges of WWTP effluent from a secondary level treatment plant. As described in section 2.5, the effluent would contain 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 salmonids and other aquatic organisms. The detectable effects of the effluent would be greatest at and immediately downstream of the outfall, but may possibly extend to the mouth of the river, but they are unlikely to persists more than a low number of hours following the end of a discharge.

2. Water quantity, depth, and velocity: Within Coal Creek, the proposed bank stabilization structure at the Condos construction area, as well as the proposed in-water stream restoration features at the Spur construction area would cause long-term minor adverse effects on the water depth and velocity attributes. Despite the bank stabilization structure's relatively low-impact design, and its intended purpose to reduce bank erosion and its related in-stream sedimentation, for some number of years after the end of construction, the bank stabilization structure would slightly alter hydraulically driven habitat forming processes that are likely to slightly alter water velocities and water depths in the creek. The effects would likely be limited to the stream reach between about 135 feet upstream to about 160 feet downstream from the ends of the structure, and to reduce over time as the structure and its plantings mature. Similarly, the in-stream restoration work at the Spur location would directly alter the existing water depth by creating pools and islands. It would also install a large number of in-water large wood structures that are likely to alter water velocities and other stream forming factors. Although these features are intended to improve in-stream habitat conditions as compared to the existing conditions, they may cause some unexpected deleterious effects on water depth and velocity, but they are likely to be very minor and to reduce in intensity over time. No impacts on water quantity are expected in Coal Creek, and no impacts on any of these attributes are expected in the Green River.

3. Riparian-stream-marine energy exchanges: Within Coal Creek, the proposed construction-related removal of riparian vegetation would cause long-term minor adverse effects on the riparian-stream energy exchange attribute. As described in section 2.5, some riparian trees and shrubs would be removed from the streambanks at the Spur and Condos in-water work areas. The vegetation would be replaced with appropriate native vegetation at the end of construction. However, until the replacement vegetation grows enough to fully replace the existing functionality (likely several years after the end of the project), small localized areas may experience increased input of solar radiation and very slightly increased water temperatures due to the reduced canopy cover. Additionally, the removal of the vegetation would reduce the input of organic material of terrestrial origin to the stream, which is important to the in-stream nutrient cycle. The removal of the vegetation may also decrease the input of large wood debris, which can affect water flows and velocities that drive stream forming processes. However, the reduced input of large wood would likely be offset by the planned installation of numerous large wood structures that are planned for the in-water restoration areas. Impacts on riparian-stream energy exchange are unlikely to be detectable beyond about 300 feet downstream of the in-water construction areas, but they may persist at diminishing intensity for many years after the completion of the project as the replacement vegetation grows. No action-related impacts on these attributes would occur in the Green River, or in marine waters.

4. Channel gradient and stability: Within Coal Creek, the proposed bank stabilization structure at the Condos construction area would cause long-term minor adverse effects on the channel

gradient and stability attribute. Despite its relatively low-impact design, the structure would permanently halt the ongoing erosion of the right bank, and for some number of years after the end of construction, the bank stabilization structure would slightly alter hydraulically driven stream forming processes in the creek between about 135 feet upstream to about 160 feet downstream from the ends of the structure. No action-related impacts on these attributes would occur in the Green River.

5. Prey availability: Within Coal Creek, the proposed action would cause minor long-term adverse effects on this attribute. As described in section 2.5, the proposed in-water work at the Spur and Condos locations would remove or kill SAV and benthic invertebrates within the footprint of the in-water work areas. Additionally, the removal of riparian vegetation would result in reduced input of organic material of terrestrial origin, all of which would negatively impact the in-stream nutrient cycle and reduce prey availability for juvenile salmonids in Coal Creek. However, the impacts are expected to be very minor, and with the exception of riparian vegetation, prey availability is expected to return to preconstruction levels within one of two seasons after the end of the project. No action-related impacts on these attributes would occur in the Green River.

6. Cover and habitat complexity: Within Coal Creek, the proposed action would cause minor adverse effects on this attribute. SAV, leaf litter, and branches provide cover for juvenile salmonids. As described in section 2.5, the proposed in-water work would remove or kill SAV within the footprints of the in-water work areas at the Spur and Condos locations, and the removal of riparian vegetation at those locations would also reduce the input of leaf litter and branches. However, the impacts on cover would be largely limited to the relatively small in-water work areas, and SAV availability is expected to return to preconstruction levels within one of two seasons after the end of the project. Additionally, the planned installation of large wood at both locations would provide cover that would help offset the loss. Additionally, the planned in-water restoration features would act to slightly increase habitat complexity at both sites. No action-related impacts on these attributes would occur in the Green River.

7. Water quantity: No changes expected.

8. Space: No changes expected.

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

10. Groundwater-stream interactions: No changes expected.

11. Connectivity with terrestrial ecosystems: Within Coal Creek, the proposed construction-related removal of riparian vegetation would cause long-term minor adverse effects on this attribute. As described in section 2.5, some riparian trees and shrubs would be removed from the streambanks at the Spur and Condos in-water work areas. The vegetation would be replaced with appropriate native vegetation at the end of construction. However, until the replacement vegetation grows enough to fully replace the existing functionality (likely several years after the end of the project), small localized areas may experience reduced input

of organic material of terrestrial origin (insects, leaf litter, etc.), which is important to the in-stream nutrient cycle. Impacts on this attribute are unlikely to be detectable beyond about 300 feet downstream of the in-water construction areas, but they may persist at diminishing intensity for many years after the completion of the project as the replacement vegetation grows. No action-related impacts on this attribute would occur in the Green River.

12. Substrate composition: Within Coal Creek, the proposed in-water work would cause short- and long-term minor effects on the substrate composition attribute. In-water construction is likely to mobilize fine sediments that may slightly increase the sedimentation of in-stream gravels downstream of the project sites. The proposed bank stabilization structure at the Condos location would likely reduce ongoing erosion on the right bank, which would reduce the input of fine sediments and the resulting sedimentation of stream gravels downstream of the structure. The structure is also likely to slightly alter hydraulically driven habitat forming processes that may slightly increase erosion and gravel sedimentation at other locations of the creek within about 135 feet upstream to about 160 feet downstream from the ends of the structure. However, the intensity of the transposed erosion is likely to be very minor (due to the design of the structure), less than the ongoing erosion at the site, and it is likely to reduce over time as the structure and its plantings mature.

    The in-stream restoration work at the Spur location may also slightly alter hydraulically driven habitat forming processes that may slightly increase erosion and gravel sedimentation at other locations of the creek. However, the intensity of the transposed erosion is likely to be very minor due to the design of the in-water features, and it is likely to reduce over time as the features mature. Additionally, the planned removal of the in-stream and bankside trunk-related structures at the Spur location is likely to reduce or eliminate the large inputs of fine sediments that have occurred in the past due to bank erosion around those structures, and from the in-water work that was periodically needed to maintain and protect them. No action-related impacts on this attribute would occur in the Green River.

Marine EFH for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species

1. Good water quality: The proposed action would cause minor long-term adverse effects on this attribute. The proposed project would replace a sewer trunk line that would result in the decades-long continuation, and increased discharge of up to about 5.4MGD of secondarily treated municipal effluent from the trunk line's service area being discharged to Central Puget Sound via the King County South WWTP. As described in section 2.5, the effluent would contain 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. Additionally, although not specifically addressed in the NPDES permit, the effluent would likely be of a lower salinity and a higher temperature than the receiving waters. The exact extent of the detectable effluent plume is unknown. The NPDES permit for the outfall allows for an 825-foot wide chronic mixing zone around the Outfall 001 diffusers. However, 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 about three

times the width of the chronic mixing zone, about 2,475 feet, around both Outfall 001 diffusers.

2. Cool water temperatures: The proposed action would cause minor long-term adverse effects on this attribute. As discussed above the proposed action would result in the decades-long continuation of effluent discharge from the service area to Central Puget Sound. Although not specifically addressed in the NPDES permit for the outfall, the effluent would likely be of a higher temperature than the receiving waters, but undetectable beyond the 825-foot wide chronic mixing zone around the Outfall 001 diffusers.

3. Abundant prey species and forage base: The proposed action would cause minor long-term adverse effects on this attribute. As described in section 2.5, action attributable effluent discharge through outfall 001 is likely to slightly reduce the numbers of available prey organism in the waters surrounding the outfall, through the direct mortality of very low numbers of planktonic organisms and small fish that enter the acute mixing zone, and through reduced long-term fitness and or reduced fecundity in some of the individuals that experience non-lethal exposures.

4. Connectivity with terrestrial ecosystems: No changes expected.

5. Adequate depth and habitat complexity including marine vegetation and algae in estuarine and near-shore habitats: No changes expected.

Habitat Areas of Particular Concern (HAPCs)

Spawning habitat and estuaries are the only HAPCs likely to be affected by the proposed action. All effects on the spawning habitat HAPC are identified above at 1, 2, 4, 7, and 12 under Freshwater EFH for Pacific Coast Salmon. All effects on the estuaries HAPC are identified above at 1 - 5 under Marine EFH for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species.

3.3 Essential Fish Habitat Conservation Recommendations

The NMFS determined that the following conservation recommendation is 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 EFH for Pacific Coast Salmon within the Coal Creek watershed.

To reduce adverse impacts on water quality that the project would cause in Central Puget Sound and in the Green River through continued discharge of wastewater from the project's service area:

1. King County 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 state-issued NPDES permits within the Puget Sound Basin, 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 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 is the USACE. Other interested users could include the governments and citizens of King County and the City of Bellevue, WDFW, and Native American tribes. Individual copies of this opinion were provided to the USACE. The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adheres 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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