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

**Refer to NMFS No.:**
**WCRO-2019-00108**

September 10, 2019

Michelle Walker
Corps of Engineers, Seattle District
Regulatory Branch CENWS-OD-RG
P.O. Box 3755
Seattle, Washington 98124-3755

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Southport Bulkhead Repair and Float Installation Project, King County, Washington, COE Number: NWS-2016-552, HUC: 171100120400 – Lake Washington

Dear Ms. Walker:

Thank you for your letter of March 20, 2019, 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 U.S. Army Corps of Engineers (COE) authorization of the Southport Bulkhead Repair and Float Installation Project. Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1855(b)) for this action.

The enclosed document contains the biological opinion (Opinion) prepared by NMFS pursuant to section 7(a)(2) of the ESA on the effects of the proposed action. In this Opinion, NMFS concludes that the proposed action is likely to adversely affect but not likely to jeopardize the continued existence of Puget Sound (PS) Chinook salmon and PS Sound steelhead. NMFS also concludes that the proposed action is likely to adversely affect designated critical habitat for PS Chinook salmon but is not likely to result in the destruction or adverse modification of that designated critical habitat. As required by section 7 of the ESA, NMFS has provided an incidental take statement with this Opinion. The incidental take statement describes reasonable and prudent measures NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action, and sets forth nondiscretionary terms and conditions that the COE 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.

This document also includes the results of our analysis of the action’s likely effects on essential fish habitat (EFH) pursuant to Section 305(b) of the MSA. NMFS reviewed the likely effects of the proposed action on EFH, and concluded that the action would adversely affect designated EFH for Pacific Coast Salmon. Therefore, we have included the results of that review in Section 3 of this document.

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

Sincerely,

Administrator
Oregon Washington Coastal Office

cc: Andrew Shuckhart, COE
Karen Walter, Muckleshoot Indian Tribe

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

**for**

Southport Bulkhead Repair and Float Installation Project
King County, Washington (COE Number: NWS-2016-552)

**NMFS Consultation Number:** WCRO-2019-00108

**Action Agency:** U.S. Army Corps of Engineers

**Affected Listed Species and Critical Habitats and NMFS's 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 | N/A | N/A |

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

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

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

**Consultation Conducted By:** National Marine Fisheries Service
West Coast Region

**Issued By:** __________
.
dministrator
Oregon Washington Coastal Office

**Date:** September 10, 2019

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# LIST OF ACRONYMS

ACZA – Ammoniacal Copper Zinc Arsenate
BE – Biological Evaluation
BMP – Best Management Practices
CFR – Code of Federal Regulations
COE – Corps of Engineers, US Army
DIP – Demographically Independent Population
DO – Dissolved Oxygen
DPS – Distinct Population Segment
DQA – Data Quality Act
EF – Essential Feature
EFH – Essential Fish Habitat
ESA – Endangered Species Act
ESU – Evolutionarily Significant Unit
FR – Federal Register
HDPE – High-density Polyethylene
HPA – Hydraulic Project Approval
HUC – Hydrologic Unit Code
Hz – Hertz (or cycles per second)
ITS – Incidental Take Statement
JARPA – Joint Aquatic Resource Permit Application Form
mg/l – Milligram per Liter
MPG – Major Population Group
MSA – Magnuson-Stevens Fishery Conservation and Management Act
NMFS – National Marine Fisheries Service
NTU – Nephlometric Turbidity Units
OHWL – Ordinary High Water Line
OWCO – Oregon Washington Coastal Office
PAH – Polycyclic Aromatic Hydrocarbons
PBF – Primary Biological Feature
PCB – Polychlorinated Biphenyl
PCE – Primary Constituent Element
PFMC – Pacific Fishery Management Council
PS – Puget Sound
PSSTRT – Puget Sound Steelhead Technical Recovery Team
PSTRT – Puget Sound Technical Recovery Team
PTS – Permanent Threshold Shift
RL – Received Level
RPM – Reasonable and Prudent Measure
SAV – Submerged Aquatic Vegetation
SL – Source Level
TTS – Temporary Threshold Shift
VSP – Viable Salmonid Population
WCR – Westcoast Region (NMFS)
WDFW – Washington State Department of Fish and Wildlife
WDOE – Washington State Department of Ecology

# 1. INTRODUCTION

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

## 1.1 Background

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

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 *et seq*.) and implementing regulations at 50 CFR 600.

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

## 1.2 Consultation History

On September 27, 2016, the NMFS received an electronic mail (e-mail) from the applicant's agent to request pre-consultation technical assistance for the Southport Bulkhead Repair and Float Installation Project. Numerous e-mails and draft documents were exchanged between the NMFS, the US Army Corps of Engineers (COE), and the applicant's agent October 14, 2016 through December 20, 2016, then again April 24, 2018 through May 2, 2018.

On March 20, 2019, the NMFS received a letter from the COE requesting formal consultation for the proposed action (COE 2019a). The request enclosed the applicant's biological evaluation (BE), project drawings, and restoration plan (SECO 2017a – c; 2018a). On April 8, 2019, the NMFS requested additional information, and provided recommendations to reduce potential impacts from the applicant's proposed project.

On April 15, 2019, the applicant's agent provided copies of the project's Joint Aquatic Resources Permit Application (JARPA) form and the Hydraulic Project Approval (HPA)). On June 26, 2019, the NMFS received the applicant's complete response to the requested information (SECO 2019a – c), which included project revisions to install additional piles instead of embedded anchors to stabilize the mooring floats. Formal consultation for the proposed action was initiated on that date.

This Opinion is based on the review of the information and project drawings identified above; the applicant's JARPA (SECO 2018b); the recovery plans, status reviews, and critical habitat designations for ESA-listed PS Chinook salmon and PS steelhead; published and unpublished scientific information on the biology and ecology of those species; and relevant scientific and gray literature (see Literature Cited). A complete record of this consultation is on file at the Oregon Washington Coastal Office (OWCO) in Lacey, Washington.

### 1.3 Proposed Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). "Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR 402.02).

The COE proposes to authorize SECO Development, Inc. (the applicant) to repair an existing bulkhead, install two mooring floats, remove derelict structures, and conduct other work at their commercial property at the south end of Lake Washington in Renton, Washington (Figure 1). The COE's action would authorize work that would extend the useful life of the existing bulkhead by decades, and authorize the installation of two new mooring structures that would support vessel activity that would be interrelated and interdependent with the proposed action.

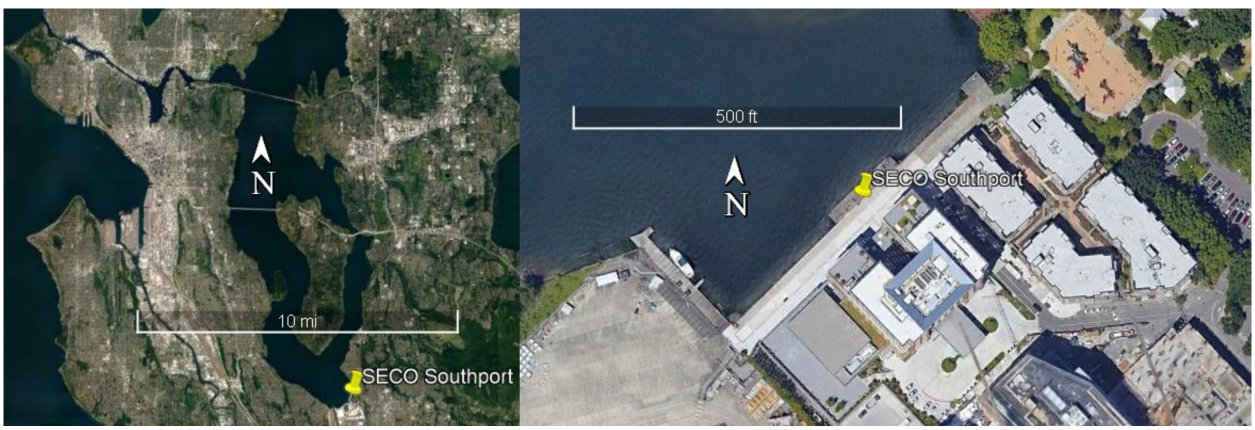


**Figure 1.** Google satellite photographs of the SECO Southport property. The left image shows the project site at the south end of Lake Washington. The right image shows the SECO Southport property bordered by the Boeing Renton facility to the southwest and the Gene Coulon Park to the northeast.

The project consists of four main components: Removal of derelict piles and old structures; bulkhead repair; mooring float installation; and construction of a shoreline cove (Figure 2). The applicant's contractors would operate a barge-mounted crane, and most supplies and debris would be transported to and from the site via supply/debris barges. All barges would moor with 2 12-inch diameter spuds.

The applicant's contractors would remove a small ell and a small finger pier, totaling about 225 square feet of solid-decked timber overwater structure. They would also remove over 180 derelict timber piles and pile stubs (including 2 7-pile dolphins). With the exception of the 51 un-treated timber pile stubs at the east side of the project area, all piles are believed to be creosote-treated. All in and over-water work would be performed within a floating debris curtain, and the applicant has further committed to perform all pile removal work within full-depth sediment curtains (SECO 2019b).

Workers would operate handheld power tools such as saws to disconnect the timber decking, frame work, and pile caps from the ell and finger pier. A barge-mounted crane would be used to place the debris on a debris barge. Using a vibratory extractor, the crane would pull the ell and finger pier piles, the 14 dolphin piles, about 165 derelict piles and pile stubs, and derelict timber walers. About 25 days of pile removal work would be required (5 5-day workweeks), with about 3 hours of vibratory extraction expected per day (SECO 2019b).

Any piles that are too decomposed for vibratory extraction would be cut-off about 2 feet below the mudline and covered. If pile cutting below the mudline is required, divers would use a handheld Venturi-type hydraulic dredge (induction dredge) to excavate bottom sediments to about 2 feet below the mudline around the base of the piles (SECO 2019b), and to deposit the excavated material near the piles. The divers would then use an underwater pneumatic chainsaw to cut the pile, and the crane would lift it out of the water. The induction dredge would then be used to backfill the excavated area with the previously excavated material.

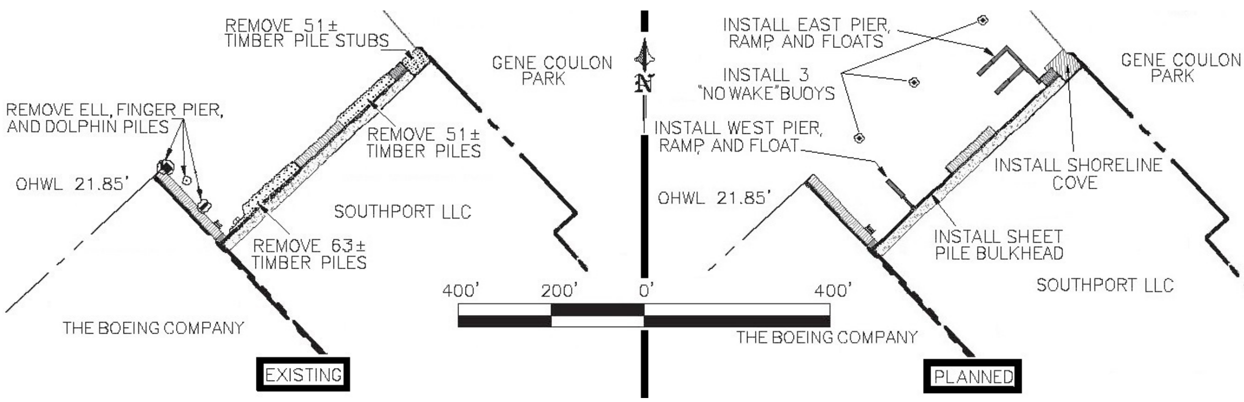


**Figure 2.** Plan drawings of the SECO Southport project site. The left image shows the existing conditions and planned removals. The right image shows the planned installations and repair work. (Adapted from SECO 2019c, Page 1 of 5).

After the piles and timber walers have been removed, the contractors would repair about 500 feet of timber and concrete bulkhead that extends between the timber-decked wharf on the west edge of the property and the western side of the eastern most timber-decked platform (Figures 2 and 3). Divers would cut-off the existing timber bulkhead below the low waterline, but above the mudline. The contractors would use a vibratory pile driver to install 22-inch wide steel sheet piles against the lake side of the remnants of the timber bulkhead. They would then bolt the steel sheet piles to the timber bulkhead. About 25 days of sheet pile installation work would be required (5 5-day workweeks), with about 3 hours of vibratory installation expected per day, and no impact driving is planned to “proof” the piles (SECO 2019b).

Where the bulkhead extends behind the existing timber decks, the decking would be temporarily removed to allow access to the bulkhead. The decking would be reinstalled after the bulkhead work is complete (SECO 2019a). Following sheet pile installation, workers would install concrete or small crushed gravel fill landward of the new bulkhead, and install concrete paver and/or concrete decking across the top, to the edge of the new bulkhead, and install a guardrail along the length of the bulkhead. The exact configuration of the final replacement bulkhead would vary slightly depending on the location along the bulkhead, but would be very similar to the image in Figure 3 (SECO 2019c).

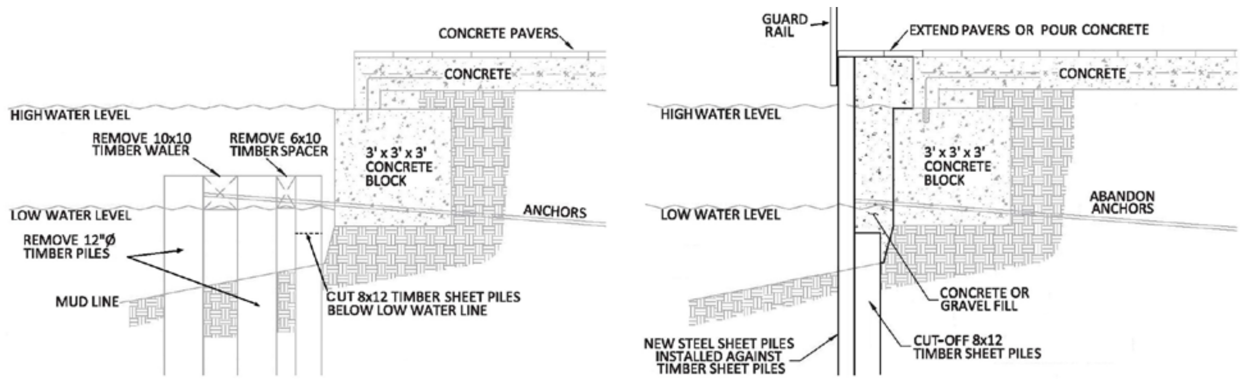


**Figure 3.** Profile drawings of the SECO Southport bulkhead. The left image shows the existing conditions and planned removals. The right image shows the general plan for the new sheet pile bulkhead. (Adapted from SECO 2019c, S3.1 and S3.2).

The contractor would install two new mooring structures. The western pier, ramp, and float would be installed about 105 feet east of the existing western wharf. It would have a combined overwater area of about 578.5 square feet, be fully decked with 60% open-area grating, and extend about 83 feet from the bulkhead (Figures 2 and 4). The contractor would use a vibratory driver to install 2 8-inch diameter steel pipe piles a few feet north of the new bulkhead. A prefabricated 6-foot by 6-foot, aluminum-framed pier would be connected to the shore and to the piles. A prefabricated a 50-foot by 8-foot aluminum-framed float would be floated into place, and secured by 2 vibratory-driven 12-inch diameter steel pipe piles. The crane would then place a 4.75-foot by 33-foot aluminum-framed ramp between the pier and the float.

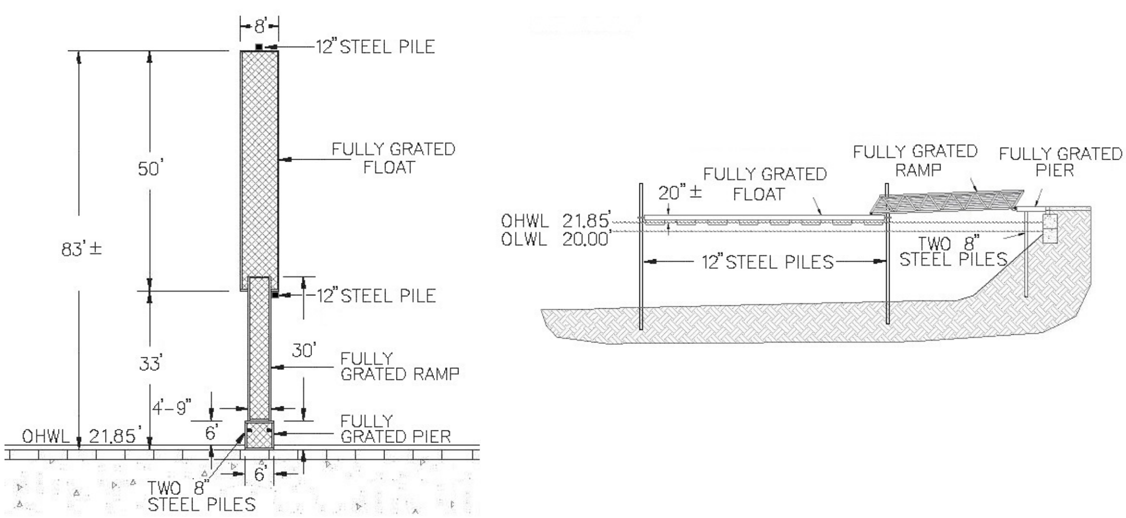


**Figure 4.** Plan and profile drawings of the SECO Southport western mooring float. (Adapted from SECO 2019c, Pages 3 and 4 of 5).

The eastern pier, ramp, and float would be installed against the western side of the existing eastern timber deck. It would have a combined overwater area of about 2,027 square feet, be fully decked with 60% open-area grating, and extend about 120 feet from the bulkhead (Figures 2 and 5). The contractor would use a vibratory driver to install 2 8-inch diameter steel pipe piles a few feet west of the northwest corner of the timber deck. A prefabricated 6-foot by 6-foot, aluminum-framed pier would be connected to the deck and to the piles. A set of 6 prefabricated 8-foot wide aluminum-framed floats would be floated into place, attached to each other, and secured by 6 vibratory-driven 12-inch diameter steel pipe piles. The crane would then place a 4.75-foot by 36-foot aluminum-framed ramp between the pier and the floats.

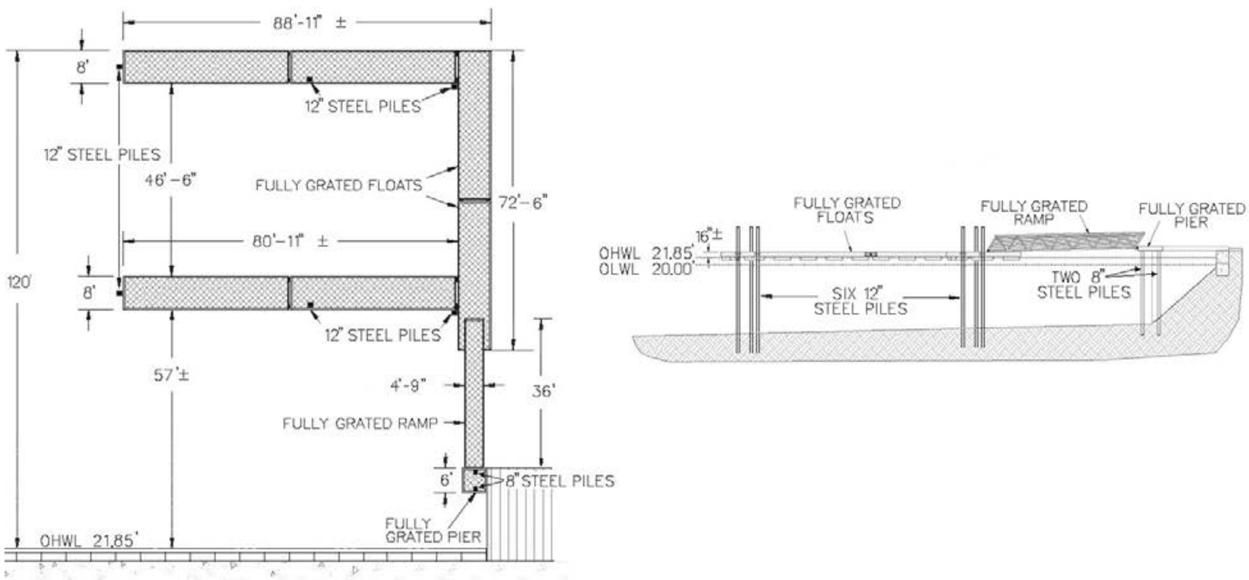


**Figure 5.** Plan and profile drawings of the SECO Southport eastern mooring float. (Adapted from SECO 2019c, Pages 3 and 4 of 5).

Pile installation for both mooring structures would include a combined total of 4 8-inch, and 8 12-inch steel pipe piles. The duration of that work was not specified. However, based on the pile-intensive bulkhead work described above, the NMFS estimates that pipe pile installation may require about 3 hours of cumulative vibratory work per day. Further, the small number of piles suggests that the work would likely be completed in 2 to 3 days.

East of the existing eastern timber deck, the applicant would create a small shoreline cove. The applicant’s contractors would operate jackhammers, concrete saws and excavators to remove about 53 linear feet of concrete bulkhead and concrete walkway. They would operate a crane and/or excavator to install about 325 cubic yards of washed, well rounded gravel (1/4- to 4-inches in diameter) and sand over the area where the walkway, bulkhead, and the 51 un-treated timber pile stubs would be removed, and slightly beyond. Upwards from the ordinary high water line (OHWL), the contractors would install sand, 7 anchored logs, and 5 boulders over the gravel. They would also plant about 160 square feet of native emergent shoreline vegetation, and about 415 square feet of native upland plants inland from the emergent vegetation (Figure 6).

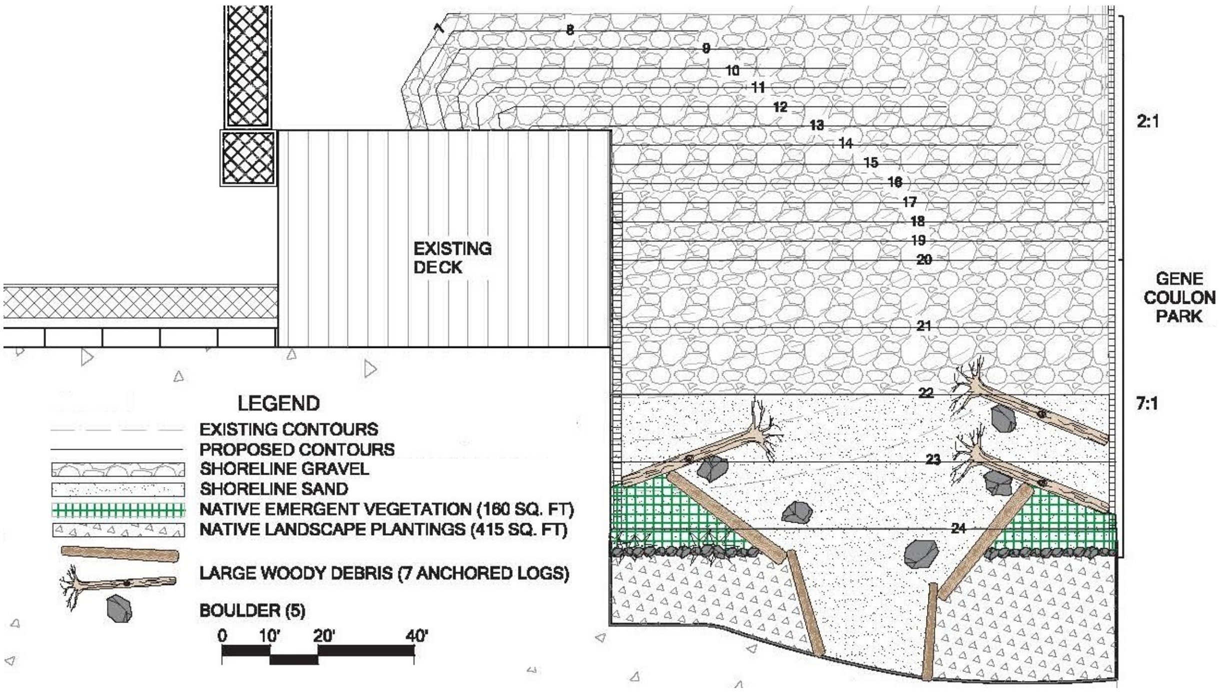


**Figure 6.** Plan drawing of the SECO Southport shoreline cove. (Adapted from SECO 2018, Sheet 3 and SECO 2019c, Sheet 8).

Divers operating from work boats would install 5 buoys. Three buoys would be installed in a line offshore from the mooring floats to establish a “no-wake” zone (Figure 2). Two additional buoys would be installed between the east mooring float and Bird Island to warn of shallow water. All 5 buoys would be moored to embedded anchors using single-line braided nylon rope with a midline float to prevent bottom scour.

The applicant’s contractors would also perform above-water and upland work to install a peristaltic pump-out facility at the eastern end of the existing western wharf. That work would include the installation of 3-inch diameter high-density Polyethylene (HDPE) sewer line under the wharf and underground landward from the bulkhead to connect the pump-out facility to the existing lift station that is located inland between the apartment buildings and the hotel.

About 6 weeks of work are expected to complete the in-water portion of the project. To reduce construction-related impacts, in-water work would be limited to July 16 through 31, and November 16 through December 31, and the applicant’s contractors would be required to comply with the conservation measures identified in the applicant’s BE and JARPA (SECO 2017a, 2018b), as well as the provisions identified in the Washington State Department of Fish and Wildlife (WDFW) HPA for the project (WDFW 2018). The applicant would also require the use of full-depth sediment curtains for all pile extraction and/or excavation work (SECO 2019b).

<u>Interrelated and interdependent activities</u>: The applicant’s mooring floats would support increased vessel operations and water recreation within the action area. The applicant reports that residents would likely use the floats for non-motorized water craft. However, the floats are also intended to support visitation, so motorized vessel operations are likely to occur.

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

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

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

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

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

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

Past critical habitat designations have used the terms primary constituent element (PCE) or essential feature (EF) to identify important habitat qualities. However, the new critical habitat regulations (81 FR 7414; February 11, 2016) replace those terms with physical or biological features (PBF). This shift in terminology does not change the approach used in conducting our analysis, whether the original designation identified PCE, EF, or PBF. For simplicity, we universally apply the term PBF in this Opinion for all critical habitat, regardless of the term used in the specific critical habitat designation.

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

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

### 2.2 Range-wide Status of the Species and Critical Habitat

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

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: http://www.nmfs.noaa.gov/pr/species/fish/, 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.

<u>Puget Sound (PS) Chinook Salmon</u>

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 (Table 2) 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.

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

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

General Life History: Chinook salmon are anadromous fish that require well-oxygenated water that is typically less than 63º F (17º C), but some tolerance to higher temperatures is documented with acclimation. Adult Chinook salmon spawn in freshwater streams, depositing fertilized eggs in gravel “nests” called redds. The eggs incubate for three to five months before juveniles hatch and emerge from the gravel. Juveniles spend from three months to two years in freshwater before migrating to the ocean to feed and mature. Chinook salmon spend from one to six years in the ocean before returning to their natal freshwater streams where they spawn and then die.

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

Chinook salmon are further grouped into “runs” that are based on the timing of adults that return to freshwater. Early- or spring-run chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and finally spawn in the late summer and early autumn. Late- or fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas, and spawn within a few days or weeks. Summer-run fish show intermediate characteristics of spring and fall runs, without the extensive delay in maturation exhibited by spring-run Chinook salmon. In Puget Sound, spring-run Chinook salmon tend to enter their natal rivers as early as March, but do not spawn until mid-August through September. Returning summer- and fall-run fish tend to enter the rivers early-June through early-September, with spawning occurring between early August and late-October.

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

Spatial Structure and Diversity: The PS Sound Chinook salmon ESU includes all naturally spawning populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington. The ESU also includes the progeny of numerous artificial propagation programs (NWFSC 2015). The PSTRT identified 22 extant populations, grouped into five major geographic regions, based on consideration of historical distribution, geographic isolation, dispersal rates, genetic data, life history information, population dynamics, and environmental and ecological diversity. The PSTRT distributed the 22 populations among five major biogeographical regions, or major population groups (MPGs), that are based on similarities in hydrographic, biogeographic, and geologic characteristics (Table 2).

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

Abundance and Productivity: Available data on total abundance since 1980 indicate that abundance trends have fluctuated between positive and negative for individual populations, but productivity remains low in most populations, and hatchery-origin spawners are present in high fractions in most populations outside of the Skagit watershed. Available data now show that most populations have declined in abundance over the past 7 to 10 years. Further, escapement levels for all populations remain well below the PSTRT planning ranges for recovery, and most populations are consistently below the spawner-recruit levels identified by the PSTRT as consistent with recovery (NWFSC 2015). The current information on abundance, productivity, spatial structure and diversity suggest that the Whidbey Basin MPG is at relatively low risk of extinction. The other four MPGs are considered to be at high risk of extinction due to low abundance and productivity (NWFSC 2015). The most recent 5-year status review concluded that the ESU should remain listed as threatened (NMFS 2017a).

<u>Limiting Factors:</u> 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

<u>PS Chinook Salmon within the Action Area:</u> The PS Chinook salmon that occur in the action area would likely be fall-run Chinook salmon from the Cedar River population (NWFSC 2015; WDFW 2019a). Both stream- and ocean-type Chinook salmon are present in the population, with the majority being ocean-types. The Cedar River population is relatively small, with a total annual abundance fluctuating at close to 1,000 fish (NWFSC 2015; WDFW 2019b). Between 1965 and 2017, the total abundance for PS Chinook salmon in the basin has fluctuated between about 133 and 2,451 individuals, with the average trend being slightly negative. The 2015 status review reported that the 2010 through 2014 5-year geometric mean for natural-origin spawner abundance had shown a positive change since the 2010 status review, with natural-origin spawners accounting for about 82% of the population. WDFW data suggest that natural-origin spawners accounted for about 83% of a combined total return of 877 fish in 2018 (WDFW 2019b).

Some returning adults and out-migrating juveniles from the Cedar River population, as well as the individuals that spawn in the numerous smaller streams across the basin, are likely to pass through the action area. Adult Chinook salmon pass through Chittenden Locks (aka Ballard Locks) between mid-June through September, with peak migration occurring in mid-August (City of Seattle 2008). Spawning occurs well upstream of the action area between early August and late October. Juvenile Chinook salmon are found in Lake Washington between January and July, primarily in the littoral zone (Tabor *et al*. 2006). Outmigration through the ship canal and through the locks occurs between late-May and early-July, with the peak in June (City of Seattle 2008).

Puget Sound (PS) steelhead

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

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

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

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

General Life History: Steelhead are anadromous fish that require well-oxygenated water that is typically less than 63º F (17º C). PS steelhead exhibit two major life history strategies. Ocean-maturing, or winter-run fish typically enter freshwater from November to April at an advanced stage of maturation, and then spawn from February through June. Stream-maturing, or summer-run fish typically enter freshwater from May to October at an early stage of maturation, migrate to headwater areas, and hold for several months prior to spawning in the following spring. After hatching, juveniles rear in freshwater from one to three years prior to migrating to marine habitats (two years is typical). Smoltification and seaward migration typically occurs from April to mid-May. Smolt lengths vary between watersheds, but typically range from 4.3 to 9.2 inches (109 to 235 mm) (Myers *et al*. 2015). Juvenile steelhead are generally independent of shallow nearshore areas soon after entering marine water (Bax *et al*. 1978, Brennan *et al*. 2004, Schreiner *et al*. 1977), and are not commonly caught in beach seine surveys. Recent acoustic tagging studies (Moore *et al*. 2010) have shown that smolts migrate from rivers to the Strait of Juan de Fuca from one to three weeks. PS steelhead feed in the ocean waters for one to three years (two years is again typical), before returning to their natal streams to spawn. Unlike Chinook salmon, most female steelhead, and some males, return to marine waters following spawning (Myers *et al*. 2015).

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

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

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

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

<u>PS Steelhead within the Action Area:</u> The PS steelhead that most likely occurs in the action area would be winter-run fish from the Cedar River DIP, which is among the smallest within the DPS (NWFSC 2015; WDFW 2019c). WDFW reports that the total PS steelhead abundance in the Cedar River basin has fluctuated between 0 and 900 individuals between 1984 and 2018, with a strong negative trend. Since 2000, the total annual abundance has remained under 50 fish. NWFSC (2015) suggests that the returns may have been above 1,000 individuals during the 1980s, but agrees with the steep decline to less than 100 fish since 2000. It is unclear what proportion of the returns are natural-origin spawners, if any, and a total of only 4 adults are thought to have returned in 2018 (WDFW 2019c).

Some returning adults and out-migrating juveniles from the Cedar River DIP are likely to pass through the action area. Adult steelhead pass through Chittenden Locks (aka Ballard Locks) and the Lake Washington Ship Canal between January and May, and may remain within Lake Washington through June (City of Seattle 2008). The timing of steelhead spawning in the basin is uncertain, but occurs well upstream of the action area. Juvenile steelhead enter Lake Washington in April, and typically migrate through the ship canal and past the action area to the locks between April and May (City of Seattle 2008).

## 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.

### Puget Sound Chinook Salmon Critical Habitat

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

The 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.

**Table 4.** Physical or biological features (PBFs) of designated critical habitat for PS Chinook salmon, 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<br>Water quality<br>Substrate | Adult spawning<br>Embryo incubation<br>Alevin growth and development |
| Freshwater rearing | Water quantity and Floodplain connectivity<br>Water quality and Forage<br>Natural cover | Fry emergence from gravel<br>Fry/parr/smolt growth and development |
| Freshwater migration | (Free of obstruction and excessive predation)<br>Water quantity and quality<br>Natural cover | Adult sexual maturation<br>Adult upstream migration and holding<br>Kelt (steelhead) seaward migration<br>Fry/parr/smolt growth, development, and seaward migration |
| Estuarine | (Free of obstruction and excessive predation)<br>Water quality, quantity, and salinity<br>Natural cover<br>Forage | Adult sexual maturation and "reverse smoltification"<br>Adult upstream migration and holding<br>Kelt (steelhead) seaward migration<br>Fry/parr/smolt growth, development, and seaward migration |
| Nearshore marine | (Free of obstruction and excessive predation)<br>Water quality, quantity, and forage<br>Natural cover | Adult growth and sexual maturation<br>Adult spawning migration<br>Nearshore juvenile rearing |
| Offshore marine | Water quality and forage | Adult growth and sexual maturation<br>Adult spawning migration<br>Subadult rearing |

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

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

Diking, agriculture, revetments, railroads and roads in lower stream reaches have caused significant loss of secondary channels in major valley floodplains in this region. Confined main channels create high-energy peak flows that remove smaller substrate particles and LW. 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. 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 LW to downstream areas (SSPS 2007). These actions tend to promote downstream channel incision and simplification (Kondolf 1997), limiting fish habitat. Water withdrawals reduce available fish habitat and alter sediment transport. Hydropower projects often change flow rates, stranding and killing fish, and reducing aquatic invertebrate (food source) productivity (Hunter 1992).

Juvenile mortality occurs in unscreened or inadequately screened diversions. Water diversion ditches resemble side channels in which juvenile salmonids normally find refuge. When diversion headgates are shut, access back to the main channel is cut off and the channel goes dry. Mortality can also occur with inadequately screened diversions from impingement on the screen, or mutilation in pumps where gaps or oversized screen openings allow juveniles to get into the system. Blockages by dams, water diversions, and shifts in flow regime due to hydroelectric development and flood control projects are major habitat problems in many Puget Sound tributary basins (SSPS 2007). The nearshore marine habitat has been extensively altered and armored by industrial and residential development near the mouths of many of Puget Sound's tributaries. A railroad runs along large portions of the eastern shoreline of Puget Sound, eliminating natural cover along the shore and natural recruitment of beach sand (SSPS 2007).

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

Critical Habitat within the Action Area: All of Lake Washington, and well upstream into the Cedar River watershed has been designated as freshwater critical habitat for PS Chinook salmon. The critical habitat in within the action area primarily supports the Freshwater Migration PBF for juvenile and adult PS Chinook (WDFW 2019a).

## 2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). As described in Section 2.5, elevated turbidity and impacted water quality within about 300 feet (91 m) around the project site would be the project-related stressor with the greatest range of effect. All other project-related effects, including indirect effects would be undetectable beyond that range. This action area overlaps with the geographic ranges and boundaries of the ESA-listed species and designated critical habitat identified earlier in Table 1. The action area also overlaps with areas that have been designated, under the MSA, as EFH for Pacific Coast salmon.

## 2.4 Environmental Baseline

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

Environmental conditions at the project site and the surrounding area: The project site is located along the southeastern shore of Lake Washington, about 800 yards east-northeast of the mouth of the Cedar River (Figure 1). Lake Washington is a long, narrow, freshwater lake with steeply sloping sides. It is about 22 miles long, north to south, has an average width of 1.5 miles, and covers about 21,500 acres. The lake has an average depth of about 100 feet, and is just over 200 feet deep at its deepest (City of Seattle 2010). The Lake Washington watershed covers about 300,000 acres (472 square miles), and its major influent streams are the Cedar and Sammamish Rivers. The Cedar River enters at the southern end of the lake and contributes about 57 percent of the lake's water. The Sammamish River enters at the north end of the lake, and contributes about 27 percent of the lake's water (King County 2016). Numerous creeks, including Coal, Forbes, Juanita, May, McAleer, Ravenna, and Thornton Creeks also flow directly into Lake Washington.

The geography and ecosystems in and adjacent to the action area have been dramatically altered by human activity since European settlers first arrived in the 1800s. Historically, Lake Washington's waters flowed south to the Duwamish River via the now absent Black River, and the Cedar River did not enter the lake. In 1911, engineers rerouted the Cedar River into Lake Washington to create an industrial waterway and to prevent flooding in Renton. In 1916, the Lake Washington Ship Canal was opened, which lowered water levels in the lake by about nine feet, and stopped flows through the Black River. At the project site, the coal-fired Shuffleton power plant was built on filled swampland in 1929, and the Boeing aircraft construction facilities were built next door in the early 1940s.

The majority of the lake's watershed is now highly developed and urban in nature with 63 percent of the area considered fully developed (King County 2016). The City of Seattle boarders most of the west side of the lake. The cities of Bellevue and Kirkland are along the eastern shoreline, with the Cities of Kenmore and Renton on the north and south ends, respectively.

Water quality in the lake has been impacted by urban and residential runoff and by past sewage discharges. It has also been impacted by upstream forestry and agricultural practices. Cleanup efforts since the 1960s and 1970s, including diversion of wastewater away from the lake, have improved conditions, such that water quality in the lake is generally considered good (City of Seattle 2010). However, lake waters at the project site are currently listed on the State's 303(d) list of impaired and threatened water bodies for bacteria (WDOE 2019).

Urban development has converted most of the original lake shoreline from a mix of thick riparian forests, shrub-scrub, and emergent wetlands to residential gardens and lawns. Only small scattered patches of natural riparian growth remain (Toft 2001). Additionally, as of the year 2000, over 70 percent of the lake's shoreline had been armored by bulkheads and rip rap, and over 2,700 docks had been installed around the lake (Toft 2001). It is almost certain that those numbers have increased since then.

The armored shorelines at the project site and around most of Lake Washington, have converted the gently sloping gravel shorelines with very shallow waters that are favored by juvenile salmon, into artificially steep substrates with relatively deep water. The numerous piers and docks create harsh over-water shadows that limit aquatic productivity and hinder passage of juvenile salmon along much of the lake's shoreline. Additionally, the artificial shorelines and overwater structures provide habitat conditions that favor fish species that prey on juvenile salmonids, especially the non-native smallmouth bass. Other predators in the lake include the native northern pikeminnow and the non-native largemouth bass (Celedonia *et al*. 2008a and b; Tabor *et al*. 2010).

At the project site, the Shuffleton power plant was closed in 1989, and demolished in 2001. Since then, the property has been redeveloped. The SECO Southport development now includes a hotel composed of two 12-story buildings, and a mixed-use apartment complex composed of four 5-story buildings with basement parking. The surrounding substrate consists of impervious pavement or semi-pervious compacted gravel, with very little vegetation. The closely spaced buildings have been built to within 50 feet of the existing bulkhead shoreline. The developers plan to construct three office buildings at the site soon. The Boeing Renton plant now abuts the southwest side of the Southport property, where it currently produces 737 jet airplanes. The Gene Coulon Memorial Beach Park lies immediately northeast of the Southport property.

The shoreline at the project site consists primarily of 580 feet of timber and concrete bulkhead that (Figures 1 and 2). A 204-foot-long by 21-foot-wide solid-decked timber wharf lies along the southwestern edge the property. The wharf covers the former water outlet for the old power plant. The outlet now serves as an outlet channel for stormwater from areas outside of the Southport site. A 130-foot long by 20-foot-wide solid-decked platform is situated near the middle of the bulkhead, and a second solid-decked timber platform is located at the northeast end of the bulkhead. The northeastern platform is 34 feet long by 20 feet-wide, and rests on the concrete intake of the former power plant. That structure now serves as the outfall for treated stormwater from the Southport site.

Over 180 derelict piles and timbers are located at the project site, slightly offshore from the bulkhead. Other piles are also located under the small ell and finger pier along the west side of the property. The 51 pile stubs that are located at the northeast corner of the project site are identified as untreated. However, most or all of the remaining piles and timbers and believed to be creosote-treated, which has likely leached Polycyclic Aromatic Hydrocarbons (PAHs) and other pollutants into the water and sediments at the site for many years.

Water depths along the bulkhead range between 8 and 17 feet relative to the high water mark, and the lake bed consists of gently sloped organically-rich fine-grained sediments. A 2016 site visit to the adjacent Boeing site reported no macroalgae or other submerge aquatic vegetation (SAV) growing along the shoreline (Boeing 2017). The organically-rich fine-grained sediments at the site are suggestive of a benthic community that likely consists predominantly of chironomids and oligochaete worms.

The past and ongoing anthropogenic impacts described above have reduced the action area’s ability to support out-migrating juvenile PS Chinook salmon and PS steelhead. However, the action area continues to provide migratory habitat for adult and juvenile PS Chinook salmon and PS steelhead. The area has also been designated as critical habitat for PS Chinook salmon.

<u>Climate Change:</u> Climate change has affected the environmental baseline of aquatic habitats across the region and within the action area. However, the effects of climate change have not been homogeneous across the region, nor are they likely to be in the future. During the last

century, average air temperatures in the Pacific Northwest have increased by 1 to 1.4° F (0.6 to 0.8 °C), and up to 2° F (1.1 °C) in some seasons (based on average linear increase per decade; Abatzoglou *et al*. 2014; Kunkel *et al*. 2013). Recent temperatures in all but two years since 1998 ranked above the 20th century average (Mote *et al*. 2013). Warming is likely to continue during the next century as average temperatures are projected to increase another 3 to 10° F (1.7 to 5.6° C), with the largest increases predicted to occur in the summer (Mote *et al*. 2014).

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

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

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

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

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

## 2.5 Effects of the Action on Species and Designated Critical Habitat

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the species, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Direct effects are caused by exposure to action-related stressors that occur at the time of the action. Indirect effects are effects caused by the proposed action that occur later in time but are still reasonably certain to occur.

As described in Section 1.3, the applicant's contractors would conduct about 6 weeks of in- and above-water work at the south end of Lake Washington. Work would be done July 16 through July 31, and/or November 16 through December 31. They would remove about 180 derelict piles and other old wood structures; repair about 580 feet of bulkhead; install 2 fully-grated mooring structures totaling about 2,605 square feet; and construct a small shoreline cove (Figures 2 - 6).

As described in Section 2.2, PS Chinook salmon and PS steelhead regularly migrate through the action area, and critical habitat has been designated for PS Chinook salmon within the action area. The proposed work window avoids the typical migration periods for both adult and juvenile PS steelhead. However, the July 16 through 31 window is near the center of the typical in-migration period for adult PS Chinook salmon, and it overlaps with the last two weeks of the typical out-migration period for juveniles.

Construction is likely to cause direct effects on PS Chinook salmon and the PBFs of their critical habitat through exposure to construction-related elevated noise and propeller wash. Construction would also cause indirect effects on PS Chinook salmon and PS steelhead through exposure to contaminated forage. The COE-authorized bulkhead repairs would have the additional effect of extending the bulkhead's useful life several decades beyond that of the existing bulkhead, and the two new COE-authorized mooring structures would also remain in the action area for several decades. Over that time, the bulkhead, mooring structures, and their interrelated activities would cause effects on both species and on the PBFs of PS Chinook salmon critical habitat through armored shoreline, altered lighting, vessel noise, and propeller wash.

### <u>2.5.1 Effects on List Species</u>

<u>Construction-related Elevated Noise</u>

Exposure to construction-related noise would cause adverse effects in PS Chinook salmon. However, because the planned work windows avoid the expected presence of PS steelhead, it is very unlikely that any steelhead would be exposed to construction-related noise. Elevated in-water noise at levels capable of causing detectable effects in exposed fish would be caused by the in-water use of vibratory pile installation and extraction equipment, tugboats, jackhammers, and handheld underwater power saws.

The effects of a fishes' exposure to noise vary with the hearing characteristics of the exposed 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. The metrics are based on exposure to peak sound level and sound exposure level (SEL), respectively. 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. 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 be affected by the noise, regardless of accumulation of the sound energy (Stadler and Woodbury 2009). Therefore, when there is a difference between the ranges to the isopleths for effective quiet and $SEL_{cum}$, the shorter range shall apply.

The discussion in Stadler and Woodbury (2009) makes it clear that the thresholds likely overestimate the potential effects of exposure to impulsive sounds. Further, the assessment did not consider non-impulsive sound because it is believed to be less injurious to fish than impulsive sound. Therefore, any application of the criteria to non-impulsive sounds is also likely to overestimate the potential effects in fish. However, this assessment applies the criteria to both impulsive and non-impulsive sounds for continuity, and as a tool to gain a conservative idea of the sound energies that fish may be exposed to during the majority of this project.

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 recent acoustic assessments for a similar project (NMFS 2016; 2017b & c; 2018) and in other sources (CalTrans 2009; COE 2011; FHWA 2017). Based on the available information, the SLs for all sources would be below the 206 $dB_{peak}$ threshold for the onset of instantaneous injury in fish, but most are above the 150 $dB_{SEL}$ threshold.

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). Acoustic measurements in shallow water environments support the use of a value close to 15 for projects like this one (CalTrans 2009). This value is considered the practical spreading loss coefficient. Application of the practical spreading loss equation to the expected SLs suggests that noise levels above the 150 $dB_{SEL}$ threshold could extend to about 177 feet (54 m) around spud deployments, and 151 feet (46 m) around sheet pile installation. Noise levels above the 150 $dB_{SEL}$ threshold from all other construction-related sources would extend only about half as far as those for spuds and sheet piles (Table 5).

**Table 5.** Estimated in-water dBpeak and dBSEL Source Levels for construction-related sound sources. The ranges to the applicable source-specific effects thresholds for fish are highlighted in grey.

| Source | Acoustic Signature | Source Level | Threshold Range |
|---|---|---|---|
| Spuds | < 1,600 Hz Impulsive | 201 $dB_{peak}$ | 206 @ N/A |
| Daily, with 8 impacts per day | | 176 $dB_{SEL}$ | 183 @ N/A |
| | | 176 $dB_{SEL}$ | 187 @ N/A |
| | | 176 $dB_{SEL}$ | 150 @ 54 m |
| Vib. Install 24-inch Steel Sheet Pile | < 2.5 kHz Non-Impulsive | 190 $dB_{peak}$ | 206 @ N/A |
| 30 days with 3 hours of continuous vibratory noise per day | | 175 $dB_{SEL}$ | 183 @ 123 m |
| | | 175 $dB_{SEL}$ | 187 @ 66 m |
| | | 175 $dB_{SEL}$ | 150 @ 46 m |
| Jackhammer | < 1 kHz Impulsive | 188 $dB_{peak}$ | 206 @ N/A |
| The timing and duration of this work is unknown, and the number of impacts impossible to predict. To be conservative, the 150 $dB_{SEL}$ threshold is applied here. | | 168 $dB_{SEL}$ | 183 @ UNK |
| | | 168 $dB_{SEL}$ | 187 @ UNK |
| | | 168 $dB_{SEL}$ | 150 @ 16 m |
| Vib. Install 12-inch Steel Pipe Pile | | 186 $dB_{peak}$ | 206 @ N/A |
| Total of 8 piles; 2 days with 3 hours of continuous vibratory noise per day assumed | | 170 $dB_{SEL}$ | 183 @ 66 m |
| | | 170 $dB_{SEL}$ | 187 @ 36 m |
| | | 170 $dB_{SEL}$ | 150 @ 22 m |
| Vib. Install 8-inch Steel Pipe Pile | | 184 $dB_{peak}$ | 206 @ N/A |
| Total of 4 piles; 1 day with 3 hours of continuous vibratory noise per day assumed | | 167 $dB_{SEL}$ | 183 @ 42 m |
| | | 167 $dB_{SEL}$ | 187 @ 22 m |
| | | 167 $dB_{SEL}$ | 150 @ 14 m |
| Vib. Extract 14-inch Timber Pile | < 2.5 kHz Non-Impulsive | 181 $dB_{peak}$ | 206 @ N/A |
| 30 days with 3 hours of continuous vibratory noise per day | | 171 $dB_{SEL}$ | 183 @ 185 m |
| | | 171 $dB_{SEL}$ | 187 @ 100 m |
| | | 171 $dB_{SEL}$ | 150 @ 25 m |
| Tugboat Propulsion | < 1 kHz Combination | 185 $dB_{peak}$ | 206 @ N/A |
| Daily, with 2 hours of continuous vessel noise per day | | 170 $dB_{SEL}$ | 183 @ 46 m |
| | | 170 $dB_{SEL}$ | 187 @ 25 m |
| | | 170 $dB_{SEL}$ | 150 @ 22 m |
| Saw | < 4 kHz Non-Impulsive | 145 $dB_{peak}$ | 206 @ N/A |
| 2 days with 5 hours of continuous saw noise per day | | 135 $dB_{SEL}$ | 183 @ N/A |
| | | 135 $dB_{SEL}$ | 187 @ N/A |
| | | 135 $dB_{SEL}$ | 150 @ N/A |

Spud-barges deploy steel pipes or girders (spuds) to hold their position instead of using anchors. Deploying their spuds causes brief impulsive sound events when they strike the substrate. Barges often remain in the same place for multiple days before being moved. However, to be protective of listed species, this assessment assumes that two barges with 2 spuds each (SECO 2019b), would both be moved once daily, and cause 4 impulsive noise events every day during the work windows.

The applicant predicts that timber pile extraction and sheet-pile installation would each require about 25 days of work, and they would likely occur during the same work window. To account for uncertainty, the NMFS assumes that 30 days of work may be required for each. Both project components are each expected to cause about 3 hours of vibratory noise per day. The exact timing and duration of these two components is unpredictable beyond the expectation that some pile extraction would likely precede sheet pile installation, and that some overlap of the two components could occur on any given day. To be protective of listed fish, this assessment assumes that 60 days of noise from the louder of the two sources, sheet pile installation, would be present in the water for up to 6 hours each day.

Fish-detectable sound levels from all other construction-related sources would extend only about half as far as those described above. Further, the various sound sources are very unlikely to have any additive effects with each other due the differences in their frequencies. At most, the combination of the various types of equipment during any given day may cause detectable in-water noise levels across the entire workday.

Given the expectation that timber pile extraction and sheet pile installation would both require 30 days of work, and that at least some of that work must be completed prior to installation of the new mooring structures, the NMFS expects that most, if not all, timber pile extraction and sheet pile installation would likely occur during the November 16 through December 31 in-water work window, which avoids the expected presence of Chinook salmon and steelhead. However, some of that work, along with the vibratory installation of 8- and 12-inch steel pipe piles, and other project components may occur during the July construction window when adult and juvenile PS Chinook salmon could be present.

PS Chinook salmon that are beyond the 150 $dB_{SEL}$ isopleth would be unaffected by the exposure. However, fish within the 150 $dB_{SEL}$ isopleth are likely to experience a range of impacts that would depend on their distance from the source and the duration of their exposure. All of the adult PS Chinook salmon that may be exposed to construction noise would be much larger than 2 grams, independent of shoreline waters, and extremely unlikely to remain near enough to the project site to accumulate injurious levels of sound energy. The most likely effect of exposure to project-related noise would be temporary minor behavioral effects, such as avoidance of the area within about 177 feet around the project site. The exposure would cause no measurable effects on the fitness of exposed adults. Further, it is extremely unlikely that any avoidance of the project site would prevent fish from moving past the area, nor would it prevent them from accessing important habitat resources.

The juvenile PS Chinook salmon that may be present would be shoreline obligated, and some may be smaller than 2 grams. Juveniles that are within the 150 $dB_{SEL}$ isopleth, are likely to experience behavioral disturbance, such as acoustic masking, startle responses, altered swimming patterns, avoidance, and increased risk of predation. Individuals that remain within the range where accumulated sound energy would exceed the 183/187 dB $SEL_{cum}$ thresholds may also experience some level of auditory- and non-auditory tissue injury, which could reduce their likelihood of survival.

The number of juvenile PS Chinook salmon that may be impacted by construction-related noise is unquantifiable with any degree of certainty. However, it is expected to be very low because the July work window occurs after the density of juvenile PS Chinook salmon in the lake typically drops sharply following the June out-migration peak. Further, the area of acoustic effect would be relatively small and located in an area where the density of late-migrating fish would be lowest due to its distance from the lake's outlet to marine waters. Therefore, the number of juvenile PS Chinook salmon that may be affected by construction-related noise would comprise such a small subset of their cohort, that their loss would cause no detectable population-level effects.

Construction-related Degraded Water Quality

Exposure to construction-related degraded quality would cause minor effects in PS Chinook salmon, and it is very unlikely that any PS steelhead would be exposed. Water quality would be temporarily affected through increased turbidity. It may also be temporarily affected by reduce dissolved oxygen (DO) concentrations and by toxic materials that may be introduced to the water through construction-related spills and discharges, and during the removal of creosote-treated piles and timbers that may release creosote-related toxins into the water.

Turbidity: Pile removal would mobilize bottom sediments that would cause episodic, localized, and short-lived turbidity plumes with relatively low concentrations of total suspended sediments (TSS). The intensity of turbidity is typically measured in Nephlometric Turbidity Units (NTU) that describe the opacity caused by the suspended sediments, or by the concentration of TSS as measured in milligrams per liter (mg/L). A strong positive correlation exists between NTU values and TSS concentrations. Depending on the particle sizes, NTU values roughly equal the same number of mg/L for TSS (i.e. 10 NTU = ~ 10 mg/L TSS, and 1,000 NTU = ~ 1,000 mg/L TSS) (Campbell Scientific Inc. 2008; Ellison *et al*. 2010). Therefore, the two units of measure are easily compared.

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

Vibratory removal of hollow 30-inch steel piles in Lake Washington mobilized sediments that adhered to the piles as they were pulled up through the water column (Bloch 2010). Much of the mobilized sediment likely included material that fell out of the hollow piles. Turbidity reached a peak of about 25 NTU (~25 mg/L) above background levels at 50 feet from the pile, and about 5 NTU (~5 mg/L) above background at 100 feet. Turbidity returned to background levels within 30 to 40 minutes. Pile installation created much lower turbidity. The planned extraction of 12-inch derelict timber piles is extremely unlikely to mobilize as much sediment as described above, because the timber piles have much smaller surface areas for sediments to adhere to, and no tube to hold packed-in sediments. Therefore, the mobilization of bottom sediments, and resulting turbidity from the planned pile removal is likely to be less than that reported by Bloch. Lifting barge spuds would also mobilize sediments, but likely less than that of pile removal because the spuds would not be embedded as deeply as the piles described above.

The divers may use induction dredges to remove sediments from around piles that would be cut below the mudline (SECO 2019b). The typical induction dredge is a handheld underwater excavation tool that consists of a relatively small diameter (inches) metal or hard plastic tube with a small-gage high-velocity water jet aimed inward near its opening. The back flowing water creates suction at the opening. Sediments are drawn into the tube and away from the excavation. This type of dredge typically includes tubing that is used to deposit excavated sediments nearby. The induction dredge would also be used to return the sediments to backfill the excavation site. The delivery tube would limit sediment mobilization in the water column. However, finer materials would likely drift before settling to seafloor. Given the small size and low number of the excavations on any workday, it is extremely unlikely that the extent and duration of resulting turbidity plumes would exceed that of pile removal discussed above. Further, the project includes the installation of full-depth sediment curtains around pile removal and excavation (SECO 2019b), which would contain most or all of the mobilized sediments until turbidity returns to background levels.

Tugboats would also mobilize bottom sediments. Based on similar projects, tugboat trips to the site would be relatively infrequent, and brief. Therefore, the resulting propeller wash turbidity plumes would be episodic and low in number. The intensity and duration of the resulting turbidity plumes are uncertain. They would depend on a combination of the tugboat's thrust, the water depth under it, and the type of substrate. The higher the thrust and the finer the sediment, the more mobilized sediment. Fine material (silt) remains mobilized longer than coarse material (sand). The shallower the water, the more thrust energy that would reach the substrate.

A recent study described the turbidly caused by large tugboats operating in Navy harbors in water about 40 feet (12 m) deep (ESTCP 2016). At about 13 minutes, the plume extended about 550 yards (500 m) and had a TSS concentration of about 80 mg/L. The plume persisted for many hours and extend far from the event, but the TSS concentration fell to 30 mg/L within 1 hour and to 15 mg/L within 3 hours. Given the relatively small sizes of the tugboats and barges that would likely be used for the project, the low operating speeds of the tug when positioning the barges, and the water depths where the tug would operate (likely 20 feet or more), sediment mobilization from propeller wash would likely consist of relatively low-concentration plumes that would extend no more than 300 feet from the site, and last less than an hour.

Based on the best available information, construction-related turbidity would be very short-lived and at concentrations too low to cause more than very brief, non-injurious behavioral effects such as avoidance of the plume, mild gill flaring (coughing), and slightly reduced feeding rates and success in the PS Chinook salmon that may be exposed to it. None of these potential responses, individually, or in combination would affect the fitness or normal behaviors in exposed fish.

Dissolved Oxygen (DO): Mobilization of anaerobic sediments can decrease dissolved oxygen (DO) levels (Hicks *et al*., 1991; Morton 1976). The impact on DO is a function of the oxygen demand of 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 DO can affect salmonid swimming performance (Bjornn and Reiser 1991), as well as cause avoidance of water with low DO levels (Hicks 1999), and impacts tend to be more severe lower in the water column (LaSalle 1988). However, the small amount of sediments that would be mobilized suggests that any impacts on DO would be too small and short-lived to cause detectable effects in exposed fish.

Toxic Materials: Toxic materials may enter the water through construction-related spills and discharges, the mobilization of contaminated sediments, and/or the release of PAHs from creosote-treated timber piles during their removal. 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). Petroleum-based fuels, lubricants, and other fluids commonly used by construction-related equipment contain Polycyclic Aromatic Hydrocarbons (PAHs). Other contaminants can include metals, pesticides, Polychlorinated Biphenyls (PCBs), phlalates, and other organic compounds. Depending on the pollutant, its concentration, and/or the duration of exposure, exposed fish may experience effects that can range from avoidance of an affected area, to reduced growth, altered immune function, and mortality (Brette *et al*. 2014; Feist *et al*. 2011; Gobel *et al*. 2007; Incardona *et al*. 2004, 2005, and 2006; Mcintyre *et al*. 2012; Meadore *et al*. 2006; Sandahl *et al*. 2007; Spromberg *et al*. 2015).

Many of the fuels, lubricants, and other fluids commonly used in motorized vehicles and construction equipment are petroleum-based hydrocarbons with PAHs that are known to be injurious to fish. However, the project includes best management practices (BMPs) to reduce the risk and intensity of discharges and spills during construction. In the unlikely event of a construction-related spill or discharge, the event would likely be very small, quickly contained and cleaned. 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. Based on the best available information, the in-water presence of spill and discharge-related contaminants would be very infrequent, very short-lived, and at concentrations too low to cause detectable effects should a listed fish be exposed to them.

The sediments that would be mobilized during derelict pile removal very likely contain PAHs from the creosote-treated piles. PAHs may also be released directly from timber piles should they break during their removal, or during the cutting of the timber bulkhead (Evans *et al*. 2009; Parametrix 2011; Smith 2008; Werme *et al*. 2010). As described above, the amount of sediment that would be mobilized by construction activities would be small, and any PAHs that may be mobilized would likely dissipate within a few hours, through evaporation at the surface, dilution in the water column (Smith 2008; Werme *et al*. 2010), or by settling out of the water with the sediments. Therefore, in-water contaminant concentrations would be very low and short-lived. Further, most of the mobilized contaminants would be contained within full-depth sediment curtains until they settle out of the water. In the unlikely event of exposure to mobilized contaminants, the in-water concentrations would be too low, and exposure too brief to cause detectable effects in exposed individuals.

Based on the best available information, as described above, any fish that may be exposed to construction-related water quality impacts would experience no more than temporary low-level behavioral effects, which individually, or in combination would not affect the fitness of exposed individuals.

Construction-related Contaminated Forage

Exposure to contaminated forage is likely to adversely affect PS Chinook salmon and PS steelhead. In addition to direct uptake of contaminants through their gills, salmonids may absorb contaminants through dietary exposure (Meador *et al*. 2006; Varanasi *et al*. 1993). The removal of creosote-treated derelict timber piles would mobilize small amounts of contaminated subsurface sediments that would settle onto the top layer of substrate, where contaminants such as PAHs and PCBs may remain biologically available for years.

Romberg (2005) discusses the spread of contaminated sediments that were mobilized by the removal of creosote-treated piles from the Seattle Ferry Terminal, including digging into the sediment with a clamshell bucket to remove broken piles. Soon after the work, high PAH levels were detected 250 to 800 feet away, across the surface of a clean sand cap that had been installed less than a year earlier. Concentrations decreased with distance from the pile removal site, and with time. However, PAH concentrations remained above pre-contamination levels 10 years later. Lead and mercury values also increased on the cap, but the concentrations of both metals decreased to background levels after 3 years.

The applicant's project would remove over 180 derelict timber piles. Although sediment mobilization due to the planned work would be much less severe than was described by Romberg (2005), the sediments that would be mobilized the project are almost certainly contaminated by PAHs of creosote origin. As discussed above, most of the sediment, and therefore the highest concentrations of contaminants would likely settle out of the water within the bounds of the full-depth sediment curtains. However, propeller wash from tugboats may later spread those sediments as far away as 300 feet.

Amphipods and copepods uptake PAHs from contaminated sediments (Landrum and Scavia 1983; Landrum et al. 1984; Neff 1982), and pass them to juvenile Chinook salmon and other small fish through the food web. Varanasi et al. (1993) found high levels of PAHs in the stomach contents of juvenile Chinook salmon in a contaminated waterway (Duwamish). They also reported reduced growth, suppressed immune competence, as well as increased mortality in juvenile Chinook salmon that was likely caused by the dietary exposure to PAHs. Meador et al. (2006) demonstrated that dietary exposure to PAHs caused "toxicant-induced starvation" with reduced growth and reduced lipid stores in juvenile Chinook salmon. The authors surmised that these impacts could severely impact the odds of survival in affected juvenile Chinook salmon.

Juvenile PS steelhead were not specifically addressed in the available literature, but it is reasonable to expect that they may be similarly affected by dietary uptake of contaminants.

The annual number of juvenile PS Chinook salmon and PS steelhead that may be exposed to contaminated forage that would be attributable to this action is unquantifiable with any degree of certainty, as is the amount of contaminated prey that any individual fish may consume, or the intensity of any effects that an exposed individual may experience. However, the small affected area suggests that the probability of trophic connectivity to the contamination would be very low for any individual fish. Therefore, for both species, the numbers of fish that may be annually exposed to contaminated prey would likely comprise extremely small subsets of the cohorts from their respective populations, and the numbers of exposed fish would be too low to cause detectable population-level effects.

Construction-related Propeller Wash

Construction-related propeller wash is likely to adversely affect PS Chinook salmon, but it is very unlikely that any PS steelhead would be exposed. Spinning boat propellers kill fish and small aquatic organisms (Killgore *et al*. 2011; VIMS 2011). Spinning propellers also generate fast-moving turbulent water that is known as propeller wash. Exposure to propeller wash can displace and disorient small fish. It can also mobilize sediments and dislodge aquatic organisms, including SAV, particularly in shallow water and/or at high power settings. This is called propeller scour.

During construction, episodic tugboat operations cause propeller wash within the action area. Adult Chinook salmon that migrating through the action area are likely to remain in relatively deep water and avoid construction-related noise and activity. Further, they would be able to swim against most propeller wash they might be exposed to without any measurable effect on their fitness or normal behaviors. Conversely, juvenile Chinook salmon that are within the area are likely to be relatively close to the surface and too small to effectively swim against the propeller wash. Individuals that are struck or very nearly missed by the propeller would be injured or killed by the exposure. Farther away, propeller wash may displace and disorient fish. Depending on the direction and strength of the thrust plume, displacement could increase energetic costs, reduce feeding success, and may increase the vulnerability to predators for individuals that tumble stunned and/or disoriented in the wash.

The number of individuals that would be affected by propeller wash is unquantifiable with any degree of certainty. However, based on the timing and location of the work, and on the relatively low number of tugboat trips that would occur, the numbers of affected individuals would represent such a small subset of their cohort that their loss would cause no detectable population-level effects.

Construction-related propeller scour may also reduce SAV and diminish the density and diversity of the benthic community at the project site. However, the affected area would be limited to a very small area where little to no SAV is believed to exist. Further, any affected resources, such as benthic invertebrates would likely recover very quickly after work is complete. Therefore, the effects of propeller scour would be too small to cause any detectable effects on the fitness and normal behaviors of juvenile Chinook salmon and steelhead in the action area.

Structure-related Degraded Water Quality

Structure-related impacts on water quality would cause minor effects in PS Chinook salmon and PS steelhead. The new piers, ramps, and floats would be constructed with aluminum framing, instead of timber that has been treated with ammoniacal copper zinc arsenate (ACZA) or other preservatives. Therefore, the new structures would not be sources of copper or other preservative chemicals. However, the vessels that moor at the floats may impact water quality should they have hulls that are coated with anti-fouling paints that contain copper, or if they discharge fuels and lubricants to the water while moored at the structures.

Copper from Anti-fouling Hull Paints: Copper-based anti-fouling paints leach copper into the water at fairly constant levels and can be a significant source of dissolved copper in harbors and marinas (Schiff et al. 2004). This is most notable under conditions of high boat occupancy in enclosed moorages where water flows are restricted. WDOE (2017) reports that dissolved copper concentrations from anti-fouling paints can be above 5 µg/L in protected moorages, but below 0.5 µg/L in open moorages with high flushing rates. 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, dissolved copper concentrations that may be attributable to the new moorage would likely be below the threshold of effect in salmonids because the project site is not enclosed, and vessel occupancy is expected to be very low, consisting mostly of day use by unpowered water craft that are very unlikely to have anti-fouling hull paint. Further, very few of the low numbers of power boats that would episodically visit the site are expected to have anti-fouling hull paint. Based on the available information, dissolved copper concentrations that would be attributable to the new floats are expected to be below the threshold of effect in salmonids.

Petroleum-based fuels and lubricants: Visiting powerboats moored at the new floats may episodically discharge fuels and lubricants. However, the numbers of visiting powerboats would likely be low, discharges would be infrequent and typically very small. Further, the moorage is open and exposed to lake currents that would facilitate dilution and evaporation of any discharges that may occur. Based on the available information, the concentrations and residence times of vessel-related petroleum-based substances would be too low to cause detectable effects in PS Chinook salmon and PS steelhead. Further, most power vessel use would likely occur during the summer after juvenile Chinook salmon and steelhead have left the lake.

Armored Shoreline

The repaired bulkhead is likely to adversely affect juvenile PS Chinook salmon and PS steelhead that annually pass through the action area. The proposed bulkhead repair would extend the useful life of the exiting bulkhead by several decades. The repaired bulkhead would maintain the existing vertical and simplified shoreline habitat conditions at the site.

Survival of out-migrating juvenile PS Chinook salmon and other salmonids is positively influenced by early rapid growth. While in freshwater, and for several weeks to months after they leave their natal streams, juvenile Chinook salmon and many other salmonids typically prefer undisturbed, gently sloping, shallow nearshore habitats. These habitats are very important to juvenile salmon because they provide high quality forage resources and refuge from predators. A growing body of research indicates that shoreline armoring negatively impacts aquatic and marine shoreline areas. It artificially steepens the shoreline and interrupts sediment recruitment and transport, which alters grain size. It often disconnects aquatic and terrestrial ecosystems that are naturally inter-dependent. It limits the retention of wood and beach wrack that support invertebrate organisms that are prey resources for juvenile salmon (Dethier *et al*. 2016; Heerhartz and Toft 2015; Sobocinski *et al*. 2010). Armoring with sheet pile bulkheads can also interrupt hyporheic flows that are important to healthy shoreline gravel habitats.

The steepened banks that are typical along armored shorelines effectively force migrating juvenile salmon to swim in deeper waters where foraging often comes at a higher energetic cost, and where they may encounter increased predation risk. Heerhartz and Toft (2015) report that feeding behaviors of juvenile salmon are higher along unarmored shorelines than along armored shorelines, and that decreased or altered prey availability along armored shorelines is detrimental to juvenile salmon in nearshore ecosystems. Deeper water also favors freshwater predatory species, such as smallmouth bass and northern pikeminnow that are known to prey heavily on juvenile salmonids (Celedonia *et al*. 2008a; Tabor *et al*. 2010). Willette (2001) reports that marine piscivorous predation of juvenile salmon increased fivefold when the juvenile salmon were forced to leave shallow nearshore habitats.

The repaired bulkhead would maintain about 500 feet of vertical bank with a depth of about 7 feet, virtually no SAV, and no riparian vegetation. While swimming along the bulkhead, juvenile Chinook salmon are likely to experience increased energetic costs during a life stage when rapid growth is critical. They may also experience increased exposure to piscivorous predators. Individuals that fail to escape predatory attacks would be killed. Individuals that do escape would experience reduced fitness due to increased energetic costs and stress-related effects that may reduce their overall likelihood of survival. Although typically larger and less shoreline obligated than out-migrating juvenile Chinook salmon, out-migrating juvenile steelhead that pass along this section of shoreline would also experience reduced forage success and increased exposure to piscivorous predators.

The annual numbers of juvenile Chinook salmon and PS steelhead that would be exposed to this stressor are unquantifiable with any degree of certainty, as are the intensities of the resulting effects exposed individuals would experience. However, over the life of the bulkhead, some Chinook salmon and steelhead are reasonably likely to experience measurably reduced fitness or mortality due to the exposure. The relatively small affected area suggests that the probability of exposure would be very low for any individual fish. Therefore, the annual numbers of fish that may experience measurably reduced fitness or mortality due to structure-related shoreline armoring would likely comprise extremely small subsets of the cohorts from their respective populations, and the numbers of exposed fish would be too low to cause detectable population-level effects.

Structure-related Altered Lighting

Structure-related altered lighting is likely to adversely affect PS Chinook salmon and PS steelhead. The applicant's new pier, ramp, and float structures would create unnatural lighting conditions at the project site. The new bulkhead and mooring structures would include no artificial lighting systems. However, the new mooring structures and moored boats would create shade during the day. Structure-related shade may reduce SAV and forage resources. It may also increase migratory distances and increase vulnerability to predators.

The two new mooring structures would extend 83 and 120 feet from the existing bulkhead. They have a combined over-water footprint of about 2,605 square feet, but would also be fully-decked with 60 % open-area grating. The water depth under the new mooring structures ranges from about -8 to over -20 feet relative to the ordinary high water mark (Figures 4 and 5). The new structures would cause dappled shading with less than 50 percent light transmittance over relatively deep substrate, and the vessels that moor there would add to the size and intensity of the shade.

Structure-related shade is likely to have very little impact on SAV and forage resources due to the absence of SAV in the action area, and the water depth under the structures. Therefore the effects of structure-related prey and cover reduction would be too small to cause detectable effects on the fitness and normal behaviors of juvenile salmonids in the area. However, the shade from the float and moored boats is likely to alter migration for some juvenile Chinook salmon and may increase the vulnerability of some juvenile Chinook salmon and steelhead to predators. The intensity of shadow effects on migration and risk of predation are likely to vary based on the brightness and angle of the sun. They would be most intense on sunny days, and less pronounced to possibly inconsequential on cloudy days.

Numerous studies demonstrate that juvenile salmonids, in both freshwater and marine habitats, are more likely to avoid the shadow of an overwater structure than to pass through it (Celedonia *et al*. 2008a and b; Kemp *et al*. 2005; Moore *et al*. 2013; Munsch *et al*. 2014; Nightingale and Simenstad 2001; Ono *et al*. 2010; Southard *et al*. 2006). Swimming around overwater structures increases the migratory distance, which has been positively correlated with increased mortality in juvenile Chinook salmon (Anderson *et al*. 2005).

The western float's shadow would be about 83 feet long, and the eastern float's shadow would be about 120 feet long. Both would extend across the shoreline route likely to be followed by juvenile Chinook salmon and steelhead that would migrate through the action area. The shade of the new structures is likely to delay the passage under the structure for some juveniles, and/or induce some juveniles to swim around the structures. In addition to increasing migratory distance, off-bank migration places juvenile salmonids in relatively deep water where foraging is likely to have higher energetic costs than shallow shoreline waters (Heerhartz and Toft 2015). Therefore, the juvenile Chinook salmon and steelhead that swim around the mooring floats are likely to experience some degree of reduced fitness due to increased energetic costs.

The shade from the new mooring structures is likely to increase juvenile salmonid exposure and vulnerability to predators. Shade and deep water both favor freshwater predatory species, such as smallmouth bass and northern pikeminnow that hide in shadows and are known to prey heavily on juvenile salmonids (Celedonia *et al*. 2008a and b; Tabor *et al*. 2010). The applicant's new mooring structures would cast shadows that would extend 83 and 120 feet from the shoreline, across bottom depths of 8 to 20 feet. The shadows would not necessarily increase the population of predatory fish in the action area, but they are likely to concentrate predatory fish within them. Therefore, juvenile Chinook salmon and steelhead would be more likely to encounter predatory fish at the project site after the installation of the new structures than they would in their absence. The risk of predation would be further increased for the juvenile salmonids that swim around the structures simply due the increased distance traveled in proximity to the predator-friendly shadows, and their vulnerability to attack would be increased because some juvenile salmonids

Individuals that fail to escape an attack would be killed. Individuals that do escape would experience reduced fitness due to increased energetic costs and stress-related effects that may reduce their overall likelihood of survival. The likelihood that any individual juvenile Chinook salmon or steelhead would be injured or killed due to increased exposure to predators at the site is expected to be very low, and that likelihood would vary greatly over time due to the complexities of predator/prey dynamics as well as variations in environmental conditions at the site. However, over the life of the applicant's new mooring structures, it is extremely likely that at least some individuals would be killed due to the increased risk of predation that would be caused by the shade of the new mooring structures.

<u>Summary:</u> Structure-related shade would cause a combination of altered behaviors and increased risk of predation that would reduce fitness or cause mortality for some juvenile PS Chinook salmon and juvenile PS steelhead that pass the site. The annual numbers of either species that would be impacted by this stressor is unquantifiable with any degree of certainty, and the numbers are likely to vary greatly over time. However, the available information suggests that the probability of exposure would be very low for any individual fish, and only a subset of the exposed individuals would be measurably affected. Therefore, for both species, the proportion of any year's cohort that would be killed or experience measurably reduced fitness due to this stressor would be too low to cause any detectable population-level effects.

<u>Structure-related Vessel Noise</u>

Structure-related noise is likely to adversely affect PS Chinook salmon and PS steelhead. The applicant's new mooring structures would support increased vessel operations within the action area. The applicant reports that the mooring structures would be used primarily to support non-motorized water craft use by residents and hotel guests, but that they would also be used to support vessel-borne visits to the Southport facilities, which would include the use of motorized vessels.

Based size and design of the applicant's proposed mooring floats, and on satellite imagery of the many piers and marinas that line Lake Washington, the powerboats that would moor at the floats would typically be about 20 to 50 feet in length. The best available information for source levels for powerboats close to those sizes is described in the acoustic assessment done for a similar project (NMFS 2018). However, the available information describes vessels running at or close to full-speed, and tugboat noise is used here to conservatively estimate the noise from the larger recreational powerboats that would moor at the floats.

Recreational vessel operations around a mooring structure typically consists of brief periods of relatively low-speed movement as boats are driven to the float and tied up, with their engines being shut off within minutes of arrival. The engines of departing vessels are typically started shortly before the boats are untied and driven away. As describe earlier, exposure to noise may cause a range of physiological effects in fish that are largely dependent on the intensity of the sound and the duration of exposure. The best available information suggests that the peak source levels for tugboat-sized boats and for 23-foot long powerboats would be well below the threshold for instantaneous injury in fish, and that fish would be unaffected by boating noise beyond 72 feet (22 m; Table 6).

**Table 6.** In-water Source Levels for vessels with noise levels similar to those likely to moor at the applicant's piers, with estimated ranges to effects thresholds for fish.

| Source | Acoustic Signature | Source Level | Threshold Range |
|---|---|---|---|
| Tugboat | < 2 kHz Combination | 185 $dB_{peak}$ | 206 @ N/A |
| Episodic brief periods measures in minutes | | 170 $dB_{SEL}$ | 150 @ 22 m |
| 23 foot Boat w/ 2 4~ 100 HP Outboard Engines. | < 2 kHz Combination | 175 $dB_{peak}$ | 206 @ N/A |
| Episodic brief periods measures in minutes | | 165 $dB_{SEL}$ | 150 @ 10 m |

It is extremely unlikely that any visiting powerboats would be operated at anything close to full speed in proximity to the mooring structures. Further, most vessels would be smaller than a typical tugboat, and the duration of operations would likely be too short to cause injuries due to accumulated noise. Therefore, boating noise levels would be non-injurious, and the 150 $dB_{SEL}$ isopleth would likely remain well within 72 feet around the mooring floats. However, juvenile Chinook salmon and steelhead that are within the 150 $dB_{SEL}$ isopleth, are likely to episodically experience behavioral disturbance, such as acoustic masking, startle responses, altered swimming patterns, avoidance, and increased risk of predation that may reduce fitness and/or cause mortality for some juvenile PS Chinook salmon and juvenile PS steelhead within the action area. The intensity of these effects would increase with increased proximity to the source and/or duration of exposure.

The annual numbers of either species that would be impacted by this stressor is unquantifiable with any degree of certainty, and the numbers are likely to vary over time. However, powerboat operations at the site would be episodic and of short duration, and the size of the affected area would be very small. Further, most powerboat use is likely to occur during the summer after most juvenile Chinook salmon and steelhead have left the lake. Therefore, the annual numbers of fish that would be killed or experience measurably reduced fitness from exposure to structure-related noise would be too low to cause any detectable population-level effects.

Structure-related Propeller Wash

Structure-related propeller wash is likely to adversely affect PS Chinook salmon and PS steelhead. Propeller wash from the episodic recreational powerboat operations at the applicant's mooring structures would cause virtually identical effects as those described above for construction-related propeller wash. However those effects may occur year-round instead of being limited to the work windows, and they would extend decades into the future. Therefore, it is likely that over the life of the applicant's mooring structures, at least some juvenile Chinook salmon and steelhead would experience reduced fitness or mortality from exposure to spinning propellers and/or propeller wash at the site.

The annual number of individuals that may be impacted by this stressor is unquantifiable with any degree of certainty. However, powerboat operations at the site would be episodic and of short duration, and most powerboat use is likely to occur during the summer after most juvenile Chinook salmon and steelhead have left the lake. Further, the likelihood of this interaction would be very low for any individual fish or any individual vessel trip. Therefore, the annual numbers of fish that would be killed or experience measurably reduced fitness from exposure to structure-related propeller wash would be too low to cause any detectable population-level effects.

### 2.5.2 Effects on Critical Habitat

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

Puget Sound Chinook Salmon Critical Habitat: The proposed action is likely to adversely affect critical habitat that has been designated for PS Chinook salmon. The essential PBFs of PS Chinook salmon critical habitat are listed below. The expected effects on those PBFs from completion of the planned project, including full application of the conservation measures and BMPs, would be limited to the impacts on the PBF of freshwater migration corridors free of obstruction and excessive predation as described below.

1. Freshwater spawning sites – None in the action area.
2. Freshwater rearing sites – None in the action area.
3. Freshwater migration corridors:
   a. Free of obstruction and excessive predation – The proposed action would cause long-term minor effects on this PBF. Shade from the new mooring structures is likely to cause short delays and/or slightly increase the migration distances for some of the juvenile Chinook salmon that encounter them. The shade is also likely to concentrate piscivorous predators at the site and slightly improve their success. The relatively deep water along the vertical bulkhead may also slightly improve predatory success. Boating noise would cause episodic ephemeral conditions that may synergistically increase the intensity of these effects.
   b. Water quantity – The proposed project would cause no effect on this PBF.

c. Water quality – The proposed action would cause minor ephemeral adverse effects, and long-term minor beneficial effects on this PBF. The action would cause no measurable changes in water temperature or salinity, but construction would briefly introduce contaminants and may slightly reduce DO. Detectable construction-related effects are expected to be limited to the area within 300 feet around the project site, and are not expected to persist past several hours after work stops. The removal of about 180 creosote-treated timber piles would reduce ongoing PAH contamination at the site.
d. Natural Cover – The proposed action would cause long-term minor effects on this PBF. Extending the life of the bulkhead would maintain previously altered habitat conditions at the site that limit natural shoreline processes that would support the growth of submerged aquatic vegetation at the project site, which in combination with adjacent structures acts to limit the availability of natural cover in the action area.

4. Estuarine areas – None in the action area.
5. Nearshore marine areas – None in the action area.
6. Offshore marine areas – None in the action area.

**2.6 Cumulative Effects**

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

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

The current condition of ESA-listed species and designated critical habitat within the action area are described in the Status of the Species and Critical Habitat and the Environmental Baseline sections above. The contribution of non-federal activities to those conditions include past and on-going bankside development in the action area, as well as upstream forest management, agriculture, urbanization, road construction, water development, and restoration activities. Those actions were driven by a combination of economic conditions that characterized traditional natural resource-based industries, general resource demands associated with settlement of local and regional population centers, and the efforts of conservation groups dedicated to 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 shoreline and upstream 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 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 our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat for the conservation of the species.

As described in more detail above at Section 2.4, climate change is likely to increasingly affect the abundance and distribution of the ESA-listed species considered in the Opinion. 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 DO, 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 and PS steelhead are both listed as threatened, based on declines from historic levels of abundance and productivity, loss of spatial structure and diversity, and an array of limiting factors as a baseline habitat condition. Both species will be affected over time by cumulative effects, some positive – as recovery plan implementation and regulatory revisions increase habitat protections and restoration, and some negative – as climate change and unregulated or difficult to regulate sources of environmental degradation persist or increase. Overall, to the degree that habitat trends are negative, as described below, effects on viability parameters of each species are also likely to be negative. In this context we consider the effects of the proposed action's effect on individuals of the listed species at the population scale.

PS Chinook salmon

The long-term abundance trend of the PS Chinook salmon ESU is slightly negative, and the South Puget Sound MPG, which includes the Cedar River population, is considered at high risk of extinction due to low abundance and productivity. 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 project site is located along the southeastern shore of Lake Washington, about 800 yards east-northeast of the mouth of the Cedar River. The environmental baseline within the action area has been degraded by the effects of intense streambank and shoreline development. The baseline has also been degraded by nearby and upstream industry, urbanization, agriculture, forestry, water diversion, and road building and maintenance.

Short-term construction-related impacts, and long-term structure-related impacts, are likely to cause a range of effects that both individually and collectively would cause altered behaviors, reduced fitness, and possible mortality in low numbers of exposed individuals for decades to come. The annual numbers of individuals that are likely to be impacted by action-related stressors is unknown, but they are expected to be very 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 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 PS steelhead DPS is currently considered "not viable", and the extinction risk for most DIPs is estimated to be moderate to high. Long-term abundance trends have been predominantly negative or flat across the DPS, especially for natural spawners, and growth rates are currently declining at 3 to 10% annually for all but a few DIPs. The abundance trend between 1984 and 2016 is strongly negative for the Cedar River DIP. Reduced or eliminated accessibility to historically important habitat, combined with degraded conditions in available habitat due to land use activities appear to be the greatest threats to the recovery of PS steelhead. Fisheries activities also continue to impact this species.

The project site is located along the southeastern shore of Lake Washington, about 800 yards east-northeast of mouth of the Cedar River. The environmental baseline within the action area has been degraded by the effects of intense streambank and shoreline development. The baseline has also been degraded by nearby and upstream industry, urbanization, agriculture, forestry, water diversion, and road building and maintenance.

PS steelhead are unlikely to be exposed to project-related work. However, long-term structure-related impacts, are likely to cause a range of effects that both individually and collectively would cause altered behaviors, reduced fitness, and possible mortality in low numbers of exposed individuals for decades to come. The annual numbers of individuals that are likely to be impacted by action-related stressors is unknown, but they are expected to be very 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 salmon population (abundance, productivity, distribution, or genetic diversity) for the affected PS steelhead populations. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

### 2.7.2 Critical Habitat

As described above at Section 2.5, the proposed action is likely to adversely affect designated critical habitat for PS Chinook salmon.

Chinook salmon critical habitat

Past and ongoing land and water use practices have degraded salmonid critical habitat throughout the Puget Sound basin. Hydropower and water management activities have reduced or eliminated access to significant portions of historic spawning habitat. Timber harvests, agriculture, industry, urbanization, and shoreline development have adversely altered floodplain and stream morphology in many watersheds, diminished the availability and quality of estuarine and nearshore marine habitats, and reduced water quality across the region. Global climate change is expected to increase in-stream water temperatures and alter stream flows, possibly exacerbating impacts on baseline conditions in freshwater habitats across the region. Rising sea levels are expected to increase coastal erosion and alter the composition of nearshore habitats, which could further reduce the availability and quality of estuarine habitats. Increased ocean acidification may also reduce the quality of estuarine habitats.

In the future, non-federal land and water use practices and climate change are likely to increase. The intensity of those influences on salmonid critical habitat is uncertain, as is the degree to which those impacts may be tempered by adoption of less environmentally impacting 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 PBF for PS Chinook salmon critical habitat in the action area is limited to freshwater migration corridors free of obstruction and excessive predation. The site attributes of that PBF that would be affected by the action are limited to freedom from obstruction and excessive predation, water quality, and natural cover. As described above, the project site is located along a heavily impacted shoreline, and all of these site attributes currently function at greatly reduced levels as compared to undisturbed freshwater migratory corridors. Construction and the long-term presence of the applicant's bulkhead, mooring floats, and their interrelated activities would cause ephemeral and long-term minor adverse effects on obstruction and predation, water quality, and natural cover.

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 cause minor long-term negative changes in the quality or functionality of the freshwater migration corridors PBF in the action area. However, those changes are not expected to measurably reduce this critical habitat's current level of functionality or its current ability for PBF to become functionally established, to serve the intended conservation role for PS Chinook salmon.

## 2.8 Conclusion

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

## 2.9 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement (ITS).

### 2.9.1 Amount or Extent of Take

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

Harm of PS Chinook salmon from exposure to:

- construction-related noise,
- construction-related propeller wash,

- construction-related contaminated forage,
- armored shoreline,
- structure-related altered lighting,
- structure-related vessel noise, and
- structure-related propeller wash.

Harm of PS steelhead from exposure to:

- construction-related contaminated forage,
- armored shoreline,
- structure-related altered lighting,
- structure-related vessel noise, and
- structure-related propeller wash.

The NMFS cannot predict with meaningful accuracy the number of PS Chinook salmon and PS steelhead that are reasonably certain to be injured or killed by exposure to any of these stressors. The distribution and abundance of the fish that occur within an action area are affected by habitat quality, competition, predation, and the interaction of processes that influence genetic, population, and environmental characteristics. These biotic and environmental processes interact in ways that may be random or directional, and may operate across far broader temporal and spatial scales than are affected by the proposed action. Thus, the distribution and abundance of fish within the action area cannot be attributed entirely to habitat conditions, nor can the NMFS precisely predict the number of fish that are reasonably certain to be injured or killed if their habitat is modified or degraded by the proposed action. Additionally, the NMFS knows of no device or practicable technique that would yield reliable counts of individuals that may experience these impacts. In such circumstances, the NMFS uses the causal link established between the activity and the likely extent and duration of changes in habitat conditions to describe the extent of take as a numerical level of habitat disturbance. The most appropriate surrogates for take are action-related parameters that directly relate to the magnitude of the expected take.

For this action, the timing and duration of work, the type and size of the piles to be extracted and installed, and the method of their extraction and installation are the best available surrogates for the extent of take of juvenile PS Chinook salmon from exposure to construction-related noise. The timing and duration of work is also the best available surrogate for the extent of take of juvenile PS Chinook salmon from exposure to construction-related propeller wash.

Timing and duration of work is applicable for construction-related take because the planned work windows were selected to reduce the potential for juvenile salmonid presence at the project site. Therefore, working outside of the planned work window and/or working for longer than planned could increase the number of fish likely to be exposed to construction-related noise and propeller wash. The piles and the method of their extraction and installation are applicable for construction-related noise because the intensity of effect is positively correlated with the loudness of the sound, which is determined by the type and size of the pile and the method of extraction and/or installation. Further, the number of fish that would be exposed to the noise is positively correlated with the size of the area of acoustic effect and the number of days that the area would be ensonified. In short, as the sound levels increase, the intensity of effect and the size of the ensonified area increases, and as the size of the ensonified area increases, and/or as the number of days the area is ensonified increases, the number of PS Chinook salmon that would be exposed to the sound would increase despite the low density and random distribution of individuals of this species in the action area. Based on the best available information about the planned pile extraction and installation, as described in Section 2.5, the applicable ranges of effect for this project are driven by the type and size of the piles and the method of their extraction and installation, not by the daily duration of vibratory work. Therefore, daily duration of vibratory work is not considered a measure of take for this action.

The number of pile removals and the extent of the turbidity plumes around that work are the best available surrogates for the extent of take of juvenile PS Chinook salmon and PS steelhead from exposure to construction-related contaminated forage. This is because the intensity of surface contamination would be positively correlated with the amount of contaminated subsurface sediments that would be brought to the surface, and the numbers of contaminated prey organisms and/or exposed fish would be positively correlated with the size of the affected area. As the number of pile removals increase, the amount of biologically available contaminated sediments would increase. Also, as the size of the visible turbidity plume increases, the size of the area where contaminated sediments would be biologically available would increase. Therefore, as the number of affected piles and/or the size of the visible turbidity plumes increase, the number of prey organisms that may become contaminated and then eaten by juvenile PS Chinook salmon and PS steelhead would increase, despite the low density and random distribution of juveniles of both of these species in the action area.

The length and configuration of the applicant's repaired bulkhead are the best available surrogates for the extent of take of juvenile PS Chinook salmon and PS steelhead from exposure to armored shoreline. Increasing the bulkhead's length would increase energetic costs and risk of predation for juvenile Chinook salmon and steelhead. The increased length would increase the distance they must swim where forage efficiency would be reduced and where deeper water would increase their vulnerability to piscivorous predators. Alteration of the bulkhead's configuration through the installation of rip rap would increase the risk of predation by improving habitat conditions for piscivorous predators.

The size and configuration of the applicant's new mooring structures are the best available surrogates for the extent of take of juvenile PS Chinook salmon and PS steelhead from exposure to structure-related altered lighting, vessel noise and propeller wash. This is because the likelihood of avoidance and the distance required to swim around the structures would both increase as the size of a structures and the intensity of their shadows increase. Similarly, as the size of the structure and the intensity of its shadow increase, the number of predatory fish that may hide beneith the structures would increase, and the potential for juvenile PS Chinook salmon and PS steelhead to be exposed to those predators would increase as the length of the structure's outline increases. Also, as the size of a structure increases, the number of boats that could moor there increases. As the number of boats increase, boating activity would likely increase, and the potential for juvenile PS Chinook salmon and PS steelhead to be exposed to the related noise and propeller wash effects also increases.

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

Puget Sound Chinook salmon:

- In-water work July 16 through 31, and November 16 through December 31;
- 30 days of vibratory timber pile extraction or cutting with hydraulic excavation of about 200 piles;
- 30 days of vibratory installation of about 270 steel sheet piles no larger than 24-inches wide;
- Vibratory installation of 12 steel pipe piles no larger than 12 inches in diameter;
- A visible turbidity plume not to exceed 300 feet from the project site during any portion of the project, including movement of the contractor's tugboats; and
- The size and configuration of the repaired bulkhead, and the new piers, ramps, and floats, as described in the proposed action section of this biological opinion.

Puget Sound steelhead:

- In-water work July 16 through 31, and November 16 through December 31;
- Vibratory extraction or cutting with hydraulic excavation of about 200 timber piles;
- A visible turbidity plume not to exceed 300 feet from the project site during any portion of the project, including movement of the contractor's tugboats; and
- The size and configuration of the repaired bulkhead, and the new piers, ramps, and floats, 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 the size and configuration of the structure exceeds the proposal, it could still meaningfully trigger reinitiation because the Corps has authority to conduct compliance inspections and to take actions to address non-compliance, including post-construction (33 CFR 326.4).

### 2.9.2 Effect of the Take

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

### 2.9.3 Reasonable and Prudent Measures

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

The COE shall require the applicant to:

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

2. Minimize incidental take of PS Chinook salmon and PS steelhead from exposure to contaminated forage.

3. Minimize incidental take of PS Chinook salmon and PS steelhead from exposure to armored shoreline and structure-related altered light, vessel noise, and propeller wash.

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

### <u>2.9.4 Terms and Conditions</u>

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

1. To implement RPM Number 1, Minimize incidental take of PS Chinook salmon from exposure to construction-related noise and activity and propeller wash, the COE shall require the applicant to require their contractors to:
   a. Limit in-water work, including the use of tugboats, to July 16 through 31, and November 16 through December 31;
   b. Limit pile extraction and installation to vibratory equipment. No impact pile driving shall be done;
   c. Limit timber pile extraction and sheet pile installation to 30 days each; and
   d. Limit pipe pile installation to a maximum of 12 steel pipe piles no larger than 12 inches in diameter.

2. To implement RPM Number 2, Minimize incidental take of PS Chinook salmon and PS steelhead from exposure to contaminated forage, the COE shall require the applicant to require their contractors to:
   a. Fully enclose all pile extraction work, including excavation, within full-depth sediment curtains;
   b. Extract piles slowly by pulling. No water-jetting or clamshell digging shall be used;
   c. Ensure that extracted piles are not shaken, hosed off, left hanging to dry, or that any other actions are taken to remove adhering material from piles while they are suspended over the water; and
   d. Adjust pile extraction, excavation, and tugboat operations to ensure that turbidity does not exceed 300 feet from the project site, and to halt work should the visible turbidity plume approach and that range.

3. To implement RPM Number 3, Minimize incidental take PS Chinook salmon and PS steelhead from exposure to armored shoreline, and to structure-related altered light, vessel noise, and propeller wash, the COE shall require the applicant to ensure that the size and configuration of the mooring structures do not exceed the dimensions described in the proposed action section above. In particular:
   a. The repaired bulkhead shall be no longer than 500 feet, and shall include no rip rap;
   b. The mooring structures shall have a combined over-water area of no more than 2,606-square feet;
   c. The west and east mooring structures shall, respectively, extend no more than 83 and 120 feet from the south bulkhead; and
   d. Both structures shall be fully decked with grating with no less than 60 percent open area.

4. To implement RPM Number 4, Implement monitoring and reporting to confirm that the take exemption for the proposed action is not exceeded, the COE shall require the applicant to develop and implement a plan collect and report details about the take of listed fish. That plan shall:
   a. Require the contractor to maintain and submit construction logs to verify that all take indicators are monitored and reported. Minimally, the logs should include:
      i. The dates (with workday start and stop times) and descriptions of all in-water work;
      ii. The type, size, and number of piles extracted and/or installed, per day;
      iii. The method of pile extraction and/or installation;
      iv. A description of best management practices and conservation measures employed, including the installation of containment booms and/or full-depth silt curtains; and
      v. The extent (feet) and duration of visible turbidity plumes around pile work and during tugboat operations.
   b. Require the contractor to establish procedures for the submission of the construction logs and other materials to the appropriate COE office and to NMFS; and
   c. Require the contractor to submit an electronic post-construction report to NMFS within six months of project completion. Send the report to: projectreports.wcr@noaa.gov. Be sure to include Attn: WCRO-2019-00108 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).

1. The COE and the applicant should encourage contracted tugboat operator(s) to use the lowest safe maneuvering speeds and power settings when maneuvering in shallow waters close to the shoreline to minimize propeller wash and mobilization of sediments.

2. The COE should encourage the applicant to limit pile extraction and installation work to November 16 through December 31 to the greatest extent practicable.

3. The COE should encourage the applicant to install clean capping material over substrates where contaminated sediments may settle out after pile extraction.

4. The COE should encourage the applicant to develop a long-term plan to reduce the environmental impacts of their overwater structures. Suggested measures include:
   a. Provide information (signage and/or handouts) to residents and visitors about the importance of the nearshore habitats at the site to migrating juvenile salmonids;
   b. Require residents and visitors to operate power boats at low speeds near the mooring floats and other shallow shoreline areas;
   c. Require residents and visitors operate their vessels in a manner that would reduce the potential for toxic chemicals to enter or remain in the water at the site;
   d. Prohibit fueling and maintenance of power boats on the mooring floats; and
   e. Establish a system to prevent and/or remove litter and wastes from the applicant's shoreline area.

5. The Corps should conduct or support continuing research to better understand the distribution, abundance, and habitat use of PS Chinook salmon, PS steelhead, and other species in southern Lake Washington and the lower Cedar River.

### 2.11 Reinitiation of Consultation

This concludes formal consultation for the U.S. Army Corps of Engineers' authorization of the Southport Bulkhead Repair and Float Installation Project in King County, Washington. As 50 CFR 402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitats in a manner or to an extent not considered in this Opinion, (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitats that was not considered in this Opinion, or (4) a new species is listed or critical habitat is designated that may be affected by the action.

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

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect essential fish habitat (EFH). The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. This analysis is based, in part, on the description of EFH for Pacific Coast salmon contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC 2014) and approved by the Secretary of Commerce.

### 3.1 Essential Fish Habitat Affected by the Project

The waters and substrates of the action area is designated as freshwater EFH for Pacific Coast Salmon, which within Lake Washington include Chinook and coho salmon. Freshwater EFH for Pacific Coast Salmon is identified and described in Appendix A to the Pacific Coast salmon fishery management plan (PFMC 2014), and consists of four major components: (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors and holding habitat.

Those components of freshwater EFH for Pacific Coast Salmon depend on habitat conditions for spawning, rearing, and migration that include: (1) water quality (e.g., dissolved oxygen, nutrients, temperature, etc.); (2) water quantity, depth, and velocity; (3) riparian-stream-marine energy exchanges; (4) channel gradient and stability; (5) prey availability; (6) cover and habitat complexity (e.g., LWD, 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 action area provides migratory habitat for juvenile and adult Chinook and coho salmon. No salmon spawning habitat occurs within the action area, and the action area includes no known habitat features that meet the definition of habitat areas of particular concern (HAPC) for Pacific Coast Salmon.

### 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. Based on the analysis of effects presented in Section 2.5 the proposed action will cause small scale long-term adverse effects adverse effects on EFH for Pacific Coast Salmon through direct or indirect impacts as summarized below.

1. Water quality: – The proposed action would cause a long term mix of minor adverse effects and minor beneficial effects on water quality. Construction would briefly increase suspended solids and may temporarily introduce low levels of contaminants. Low levels of pollutants from powerboats may episodically enter the water over the life of the mooring structures. Conversely, the removal of derelict creosote-treated timber piles and other debris would reduce PAH contamination at the site. Detectable effects are expected to be limited to the area within about 300 feet of the project site.

2. Water quantity, depth, and velocity: – The proposed action may cause long term minor adverse effects on water velocity. The new bulkhead and overwater structures may slightly alter the direction and velocity of the water flows immediately adjacent to the structures.

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

4. Channel gradient and stability: – No changes expected.

5. Prey availability: – The proposed action would cause long term minor adverse effects on prey availability. Shade from the new over-water structures may slightly reduce the density and diversity of invertebrate communities under the new structures, and mobilization of subsurface sediments during pile removal would slightly increase PAH contamination in the invertebrate prey organisms within the action area.

6. Cover and habitat complexity: – The proposed action would cause long term minor adverse effects on cover and habitat complexity. Shade would slightly reduce aquatic productivity that may slightly reduce the density and diversity of SAV under the new mooring structures, and the new bulkhead would prevent the formation of complex habitat at the project site.

7. Space: – No changes expected.

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

9. Groundwater-stream interactions: – The proposed action would cause long term minor adverse effects on groundwater-stream interactions. The new sheet pile bulkhead may slightly disrupt hyporheic flow along its length.

10. Substrate composition: – No changes expected.

### 3.3 Essential Fish Habitat Conservation Recommendations

The proposed action includes conservation measures, BMP, and design features to reduce construction- and structure-related impacts on the quantity and quality of Pacific Coast salmon EFH. It also includes the removal of about 200 derelict creosote-treated timber piles and the construction of a small pocket beach area with LWD and native vegetation. With the exception of the following conservation recommendations to reduce impacts on water quality and prey availability, the NMFS knows of no other reasonable measures to further reduce effects on EFH.

1. To reduce adverse impacts on water quality and prey availability, the COE should require the applicant to require their contractors to:
   a. Fully enclose all pile extraction work, including excavation, within full-depth sediment curtains;
   b. Extract piles slowly by pulling with no use of water-jetting or clamshell digging;
   c. Ensure that extracted piles are not shaken, hosed off, left hanging to dry, or that any other actions are taken to remove adhering material from piles while they are suspended over the water; and

d. Adjust pile extraction, excavation, and tugboat operations to ensure that turbidity does not exceed 300 feet from the project site, and to halt work should the visible turbidity plume approach and that range.

### 3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the COE must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).
In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

### 3.5 Supplemental Consultation

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

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

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these DQA components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

### 4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this Opinion is the COE. Other users could include WDFW, the governments and citizens of King County and the City of Renton, and Native American tribes. Individual copies of this Opinion were provided to the COE. The format and naming adheres to conventional standards for style.

### 4.2 Integrity

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

### 4.3 Objectivity

***Information Product Category:*** Natural Resource Plan

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

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

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

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

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