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

Refer to NMFS Nos:
WCRO-2021-01742 (D. Sabey Dock Replacement)
WCRO-2021-02012 (J. Sabey Dock Repair & Beach Cove)

March 18, 2022

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

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the D. Sabey Dock Replacement and J. Sabey Dock Repair and Beach Cove projects in Lake Washington, Seattle, Washington (USACE Nos. NWS-2021-526 and NWS-2021-677, HUC: 171100120400 – Lake Washington)

Dear Ms. Printz:

Thank you for your letters of July 20, 2021 and August 16, 2021, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for U.S Army Corps of Engineers (USACE) authorization of Sabey Dock Replacement and Sabey Dock Repair and Beach Cove projects, respectively, in Lake Washington. Based on the locations of the proposed projects and their similar impacts on ESA-listed species and their critical habitat designated under the ESA, specifically in the freshwater habitats of Lake Washington, and in an effort to expedite and streamline the ESA consultation processes, we have batched these actions into a single Biological Opinion. This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016).

Thank you, also, for 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 the NMFS pursuant to section 7 of the ESA on the effects of these proposed actions. In this opinion, the NMFS concludes that the proposed actions would adversely affect but are not likely to jeopardize the continued existence of Puget Sound (PS) Chinook salmon and PS steelhead. The NMFS also concludes that the proposed actions are likely to adversely affect designated critical habitat for PS Chinook salmon but are not likely to result in the destruction or adverse modification of that designated critical habitat. This opinion also documents our conclusion that the proposed actions are not likely to adversely affect southern resident (SR) killer whales and their designated critical habitat.

This opinion includes an incidental take statement (ITS) that describes reasonable and prudent measures (RPMs) the NMFS considers necessary or appropriate to minimize the incidental take associated with these actions, and sets forth nondiscretionary terms and conditions that the USACE must comply with to meet those measures. Incidental take from actions that meet these terms and conditions will be exempt from the ESA's prohibition against the take of listed species.

Section 3 of this document includes our analysis of the action's likely effects on EFH pursuant to Section 305(b) of the MSA. Based on that analysis, the NMFS concluded that the actions would adversely affect designated freshwater EFH for Pacific Coast Salmon. Therefore, we have provided 2 conservation recommendations that can be taken by the USACE to avoid, minimize, or otherwise offset potential adverse effects on EFH. We also concluded that the actions would not adversely affect EFH for Pacific Coast groundfish and coastal pelagic species. Therefore, consultation under the MSA is not required for EFH for Pacific Coast groundfish and coastal pelagic species.

Section 305(b) (4) (B) of the MSA requires Federal agencies to provide a detailed written response to NMFS within 30 days after receiving this recommendation. If the response is inconsistent with the EFH conservation recommendations, the USACE must explain why the recommendations will not be followed, including the scientific justification for any disagreements over the effects of the action and recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we request that in your statutory reply to the EFH portion of this consultation you clearly identify the number of conservation recommendations accepted.

Please contact Heather Spore or Don Hubner in the North Puget Sound Branch of the Oregon/Washington Coastal Office at 808-218-2897, or by electronic mail at Heather.Spore@noaa.gov or Donald.Hubner@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

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

cc: Colleen Anderson, USACE

WCRO-2021-01742 (D. Sabey Dock Replacement)
WCRO-2021-02012 (J. Sabey Dock Repair & Beach Cove)

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

D. Sabey Dock Replacement and J. Sabey Dock Repair and Beach Cove Projects
Lake Washington, Seattle, Washington
(USACE Nos. NWS-2021-526 and NWS-2021-677)

N
MFS Consultation Number: WCRO-2021-01742 and WCRO-2021-02012

Action Agency: U.S. Army Corps of Engineers

Affected Species and Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Chinook salmon (*Oncorhynchus tshawytscha*) Puget Sound (PS)	Threatened	Yes	No	Yes	No
Steelhead (*O. mykiss*) PS	Threatened	Yes	No	N/A	N/A
Killer whales (*Orcinus orca*) Southern resident (SR)	Endangered	No	No	No	No

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

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

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

Consultation Conducted By: National Marine Fisheries Service
West Coast Region

Issued By:

lministrator
Oregon Washington Coastal Office

Date: March 18, 2022

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LIST OF ABBREVIATIONS

ACZA – Ammoniacal Copper Zinc Arsenate (wood preservative)
BE – Biological Evaluation
BMP – Best Management Practices
CFR – Code of Federal Regulations
USACE – Corps of Engineers, U.S. Army
dB – Decibel (common unit of measure for sound intensity)
DIP – Demographically Independent Population
DPS – Distinct Population Segment
DQA – Data Quality Act
EF – Essential Feature
EFH – Essential Fish Habitat
ESA – Endangered Species Act
ESU – Evolutionarily Significant Unit
FR – Federal Register
FMP – Fishery Management Plan
HAPC – Habitat Area of Particular Concern
HUC – Hydrologic Unit Code
HPA – Hydraulic Project Approval
ITS – Incidental Take Statement
mg/L – Milligrams per Liter
MPG – Major Population Group
MSA – Magnuson-Stevens Fishery Conservation and Management Act
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
OHWL – Ordinary high water line
PAH – Polycyclic Aromatic Hydrocarbons
PBF – Physical or Biological Feature
PCE – Primary Constituent Element
PFMC – Pacific Fishery Management Council
PS – Puget Sound
PSTRT – Puget Sound Technical Recovery Team
PSSTRT – Puget Sound Steelhead Technical Recovery Team
RPA – Reasonable and Prudent Alternative
RPM – Reasonable and Prudent Measure
SAV – Submerged Aquatic Vegetation
SEL – Sound Exposure Level
SL – Source Level
SR – Southern Resident (Killer Whales)
VSP – Viable Salmonid Population
WCR – West Coast 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 (ITS) 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, as amended.

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

1.2 Consultation History

On July 20, 2021 and August 16, 2021, the NMFS received letters from the U.S. Army Corps of Engineers (USACE) requesting informal consultation for the proposed actions (USACE 2021a, b). The requests on these dates included David Sabey's (the applicant's) Biological Assessments (BAs) and project drawings for the Sabey Dock Replacement Project and Joe Sabey's (the applicant's) BA for the Sabey Site Repair and Beach Cove Project, respectively.

On September 8, 2021, NMFS sent a letter to the USACE informing them that we received the BAs and project information for these two consultations, and based on that information, we were not able to concur with their not likely to adversely affect (NLAA) determinations for Puget Sound (PS) Chinook salmon and their critical habitat and for PS Steelhead. The NMFS also recommended that the USACE request formal consultation for these two actions. On September 10, the USACE requested formal consultation for the proposed actions (USACE 2021c). On September 21, 2021, NMFS emailed a request for additional information to the USACE regarding the proposed bulkhead and pier design details. That information was provided on September 22, 2021 by the applicants' agent (Waterfront 2021a). Further information was requested by the NMFS on October 1, 2021 and that request was answered by the applicants' agent on October 12, 2021 (Waterfront 2021b). The NMFS requested a copy of the applicants' Joint Aquatic Resources Permit Application (JARPA) Forms and their Washington State Department of Fish and Wildlife Hydraulic Project Approvals (HPA) for the projects on September 27, 2021 and the JARPAs were emailed to NMFS that same day (Sabey 2021a and b).

This opinion is based on the information in the applicants' BAs (Davido and Hart Crowser 2021a, b), JARPAs, and additional information and drawings by the applicants' agent (Waterfront 2021a and b); the projects' HPAs (WDFW 2021a, b); recovery plans, status reviews, and critical habitat designations for ESA-listed PS Chinook salmon and PS steelhead; published and unpublished scientific information on the biology and ecology of those species; and relevant scientific and gray literature (see Literature Cited).

1.3 Proposed Federal Action

Under the ESA, "Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02), whereas under the MSA, Federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).

The USACE proposes to authorize D. Sabey and J. Sabey (the applicants) to conduct repairs and maintenance work at two adjacent private residences that are located in Seattle, along the eastern side of Lake Washington on the western shore of Hunt's Point (Figure 1).

Figure 1. Google Earth photographs of the project sites. In the left photo the project sites are shown in relation to Seattle to the west. In the right photo, the project sites are shown close up on the Hunts Point peninsula on Lake Washington.

The applicants would repair and/or replace existing pier structures, replacing wood plank decking with light-permeable decking, installing new steel piles, and repairing a bulkhead, which includes removing creosote-treated timber piles.

Project-related in-water work for both actions would occur within the approved in-water work window for the project area (July 16 through March 15) and each project would require approximately two to four weeks to complete.

All replacement structures would be fabricated and constructed off site and barged to the project site. Similarly, all demolition and construction debris would be barged to the contractor's yard for proper disposal or recycling at approved facilities. All creosote-treated timber piles would be properly disposed of in a manner that would prevent its reuse.

The work at the two docks would be done in compliance with the best management practices (BMPs) and conservation measures identified in the applicants' BAs, the JARPA Form for each dock, as well as the provisions identified in each of the WDFW HPAs for the work at the two piers (WDFW 2021a, b). These measures include, but are not limited to comprehensive lists of contractor requirements that would reduce the risk of pollutants entering the lake, such as the pre-work installation of floating spill/debris booms and full-depth sediment curtains, sediment containment around upland work, and the use of vegetable oil-based lubricants and hydraulic fluids in heavy equipment.

At both docks, work would be conducted primarily from the water, using a work barge transported by a tugboat to stage construction materials, store and transport debris. All vessels would be moored to existing structures or mooring piles and prevented from grounding. Workers would also conduct work from the land and from the existing and new overwater structures as needed. Land-based work would include excavation and installation of upland supports for the repaired bulkhead, the disconnection and reconnection of utilities, removal of old bulkhead materials, clearing and grading of shoreline vegetation, excavation of the new beach cove, and the hand-carrying of tools and small amounts of materials.

In general, the contractors would first disconnect the electricity running to the docks, then disassemble the existing piers and framing, which would be placed on a debris barge by a barge-mounted derrick. They would then fully extract the timber piles from the pier and bulkhead by pulling them with the barge-mounted derrick and using a vibratory hammer if piles cannot be extracted by direct pulling. If a pile cannot be extracted, it will be cut off at the mudline and back-filled with native sediment or clean sand. The old piles would be placed on the debris barge that would be equipped to contain sediments and fluids from the piles. The process would be reversed after the existing structures have been removed. The contactors would use the barge-mounted derrick and a vibratory driver to install all new piles. The applicants' contractor estimates that up to 7 piles would be installed per day, with a daily maximum of 70 minutes of vibratory pile installation (Davido and Hart Crowser 2021 a, b). Any disconnected utilities would then be reconnected. Boatlifts, PWC lifts and moorage covers will be replaced as necessary.

D. Sabey Dock Replacement Project

The applicant would demolish the existing 985 square foot pier and build a 972 square foot replacement pier in the same foot footprint and configuration. The existing pier has a main walkway that is 100 feet long and 8 feet wide with an attached L-shaped finger. The perpendicular segment of the finger measures approximately 7 feet wide by 23 feet long, and the longitudinal segment is approximately 30 feet long by 3 feet wide (Figure 2). The proposed action would remove 24 existing 12-inch untreated timber piles, remove existing solid wood plank decking, and remove old lumber stringers and double fascia. New fully grated plastic decking with a minimum of 40 percent light penetration, new ACZA-treated lumber support beams and stringers, and two 8-inch and 14 new 6-inch galvanized steel piles would be installed (Figure 3). The pier would be raised from 6.5 inches to 18 inches above the OHWL. Four existing steel mooring piles would also be repaired using the sleeve method. The existing boat lift, opaque covered moorage (261 square feet), and double personal watercraft (PWC) lift would be retained and replaced once pier construction is completed. Other pier accessories including cleats, safety swim ladders, boatlift power box, and six dock lights (450 lumens each) would also be re-installed. No work is proposed on the existing concrete bulkhead.

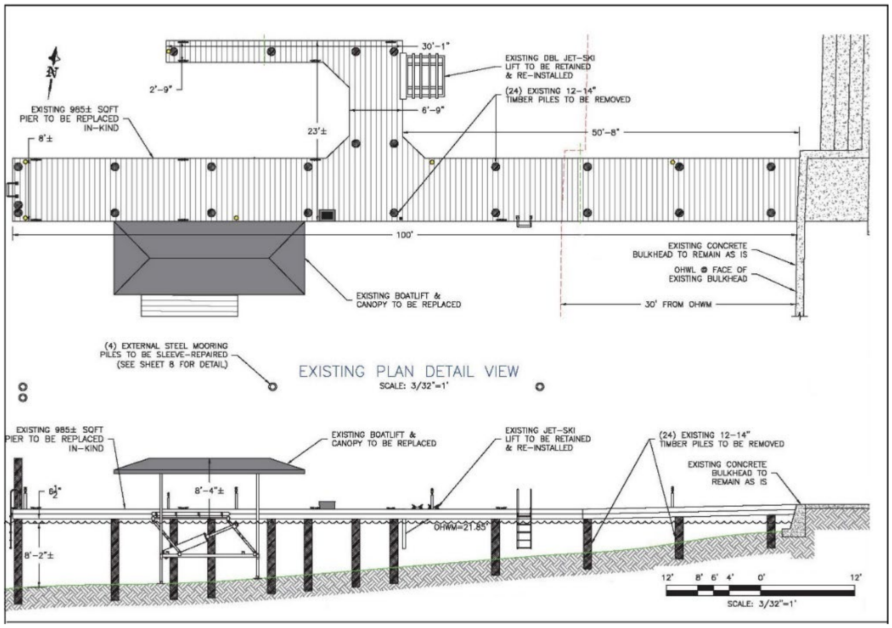

Figure 2. Plan drawings of the existing dock from above and in profile view (adapted with permission from Waterfront 2021c).

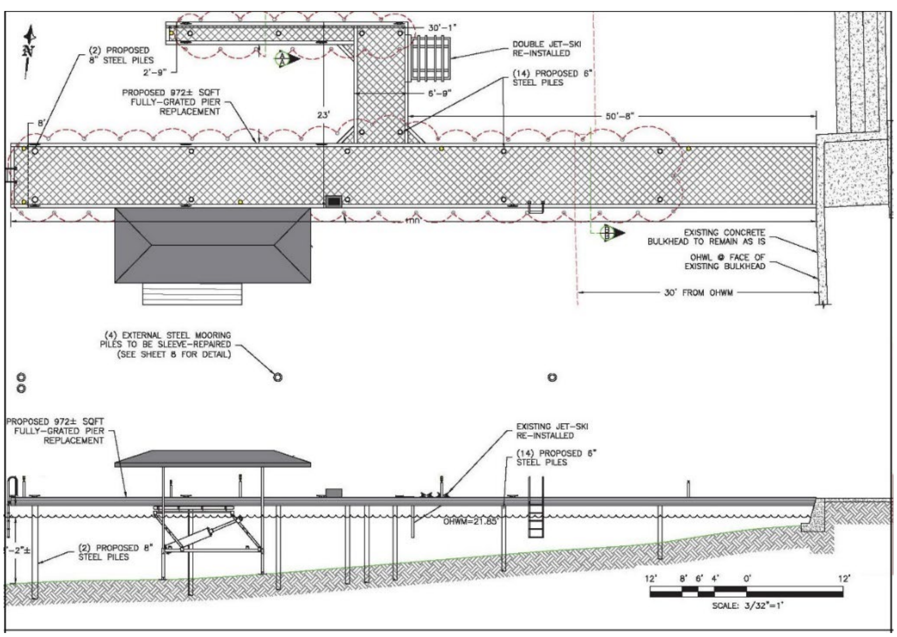

Figure 3. Plan drawings of the proposed replacement dock from above and in profile view (adapted with permission from Waterfront 2021c).

J. Sabey Site Repairs and Beach Cove Project

The applicant would repair an existing 887 square foot dock and retain one existing boat lift. The proposed action also includes repairs, maintenance, and improvements to a wood bulkhead and beach cove. The existing pier is polygonal-shaped, multi-segmented, and approximately 72.5 feet long and 8 feet wide, with an onshore segment that is nearly 20 feet wide (Figure 4).

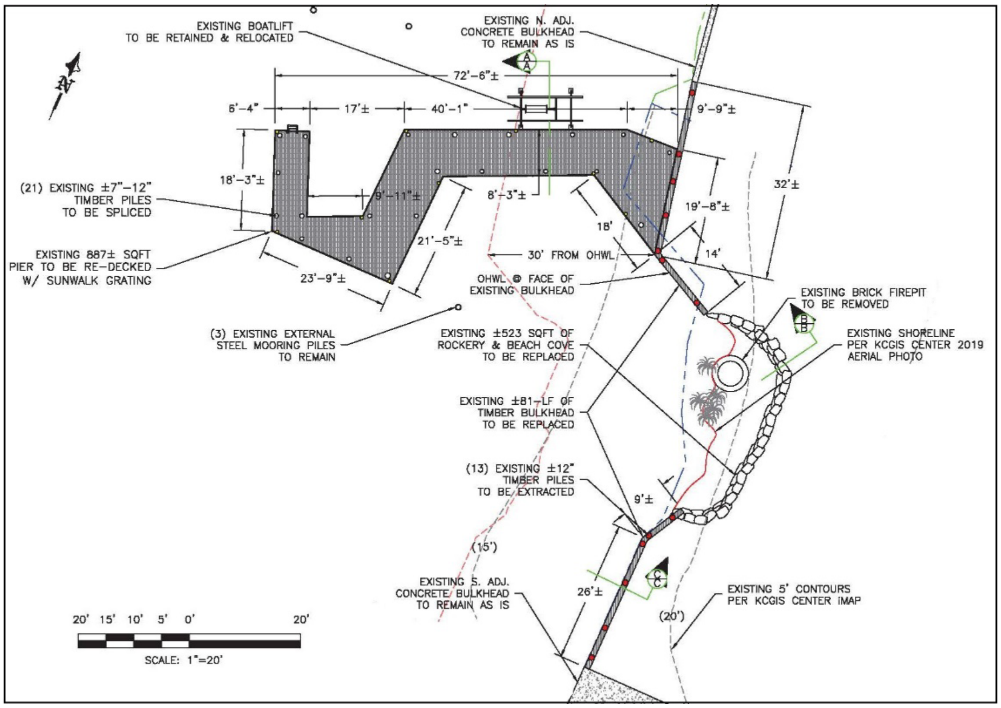

Figure 4. Plan drawings of the existing dock from above (adapted with permission from Waterfront 2021d).

New fully grated plastic decking with a minimum of 40 percent open space would replace the wood plank decking over the entire 887 square foot dock and the existing stringers and fascia would be retained. Twenty-one existing 12-inch timber piles supporting the dock would be repaired using the bonnet splice method and steel piles, with grout fill between the timber pile and bonnet for piles repaired at the mudline. During pile repair, excavation of existing sediment from the mudline down to approximately 3 feet below the mudline would occur. The pier will also be raised from 1/16-inch to 18 inches above the OHWL (Figure 5). A new fully grated 168 square foot boatlift would also be installed, increasing the total overwater footprint of the pier to 1,055 square feet. The applicant would replace and repair 81 linear feet of wooden bulkhead, including removing 13 12-inch creosote-treated timber piles, old timber lagging, and timber pile caps. The new bulkhead would be comprised of 14 epoxy-coated steel H-piles and approximately 304 square feet of timber sheet pile bulkhead constructed with 4-foot by 12-foot ACZA-treated lumber beams with a manta ray tieback sediment anchor system buried upland. All H-piles and sheet piles would be installed using a vibratory hammer until refusal. New timber caps would be placed on top of the H-piles.

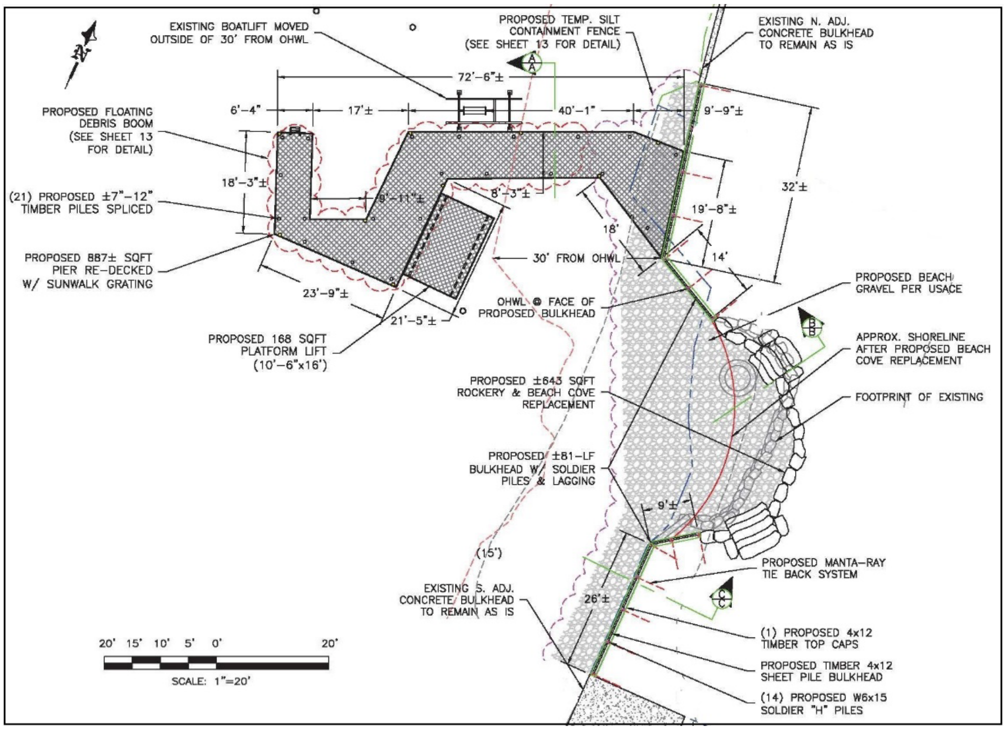

Figure 5. Plan drawings of the proposed dock from above (adapted with permission from Waterfront 2021d).

Upland excavation would be required in order to place and secure the manta ray tie back anchors. Approximately 7 cubic yards of crushed rock would be backfilled behind the new bulkhead. Once the bulkhead is complete, sediment in front of the replaced bulkhead would be re-graded to produce a more gradual slope, depth at the bulkhead face would be reduced from 18-inches to 8-inches, and 40 cubic yards of spawning gravel would be added below the OHWL (Figure 5; Waterfront 2021d). An existing brick fire pit ring located at the OHWL would be removed, and an existing 523 square foot upland area comprised of grass and approximately 65 cubic yards of large rocks and soil would also be removed. This area would be redeveloped to create a 643 square foot beach set back and cove. The sediment would be re-graded to create a more gradual slope and USACE-approved beach gravel would be placed below the OHWL. Other pier accessories including cleats, 10 dock lights (450 lumens each), and a safety swim ladder would also be re-installed once construction is complete (Figure 5).

The NMFS also considered whether or not the proposed action would cause any other activities. We determined that the action would extend, by several decades, the useful life of both piers, each with two vessels and one PWC lift. Therefore, the action would perpetuate the continued mooring and operation of approximately 4 vessels and two PWC in and around each these piers for decades to come. Consequently, we have included an analysis of the effects of vessel traffic and moorage at the piers in the effects section of this Opinion.

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

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or 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, the NMFS provide an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires 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.

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

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

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

2.1 Analytical Approach

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

CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

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

The designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The 2019 regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the regulations (84 FR 44977), that definition does not change the scope of our analysis and in this opinion we use the terms "effects" and "consequences" interchangeably.

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

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

2.2 Rangewide 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' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the PBFs that are essential for the conservation of the species.

The summaries that follow describe the status of the ESA-listed species, and their designated critical habitats, that occur within the action area and are considered in this opinion. More detailed information on the biology, habitat, and conservation status and trends of these listed resources can be found in the listing regulations and critical habitat designations published in the Federal Register and in the recovery plans and other sources at: https://www.fisheries.noaa.gov/species-directory/threatened-endangered, and are incorporated here by reference.

Listed Species

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

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

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

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

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

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

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

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

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

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

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

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

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

<u>Spatial Structure and Diversity:</u> The PS Sound Chinook salmon ESU includes all naturally spawning populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington. The ESU also includes the progeny of numerous artificial propagation programs (Ford 2022; 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 2019, the fraction of natural-origin spawners has declined across all MPGs in the last fifteen years (Ford 2022; NWFSC 2015).

<u>Abundance and Productivity:</u> Available data on total abundance since 1980 indicate that abundance trends have fluctuated between positive and negative for individual populations, but productivity remains low in most populations, and hatchery-origin spawners are present in high fractions in most populations outside of the Skagit watershed. Further, escapement levels for all populations remain well below the PSTRT planning ranges for recovery, and most populations consistently show flat or negative trends in adult spawner populations and spawner-recruits, levels below those identified by the PSTRT as consistent with recovery (Ford 2022; 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. In recent years, only 5 populations have had productivities above zero (Lower Skagit, Upper Skagit, Lower Sauk,

Upper Sauk, and Suiattle), all Skagit River populations in the Whidbey Basin MPG (Ford 2022). These data support our understanding of the continued decline of the ESU as described in the 2015 Status Review (Ford 2022; NWFSC 2015). The other four MPGs are considered to be at high risk of extinction due to low abundance and productivity (Ford 2022; NWFSC 2015). The most recent 5-year status review concluded that the ESU should remain listed as threatened (NMFS 2017a).

Table 2. Extant PS Chinook salmon populations in each biogeographic region (Ford 2022; Ruckelshaus et al. 2002).

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

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

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

PS Chinook Salmon within the Action Area: The PS Chinook salmon that are likely to occur in the action area would be fall-run Chinook salmon from the Cedar River population and from the North Lake Washington / Sammamish River population (NWFSC 2015; WDFW 2021c). Both stream- and ocean-type Chinook salmon are present in these populations, 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 2021d). Between 1965 and 2019, 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 2020 status review reported that the 2015 through 2019 5-year geometric mean for natural-origin spawner abundance had shown an overall positive change since the 2015 status review, with natural-origin spawners accounting for about 71% of the population (Ford 2022). Only 2 of the 22 populations showed a negative percent change during that 5-year timeframe. WDFW data also suggest that natural-origin spawners accounted for about 71% of a combined total return of 855 fish in 2019 (WDFW 2021d).

The North Lake Washington / Sammamish River population is also small, with a total abundance that has fluctuated between about 33 and 2,223 individuals from 1983 through 2019. Natural-origin spawners make up a small proportion of the total population, accounting for about 30% of the 365 total return in 2019, with a decreasing trend over the last five year period (Ford 2022; WDFW 2021d).

All returning adults and out-migrating juveniles of these two populations, as well as individuals that spawn in the numerous smaller streams across the basin, must pass through the action area to complete their life cycles. 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 and Lake Sammamish between January and July, primarily in the littoral zone (Tabor et al. 2006). Outmigration through the ship canal and past the action area to 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 NMFS adopted the recovery plan for this DPS in December 2019. In 2013, the Puget Sound Steelhead Technical Recovery Team (PSSTRT) identified 32 demographically independent populations (DIPs) within the DPS, based on genetic, environmental, and life history characteristics. Those DIPs are distributed among three geographically-based major population groups (MPGs); Northern Cascades, Central and South Puget Sound; and Hood Canal and Strait de Fuca (Myers et al. 2015) (Table 3).

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.

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 Creek Winter Run	Moderate
	Baker River Summer Run and Winter Run	Moderate
	Sauk River Summer Run and Winter Run	Moderate
	Stillaguamish River Winter Run	Low
	Deer Creek Summer Run	Moderate
	Canyon Creek Summer Run	Moderate
	Snohomish/Skykomish Rivers Winter Run	Moderate
	Pilchuck River Winter Run	Low
	North Fork Skykomish River Summer Run	Moderate
	Snoqualmie River Winter Run	Moderate
	Tolt River Summer Run	Moderate
Central and South Puget Sound	Cedar River Summer Run and Winter Run	Low
	North Lake Washington and Lake Sammamish Winter Run	Moderate
	Green River Winter Run	Low
	Puyallup River Winter Run	Low
	White River Winter Run	Low
	Nisqually River Winter Run	Low
	South Sound Tributaries Winter Run	Moderate
	East Kitsap Peninsula Tributaries Winter Run	Moderate
Hood Canal and Strait de Fuca	East Hood Canal Winter Run	Low
	South Hood Canal Tributaries Winter Run	Low
	Skokomish River Winter Run	Low
	West Hood Canal Tributaries Winter Run	Moderate
	Sequim/Discovery Bay Tributaries Winter Run	Low
	Dungeness River Summer Run and Winter Run	Moderate
	Strait of Juan de Fuca Tributaries Winter Run	Low
	Elwha River Summer Run and Winter Run	Low

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

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

Abundance and Productivity: Available data on total abundance since the late 1970s and early 1980s indicate that abundance trends have fluctuated between positive and negative for individual DIPs. However, low productivity persists throughout the 32 DIPs, with most showing downward trends, a few DIPs showing slight increases, and a few showing sharply downward trends (Ford 2022; Hard et al. 2015). Since the mid-1980s, trends in natural spawning abundance have also been temporally variable for most DIPs but remain predominantly negative, and well below replacement for at least 10 of the DIPs (Ford 2022). Smoothed abundance trends since 2009 show modest increases for 11 DIPs. 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. A comparison of the most recent two 5-year periods indicated positive percentage changes in spawner abundance for 14 of the DIPs (Ford 2022). For DIPs with recent 5-year abundance information, 6 out of 20 DIPs had achieved less than 10 percent of the recovery target abundance and all six populations were less than 250 fish (Ford 2022). Over the time series examined, the over-all abundance trends, especially for natural spawners, remain predominantly negative or flat across the DPS, and general steelhead abundance across the DPS remains well below the level needed to sustain natural production into the future (NWFSC 2015). The PSSTRT recently concluded that the PS steelhead DPS is currently not viable (Hard et al. 2015) and the Recovery Plan was finalized in December 2019 (NMFS 2019). Although most populations for which data is available experienced some increase in abundance over the last 5-year period, the DPS's current abundance and productivity are considered to be well below the targets needed to achieve delisting and recovery (Ford 2022). 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).

Limiting Factors: Factors limiting recovery for PS steelhead include:

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

PS Steelhead within the Action Area: The PS steelhead populations that occur in the action area consist of winter-runs from the Cedar River and North Lake Washington / Lake Sammamish DIPs (NWFSC 2015; WDFW 2021c). Both DIPs are among the smallest within the DPS. 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 (WDFW 2021e). 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 2021e). Two DIPs in the Lake Washington watershed, North Lake Washington Tributaries and Cedar River, had adult abundances near zero, based on fish ladder counts (Chittenden Locks) and Landsburg Dam (Cedar River) and redd counts (Ford 2022); however, large numbers of resident *O. mykiss* are found in the Cedar River (Cram et al. 2018).
The Sammamish River population is even smaller. WDFW reports that the total abundance for PS steelhead in the North Lake Washington / Lake Sammamish basin fluctuated between 0 and 916 individuals between 1984 and the last survey in 1999, with a strong negative trend. Abundance never exceeded 45 fish after 1992, and was only 4 in 1999 (WDFW 2021e). NWFSC (2015) disagrees with WDFW in that returns may have been above 1,500 individuals during the mid-1980s, but NWFSC agrees with the steep decline to virtually no steelhead in the basin since 2000.

All returning adults and out-migrating juveniles of these two populations must pass the action area to complete their life cycles. 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.

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.

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

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

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

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

Diking, agriculture, revetments, railroads and roads in lower stream reaches have caused significant loss of secondary channels in major valley floodplains in this region. Confined main channels create high-energy peak flows that remove smaller substrate particles and large wood. The loss of side-channels, oxbow lakes, and backwater habitats has resulted in a significant loss of juvenile salmonid rearing and refuge habitat. When the water level of Lake Washington was lowered 9 feet in the 1910s, thousands of acres of wetlands along the shoreline of Lake Washington, Lake Sammamish and the Sammamish River corridor were drained and converted to agricultural and urban uses. Wetlands play an important role in hydrologic processes, as they store water which ameliorates high and low flows. The interchange of surface and groundwater in complex stream and wetland systems helps to moderate stream temperatures. Thousands of acres of lowland wetlands across the region have been drained and converted to agricultural and urban uses, and forest wetlands are estimated to have diminished by one-third in Washington State (FEMAT 1993; Spence et al. 1996; SSPS 2007).

Loss of riparian habitat, elevated water temperatures, elevated levels of nutrients, increased nitrogen and phosphorus, and higher levels of suspended sediment, presumably from urban and highway runoff, wastewater treatment, failing septic systems, and agriculture or livestock impacts, have been documented in many Puget Sound tributaries (SSPS 2007).
Peak stream flows have increased over time due to paving (roads and parking areas), reduced percolation through surface soils on residential and agricultural lands, simplified and extended drainage networks, loss of wetlands, and rain-on-snow events in higher elevation clear cuts (SSPS 2007). In urbanized Puget Sound, there is a strong association between land use and land cover attributes and rates of coho spawner mortality likely due to runoff containing contaminants emitted from motor vehicles (Feist et al. 2011).

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

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

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

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

Critical Habitat within the Action Area: Critical habitat has been designated for PS Chinook salmon along the entire length of the Lake Washington Ship Canal, all of Lake Washington, about 950 yards upstream into in the Sammamish River, and well upstream into the Cedar River watershed. The critical habitat within the Lake Washington project area primarily provides the Freshwater Migration PBF for PS Chinook (NOAA 2021; WDFW 2021c).

2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).

The applicants' project sites are located the along the eastern shore of Lake Washington approximately 2 miles west of Route 405 and 0.35 miles north of the Route 520 Bridge in Hunts Point, Washington (Figure 1). As described in section 2.5, construction-related and structure-related water quality effects would be the stressor with the greatest range of direct and indirect effects on fish. The affected area would be limited to the waters and substrates within about 300 feet around pile removal work and tugboat operations at each of the two docks. However, trophic connectivity between PS Chinook salmon and the SR killer whales that feed on them extends the action area to the marine waters of Puget Sound. The described area overlaps with the geographic ranges of the ESA-listed species and the boundaries of designated critical habitats identified in Table 1. The action area also overlaps with areas that have been designated, under the MSA, as EFH for Pacific Coast salmon, Pacific Coast groundfish, and coastal pelagic species.

2.4 Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

Environmental conditions at the project sites and the surrounding area: The project sites are adjacent properties owned by different residents. Both are located along the eastern shore of Lake Washington approximately 2 miles west of Route 405 and 0.35 miles north of the Route 520 Bridge in Hunts Point, Washington (Figure 1). Although the action area includes the marine waters of Puget Sound, all detectable effects of the action would be limited to Lake Washington within about 300 feet around each of the two piers (Sections 2.5 & 2.12). Therefore this section focuses on habitat conditions in Lake Washington, and does not discuss Puget Sound habitat conditions.

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, the Cedar River did not enter the lake, and Lake Washington's waters flowed south to the Duwamish River via the now absent Black River. In the 1880s, dredging and excavation was started to create a navigable passage between Lake Washington and the marine waters of Shilshole Bay. 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.

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 point and nonpoint pollution sources including past sewage discharges. Ongoing sources include stormwater discharges and subsurface runoff containing pollutants from roadways, failing septic systems, underground petroleum storage tanks, and fertilizers and pesticides from commercial and residential sites. 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).
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, with only small scattered patches of natural riparian growth remaining (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 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. Numerous piers and docks create harsh over-water shadows that limit aquatic productivity and hinder shoreline migration of juvenile salmon. 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).

The date that the applicants' docks were originally built is unknown. Shoreline vegetation at the sites is absent, and consists primarily of lawn and armored shoreline. A concrete and wooden bulkhead lines the properties' shoreline, extending above and below the OHWL to a depth of approximately 2 feet. Lake substrate at the site is dominated by gravelly medium to fine sand with occasional cobble, and submerged aquatic vegetation is largely absent. The depth of the lake under the two piers range from 18 inches nearshore to 9.5 feet at the offshore end of the piers. The upland portion of the sites each consists of a large lawn and a single family residence.

No water or sediment contamination is indicted at either of the sites on the Washington State Department of Ecology (WDOE) Water Quality Atlas Map website (WDOE 2021). However, the long-term presence of creosote-treated timber piles at the J. Sabey site suggests that some level of contamination by Polycyclic Aromatic Hydrocarbons (PAHs) likely exists in the water and sediments under and around the piers. Additionally, piers' artificial shorelines and overwater structures likely induce migratory delays for juvenile salmonids, and provide habitat conditions that favor piscivorous fish such northern pikeminnow, smallmouth bass, and largemouth bass that prey on juvenile salmonids.

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

Decreases in summer precipitation of as much as 30% by the end of the century are consistently predicted across climate models (Mote et al. 2014). Precipitation is more likely to occur during October through March, less during summer months, and more winter precipitation will be rain than snow (ISAB 2007; Mote et al. 2013 and 2014). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and reduced snowpack also can lead to lower minimum flows and higher stream temperatures in summer (ISAB 2007; Mote et al. 2014; USGCRP 2018). Summer precipitation is projected to decline, exacerbating low flows and high stream temperatures in the western U.S. 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). Projections of climate change in the western U.S. (USGCRP 2018) indicate that these trends are likely to continue.

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 3.5-5.3ºC increases in Columbia Basin streams and a peak temperature of 26ºC in the Willamette (Ford 2022; NWFSC 2015). Over the last five year period much of the Pacific Northwest experienced high stream temperatures, low spring precipitation, and reduced winter snowpack, leading to widespread adult spawner mortality and reduced production for salmon (Ford 2022). 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). Further, surface temperatures in the northeast Pacific Ocean were at record high temperatures for much of the period from fall 2013-2019 (Ford 2022).

Higher temperatures will reduce the quality of available salmonid habitat for most freshwater life stages (ISAB 2007; Mauger et al. 2015). 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; Mauger et al. 2015). Temperature increases shift timing of key life cycle events for salmonids and species forming the base of their aquatic food webs (Crozier et al. 2011; Tillmann and Siemann 2011; Winder and Schindler 2004). Higher stream temperatures will also cause decreases in dissolved oxygen and may also cause earlier onset of stratification and reduced mixing between layers in lakes and reservoirs, which can also result in reduced oxygen (Meyer et al. 1999; Raymondi et al. 2013; Winder and Schindler 2004). Higher temperatures are likely to cause several species to become more susceptible to parasites, disease, and higher predation rates (Crozier et al. 2008; Raymondi et al. 2013; Wainwright and Weitkamp 2013).

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

The adaptive ability of these threatened and endangered species is depressed due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation.

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

2.5 Effects of the Action

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

The USACE would authorize the applicant to perform in and over-water work at two residential docks on Lake Washington. The applicants would perform about two to four weeks of work per dock during the July 16 to March 15 work window. As part of that work, they would remove 37 timber piles (24 untreated and 13 creosote-treated), splice 21 untreated timber piles, install 14 galvanized steel H-piles, and install 14 6-inch diameter galvanized steel piles. They would also repair and replace elements of a wood bulkhead and create a beach cove.

The effects of the proposed work can be characterized as temporary effects associated with construction, and long-term effects associated with the structure and its use. The construction effects include noise, water quality diminishment, modified substrate, artificial illumination, overwater shading, and diminished prey base. 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. The USACE's authorization of the construction would extend the operational life of the both piers and the bulkhead by several decades beyond their existing conditions. Over that time, both piers' and bulkheads' presence and normal operations would affect fish and habitat resources through over-water shading, pier-related water and forage contamination, elevated vessel noise, and propeller wash. The action would perpetuate the continued mooring and operation of approximately 4 vessels and two PWC in and around these piers for decades to come.

The action's in-water work windows avoid the normal migration season for returning adult PS Chinook salmon, but any work between December 31 and March 15 would overlap with the early part of emigration season for juveniles, which begin to enter Lake Washington in January. As such, adult PS Chinook salmon are extremely unlikely to present during the proposed in-water work, but low numbers of juveniles could be present. The work window also overlaps slightly with the normal migration seasons for juvenile and adult PS steelhead. However, PS steelhead are very rare in the Lake Washington watershed, which supports the expectation that it is very unlikely that any PS steelhead would be within the action area during the proposed in-water work. Therefore, it is extremely unlikely that adult PS Chinook salmon or any life stage of PS steelhead would be exposed to the direct effects of the proposed action. However, low numbers of juvenile Chinook salmon are likely to be exposed to the direct effects of construction, and over the decades-long life of the repaired pier, it is very likely that shoreline-obligated juveniles of both species would pass through the project area during their annual out-migration seasons, where they would be exposed to the action's indirect effects identified above. Adults of both species are much less likely to swim through the project area, and are also much less likely to be measurably affected by exposure to those indirect effects. The PBFs of PS Chinook salmon critical habitat would also be exposed to the action's direct and indirect effects. Similarly, regarding the long-term effects of the proposed action, adult salmonids of either species are not likely to linger in the action area to have sufficient exposure to the habitat effects to produce any detectable response. For this reason, the remainder of this analysis will focus on juvenile PS Chinook and juvenile steelhead.

2.5.1 Effects on Listed Species

Construction-related Noise

Juvenile Chinook salmon are likely to be adversely affected by construction-related noise from tugboat operations, construction and repair of the two piers and bulkhead, and vibratory pile installation and removal. Noise would temporarily alter aquatic habitat when the construction vessel is in operation (transiting or repositioning) and when in-water work is being conducted. The vibrations which travel through the water can make the habitat less suitable for juvenile Chinook salmon by making both prey and predators harder for juveniles to detect while the sound is occurring. This habitat disruption would be ephemeral and episodic over the 4-week work period at each project site.

The effects caused by a fish's exposure to noise vary with the hearing characteristics of the fish, the frequency, intensity, and duration of the exposure, and the context under which the exposure occurs. At low levels, effects may include the onset of behavioral disturbances such as acoustic masking (Codarin et al. 2009), startle responses and altered swimming (Neo et al. 2014), abandonment or avoidance of the area of acoustic effect (Mueller 1980; Picciulin et al. 2010; Sebastianutto et al. 2011; Xie et al. 2008) and increased vulnerability to predators (Simpson et al. 2016). At higher intensities and/or longer exposure durations, the effects may rise to include temporary hearing damage (a.k.a. temporary threshold shift or TTS, Scholik and Yan 2002) and increased stress (Graham and Cooke 2008). At even higher levels, exposure may lead to physical injury that can range from the onset of permanent hearing damage (a.k.a. permanent threshold shift or PTS) and mortality. The best available information about the auditory capabilities of the fish considered in this opinion suggest that their hearing capabilities are limited to frequencies below 1,500 Hz, with peak sensitivity between about 200 and 300 Hz (Hastings and Popper 2005; Picciulin et al. 2010; Scholik and Yan 2002; Xie et al. 2008).

The NMFS uses two metrics to estimate the onset of injury for fish exposed to high intensity impulsive sounds (Stadler and Woodbury 2009). The metrics are based on exposure to peak sound level and sound exposure level (SEL). Both are expressed in decibels (dB). The metrics are: 1) exposure to 206 dB_{peak}; and 2) exposure to 187 dB SEL_{cum} for fish 2 grams or larger, or

183 dB SEL_{cum} for fish under 2 grams. Further, any received level (RL) below 150 dB_{SEL} is considered “Effective Quiet”. The distance from a source where the RL drops to 150 dB_{SEL} is considered the maximum distance from that source where fishes can be affected by the noise, regardless of accumulation of the sound energy (Stadler and Woodbury 2009). Therefore, when the range to the 150 dB_{SEL} isopleth exceeds the range to the 187 dB SEL_{cum} isopleth, the distance to the 150 dB_{SEL} isopleth is the range at which detectable effects would begin, with the 187 dB SEL_{cum} isopleth identifying the distance within which sound energy accumulation would intensify effects. However, when the range to the 150 dB_{SEL} isopleth is less than the range to the 187 dB SEL_{cum} isopleth, only the 150 dB_{SEL} isopleth would apply because fish would be extremely unlikely to detect or be affected by the noise outside of the 150 dB_{SEL} isopleth. For all project-related sources, the ranges to the SEL_{cum} threshold isopleths exceed the range to 150 dB_{SEL} effective quite isopleth. Therefore, this assessment considers the range to the effective quite isopleths as the maximum ranges for acoustic effects.

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

As described in the proposed action section, the project would include the vibratory extraction of 37 12-inch timber piles, and the vibratory installation of 14 6-inch and 2 8-inch steel pipe piles, and 14 14-inch steel H-piles. Elevated in-water noise at levels capable of causing detectable effects in exposed fish would also be caused by tugboat operations.

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 similar projects (NMFS 2017b, 2018), and in other sources (Blackwell and Greene 2006; CalTrans 2015; Richardson et al. 1995). Based on the best available information, all project-related SLs would be below the 206 dB_{peak} threshold for the onset of instantaneous injury in fish (Table 5).

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

Source	Acoustic Signature	Source Level	Threshold Range
Vibratory Install 8-inch Steel Pipe piles	< 2.5 kHz Non-Impulsive	183 dB_{peak}	206 @ N/A
Episodic brief periods measured in hours		167 dB_{SEL}	150 @ 14 m
Vibratory Extraction 12-inch Timber piles	Non-Impulsive	180 dB_{peak}	206 @ N/A
Episodic brief periods measured in minutes		170 dB_{SEL}	150 @ 22 m
Vibratory Install 14-inch Steel H-piles	Non-Impulsive	190 dB_{peak}	206 @ N/A
Episodic brief periods measured in hours		177 dB_{SEL}	150 @ 63 m
Tugboat Propulsion	< 1 kHz Combination	185 dB_{peak}	206 @ N/A
Episodic brief periods measured 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 measured in minutes		165 dB_{SEL}	150 @ 10 m

The best available information for vibratory installation of 14-inch steel H-piles (CalTrans 2015; NMFS 2017b; WSDOT 2011) supports the understanding that the source level for that work would be about 190 dB_{peak} and 177 dB_{SEL}. Similarly, the best available information, as summarized in an acoustic assessment for a project that involved the vibratory installation of 8-inch diameter steel pipe piles (NMFS 2015), the source level for that work would be about 183 dB_{peak} and 167 dB_{SEL}, and the source level for vibratory installation of 6-inch diameter steel pipe piles would likely be slightly lower. The source level for tugboat operations would be about 185 dB_{peak} and 170 dB_{SEL}.

In the absence of location-specific transmission loss data, variations of the equation RL = SL – #Log(R) are often used to estimate the received sound level at a given range from a source (RL = received level (dB); SL = source level (dB, 1 m from the source); # = spreading loss coefficient; and R = range in meters (m). Numerous acoustic measurements in shallow water environments support the use of a value close to 15 for projects like this one (CalTrans 2015). This value is considered the practical spreading loss coefficient, and was used for all sound attenuation calculations in this assessment.

Application of the practical spreading loss equation to the expected SLs suggests that noise levels of 150 dB_{SEL} would extend up to 207 feet (63 m) from the vibratory installation of 14-inch steel H-piles, 72 feet (22 m) from vibratory extraction of timber piles and around tugboat operations, 46 feet (14 m) from vibratory installation 8-inch steel piles, and 33 feet (10 m) from a 23 foot power boat, which is a proxy for a work boat (Table 5).

The applicant reported a daily maximum of 70 minutes of vibratory installation for the installation of up to 7 piles per day, which suggests 10 minutes of vibratory installation per pile. No estimate was given for the daily total duration for vibratory extraction. However, numerous consultations for similar actions support the expectation that an average of about 30 minutes of vibratory installation could be required per pile, and that an average of about 15 minutes vibratory pile extraction could be required per pile. With that information in mind, this assessment assumes that about 10 piles could be extracted per day, each requiring about 15 minutes of vibratory extraction work (up to 150 minutes of vibratory extraction work per day). All 37 piles could be removed over 4 days of extraction work at that rate, but work delays could cause the work to extend across more than 4 days.

Similarly, the applicant's plan to install up to 7 piles per day means that at least 5 days of vibratory pile work would be required to install the 30 steel piles that are planned for this project, and that up to 210 minutes of vibratory work could occur per day. Again, work delays could cause the work to occur across more than 5 days.

Therefore, to avoid underestimating the potential duration of exposure to the project's pile extraction and installation noise, this assessment assumes all pile work would be completed within a 4-week period, during which a maximum of 210 minutes of the loudest pile installation (177 dB_{SEL} for 14-inch H-piles) could occur during any workday. For this assessment, we assume a 6-day work week, for a total of 24 potential pile driving days.

Also, although not specified by the applicant, this assessment assumes that a minimum of 12 hours of no pile extraction or installation work would elapse between the stop and start of sequential pile work days. The 12-hour period of no pile work is intended to allow exposed fish to recover fully from any potential effects from exposure to piling driving noise, and prevent accumulated acoustic impacts from occurring over multiple days.

The frequency and duration of project-related tugboat operations is uncertain, but would likely consist of 1- to 3-hour periods of relatively continuous operation during any day they are used during construction.

Juvenile Chinook salmon that remain outside of the 150 dB_{SEL} isopleths for these sources would be unaffected by the noise. However, fish within the 150 dB_{SEL} isopleth are likely to experience a range of effects that would depend on their distance from the source and the duration of their exposure. All 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. It is doubtful that any individuals would approach close enough and remain long enough to accumulate sound energy in excess of 183 dB SELcum threshold. However, if any do, they may also experience some level of auditory- and non-auditory tissue injury, which could reduce their likelihood of their long-term survival.

The numbers of juvenile PS Chinook salmon that may be impacted by this stressor is unquantifiable with any degree of certainty. However, the relatively small affected areas around the piers, the multiple routes available to emigrating juveniles of both species, and the knowledge that the majority of their typical emigration seasons are well outside of the work window supports our expectation that only a small subset of the construction year's cohort of juvenile PS Chinook salmon would pass through the area of acoustic effect. Further, the typically episodic and short-duration nature of action-related noises, combined with the juvenile salmonids typical migratory behavior in the lake, suggest that the probability and duration of exposure to construction-related noise would be very low for any individual fish, and the number of fish exposed to construction-related noise would comprise such a small subset of their cohort that any that are injured or killed due to the exposure would cause no detectable population-level effects.

Construction-related Water Contamination

Juvenile Chinook salmon are likely to be adversely affected during exposure to short-term diminishments in water quality (turbidity and contaminants) during construction most acutely within a 300 foot radius of the pier. These are likely to be episodic ephemeral diminishments, lasting up to several hours in each instance. These diminishments come from the use of the barge-associated tugboat, pile installation and removal, and removal of creosote-treated piles. The proposed action may also temporarily reduce dissolved oxygen concentrations, and may also temporarily introduce toxic materials from equipment-related spills and discharges. Direct exposure to water-borne pollutants can cause effects that range from avoidance behaviors, to reduced growth, altered immune function, and immediate mortality. The intensity of effects depends largely on the pollutant, its concentration, and/or the duration of exposure (Beitinger and Freeman 1983; Brette et al. 2014; Feist et al. 2011; Gobel et al. 2007; Incardona et al. 2004 and 2005; McIntyre et al. 2012; Spromberg et al. 2015). Beitinger and Freeman (1983) report that fish possess acute chemical discrimination abilities and that very low levels of some water-borne contaminants can trigger strong avoidance behaviors. Although the turbidity and toxics concentrations are unlikely to be directly injurious to exposed juvenile Chinook salmon, the avoidance of the turbidity and/or contaminants would have similar effects on the exposed individuals as those described above under construction-related noise, and may act synergistically with construction noise to increase the likelihood and/or intensity of reduced fitness and increased mortality risk in the exposed individuals.

Suspended Sediment: Based on previous consultations for similar projects, the NMFS anticipates that exposure to Total Suspended Solids (TSS) will be at low concentrations over short duration so that we expect only brief behavioral or physical responses below the level of injury such as avoidance of the plume, mild gill flaring (coughing), and slightly reduced feeding rates in any juvenile Chinook salmon that may be exposed to it. Pile removal, pile installation, excavation and runoff associated with bulkhead repairs, and tugboat propeller wash would mobilize bottom sediments that would cause episodic, localized, and short-lived turbidity plumes. 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.

Water quality is considered adversely affected by suspended sediments when turbidity is increased by 20 NTU for a period of 4 hours or more (Berg and Northcote 1985; Robertson et al. 2006). The effects of turbidity on fish are somewhat species and size dependent. In general, severity typically increases with sediment concentration and duration of exposure, and decreases with the increasing size of the fish. Bjornn and Reiser (1991) report that adult and larger juvenile salmonids appear to be little affected by the high concentrations of suspended sediments that may be mobilized during storm and snowmelt runoff episodes. However, empirical data from numerous studies report the onset of minor physiological stress in juvenile and adult salmon after one hour of continuous exposure to suspended sediment concentration levels between about 1,100 and 3,000 mg/L, or to three hours of exposure to 400 mg/L, and seven hours of exposure to concentration levels as low as 55 mg/L (Newcombe and Jensen 1996). The authors reported that serious non-lethal effects such as major physiological stress and reduced growth were reported after seven hours of continuous exposure to 400 mg/L and 24 hours of continuous exposures to concentration levels as low as about 150 mg/L.

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 diameter 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, no tube to hold packed-in sediments, and because they are imbedded only about 4 feet deep at these piers (Waterfront 2021a, b). Therefore, the mobilization of bottom sediments, and resulting turbidity from the planned pile removal and installation is likely to be less than that reported by Bloch (2010).

Tugboat propeller wash would also mobilize bottom sediments. The intensity and duration of the resulting turbidity plumes are uncertain, and 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 (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 hours and extended far from the event, but the TSS concentration fell to 30 mg/L within 1 hour and to 15 mg/L within 3 hours. At its highest concentration, the plume was below the concentrations required to elicit physiological responses reported by Newcombe and Jensen (1996). The exact extent of turbidly plumes from tugboat operations for this project are unknown, but it is extremely unlikely that they would rise to the levels described above. Project-related tugboat trips would be infrequent, and would likely last a low number of hours while work barges are repositioned. Therefore, the resulting propeller wash turbidity plumes would be low in number and episodic. The intensity and duration of the resulting turbidity plumes are uncertain. However, based on the information above, and on numerous consultations for similar projects in the region, sediment mobilization from tugboat propeller wash would likely consist of relatively low-concentration plumes that could extend up to about 300 feet from the site, and last a low number of hours after the disturbance ends.

Excavation of 523 square feet of upland rocks and sediment, as well as possible project site runoff, would occur during the creation of the beach cove which would mobilize lakebed and upland sediment. However, that work would occur behind sediment containment curtains which would contain the majority of mobilized sediments. Further, the project includes required turbidity monitoring, with shut-down and correction would be required if turbidity exceeded State standards. However, if sediment were to escape from the contained work area it would likely consist of relatively low-concentration plumes that would extend less than 300 feet from the site, and last a low number of hours after the disturbance ends.

Based on the best available information, construction-related turbidity concentrations would be too low and short-lived 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 in any PS Chinook salmon that may be exposed to it. However, behavioral effects such as avoidance of the sediment plume may, in combination with other water quality effects, reduce fitness for a small number of individual fish.

<u>Dissolved Oxygen:</u> Mobilization of anaerobic sediments can decrease dissolved oxygen levels (Hicks et al., 1991; Morton 1976). The impact on dissolved oxygen is a function of the oxygen demand of the sediments, the amount of material suspended in the water, the duration of suspension, and the water temperature (Lunz and LaSalle 1986; Lunz et al. 1988). Reduced dissolved oxygen can affect salmonid swimming performance (Bjornn and Reiser 1991), as well as cause avoidance of water with low dissolved oxygen levels (Hicks 1999). However, the small amount of sediments that would be mobilized suggests that any dissolved oxygen reductions would be too small and short-lived to cause detectable effects in exposed fish, and therefore would not adversely affect PS Chinook salmon. Additionally, all pile extraction, pile installation, and excavation would be done within full-depth sediment curtains that would reduce the potential for fish exposure to waters with reduced dissolved oxygen levels related to that work.

<u>PAHs:</u> Toxic materials may enter the water through construction-related spills and discharges, the mobilization of contaminated sediments, periodic discharge of petroleum-based fuels and lubricants into the water from construction vessels, and/or the release of toxins from creosote-treated timber piles in the bulkhead during their removal. Petroleum-based fuels and lubricants contain Polycyclic Aromatic Hydrocarbons (PAHs) that are known to be harmful to fish and other aquatic organisms during development and during adulthood, specifically for cardiac development and function (Incardona et al. 2004; Incardona et al. 2005). However, vessel discharges near the project sites are likely to occur relatively infrequently, with the majority being very small. Additionally, some of the pollutants may evaporate relatively quickly (Werme et al. 2010), and currents would help to disperse the pollutants. 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). 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 (Beitinger and Freeman 1983; Brette et al. 2014; Feist et al. 2011; Gobel et al. 2007; Incardona et al. 2004, 2005, 2006; Mcintyre et al. 2012; Meadore et al. 2006; Sandahl et al. 2007; Spromberg et al. 2015).

The project includes BMPs specifically intended to reduce the risk and intensity of discharges and spills during construction, tugboat, and barge operations. In the unlikely event of a construction-related spill or discharge, the event would likely be very small, quickly contained and cleaned. Additionally, 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.

No sediment contamination is indicted on the WDOE Water Quality Atlas Map website for either of the two sites (WDOE 2021). However, it is unknown how long the bulkhead has been in the lake and creosote-treated piles leach PAHs into the surrounding sediments, as well as directly into the water (Evans et al. 2009; Parametrix 2011; Smith 2008; Werme et al. 2010). Further, a long history of recreational boat operations in Lake Washington and the surrounding area supports the belief that at least some level of sediment contamination likely exists at the sites. Therefore, the sediments that would be mobilized during 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.

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. Additionally, all pile extraction, pile installation and excavation would be done within full-depth sediment curtains that would reduce the potential for fish exposure to waters with reduced dissolved oxygen levels related to that work. However, tugboat operation after the sediment curtains are removed could remobilize contaminated sediments. The NMFS estimates that tugboat mobilized sediments wouldn't exceed 300 feet and one hour after the cessation of work. In the unlikely event of exposure to waterborne contaminants outside of the full-depth sediment curtains, effects would likely be limited to temporary non-lethal behavioral effects. Similar to those described above for turbidity, behavioral of the area may, in combination with other water quality effects, reduce fitness for a small number of individual fish.

The planned removal of 13 creosote-treated piles would reduce the amount of creosote-treated timber that is in contact with lake waters and are sources of ongoing PAH contamination at the bulkhead. This is likely to cause some long-term improvement of water quality at the project site. However, the amount of improvement and the exact effects it may have on salmonids and their habitat resources within the project area is uncertain, particularly given the other sources of contamination that would remain in the general area after the project is complete.

The numbers of juvenile PS Chinook salmon that may be impacted by this stressor is unquantifiable with any degree of certainty. However, the relatively small affected areas around the project sites, the multiple routes available to emigrating juveniles of both species, and the knowledge that the majority of their typical emigration seasons are well outside of the work window supports our expectation that only a small subset of the construction year's cohort of juvenile PS Chinook salmon would pass through the affected water column. Further, the typically episodic and short-duration nature of action-related water quality impacts, combined with the juvenile salmonids typical migratory behavior in the lake, suggest that the probability and duration of exposure to construction-related water contamination would be very low for any individual fish, and the number of fish exposed to construction-related water contamination would comprise such a small subset of their cohort that any that are injured or killed due to the exposure would cause no detectable population-level effects.

Construction-related Propeller Wash and Scour

Exposure to construction-related propeller wash would adversely affect juvenile PS Chinook salmon, but it is extremely unlikely that adult PS Chinook salmon or any life stage of PS steelhead would be exposed to this stressor. During project work, vessel operations by the barge tugboat would cause propeller wash within the project area. Spinning boat propellers kill fish and small aquatic organisms (Killgore et al. 2011; VIMS 2011). Spinning propellers also generate fast-moving turbulent water (propeller wash) that can displace and disorient small fish, as well as dislodge benthic aquatic organisms and submerged aquatic vegetation (SAV), particularly in shallow water and/or at high power settings. Juvenile fish that are near the propeller when it is started, or in the transit route of the boat while the propeller is operating can be injured. Juvenile Chinook salmon and steelhead in the action area are likely to remain close to the surface where they may be exposed to spinning propellers and powerful propeller wash near the pier. Juvenile salmonids do not have the swim strength or speed of adult fish which are able to quickly maneuver away from the vortex of an operating boat motor.

Although the likelihood of this interaction is very low for any individual juvenile fish or individual boat trip, it is very likely that during construction work window, at least some juvenile PS Chinook salmon would experience injury or mortality from exposure to spinning propellers and/or propeller wash. Such an event could occur multiple times during the work window, though the number of fish harmed in any given episode is expected to be very low (single digits). Therefore, the numbers of juvenile PS Chinook salmon that may be exposed to construction-related propeller wash would represent such a small subset of their respective cohorts that their loss would cause no detectable population-level effects.

Propeller scour may also reduce SAV and diminish the density and diversity of the benthic community at the project site. However, the disturbances would be brief, the affected areas would likely consist of a tiny portion of the SAV- and invertebrate-supporting substrate in the immediate area, and the disturbed SAV and invertebrates would likely recover very quickly after work is complete. The expectation that low power settings would be used when maneuvering near the piers suggest that propeller scour would have negligible effects on benthic resources at the two sites. Therefore, the effects of construction-related propeller scour would be too small to cause any detectable effects on the fitness and normal behaviors of juvenile Chinook salmon and juvenile steelhead in the action area.

Construction-related Diminished Prey Base

Exposure to construction-related contaminated forage, sediment disturbance during pile installation and removal, and sediment removal during bulkhead repair, and beach cove construction would cause short- and long-term adverse effects to juvenile PS Chinook salmon and juvenile PS steelhead. It is extremely unlikely that adults of either species would be exposed to this stressor. However, juvenile salmon feed on planktonic organisms such as amphipods, copepods, and euphausiids, as well as the larvae of many benthic species and fish that would be negatively impacted by the sediment disturbance during construction (NMFS 2006). Increased levels of contaminants, sediment removal and disturbance during bulkhead repair, and beach cove construction may diminish the number, size, and species diversity of prey types available to foraging juvenile salmonids. The removal of 13 creosote-treated timber piles from the bulkhead would temporarily re-suspend small amounts of contaminated subsurface sediments at each pile that would settle onto the top layer of the substrate, where, through the trophic web, contaminants such as PAHs and PCBs would remain biologically available to juvenile PS Chinook salmon and PS steelhead for years. This effect is most intense near the piers and bulkhead, but over time once the creosote is removed, levels of contaminants would decline.

When juvenile fish encounter areas of diminished prey, competition for those limited resources increases, and less competitive individuals are forced into suboptimal foraging areas (Auer et al. 2020). Further, individuals with an inherently higher metabolism tend to be bolder and competitively dominant, and may outcompete other individuals for resources within a microhabitat, potentially increasing interspecific mortality (Biro and Stamps 2010).

Some subset of the juvenile PS Chinook salmon and juvenile PS steelhead that emigrate through Lake Washington are likely to pass through the project area each year. During their transit through the project area, at least some of those juveniles are likely to feed on the invertebrate resources near the piers, some of which would be affected by construction-related contaminants and sediment disturbance. Based on the available information, the NMFS expects that some juvenile Chinook salmon and juvenile steelhead are likely to be exposed to construction-related reduced forage capable of causing some combination of reduced growth, increased susceptibility to infection, and increased mortality.

The number of years that detectable amounts of contaminants would be biologically available, as well as the annual numbers of juvenile PS Chinook salmon and juvenile PS steelhead that may be exposed to construction-related contaminated forage is unquantifiable with any degree of certainty. Similarly, the amount of contaminated prey that any individual fish may consume, or the intensity of any effects that an exposed individual may experience is uncertain, and would be highly variable over time. However, the relatively small amount of sediment that would be mobilized during construction suggests that the number of years that detectable contaminants would be present would be low, and the affected areas would also be relatively small, which further suggests that the probability of trophic connectivity to the contamination would be very low for any individual fish. Therefore, the numbers of juvenile Chinook salmon and juvenile PS steelhead that would be annually exposed to construction-related contaminated prey would likely comprise such small subsets of their respective cohorts that their loss would cause no detectable population-level effects.

Pier-related Noise

Pier-related noise would adversely affect PS Chinook salmon and PS steelhead. The vessels that would moor at the repaired piers would cause in-water noise capable of causing detectable effects in fish. Unlike construction noises, vessel noise could occur year-round. Individual vessel operations around a mooring structure typically consist of brief periods of relatively low-speed movement as boats are driven to the pier and tied up. Their engines are typically shut off within minutes of arrival. The engines of departing vessels are typically started a few minutes before the boats are untied and driven away. Based on satellite imagery of the applicants' piers and on the consulting biologist's personal observations of many residential piers and commercial marinas in the region, the boats most likely to moor at the applicants' piers would be a power boat of approximately 20-50 feet long in the covered moorage area and potentially one or two additional vessels of similar size for each pier.

Numerous sources describe sound levels for ocean-going ships, tugboats, and recreational vessels (Blackwell and Greene 2006; McKenna et al. 2012; Picciulin et al. 2010; Reine et al. 2014; Richardson et al. 1995). The best available information about the source levels from vessels close in size to those that would operate at the piers is described in the acoustic assessment done for a similar project (NMFS 2018). In the current assessment, we used vessel noise from tugboats and a 23-foot long power boat as surrogates for the type and size of vessels likely to moor at the applicants' piers.

All of the expected peak source levels are below the 206 dB_{peak} threshold for instantaneous injury in fish. Application of the practical spreading loss equation to the expected SEL SLs suggests that noise levels above the 150 dB_{SEL} threshold would extend between 33 feet (10 m) and 72 feet (22 m) from the representative vessels (Table 6).

Table 6. Estimated in-water source levels for vessels with noise levels similar to those likely to moor at the applicant's new floats, and ranges to effects thresholds for fish.

Source	Acoustic Signature	Source Level	Threshold Range
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
Tugboat propulsion	< 1 kHz Combination	185 dB_{peak}	206 @ N/A
Episodic brief periods measures in minutes to hours		170 dB_{SEL}	150 @ 22 m

It is extremely unlikely that vessels would be run at anything close to full speed while near the piers. However, they may briefly use high power settings while maneuvering. To be protective of fish, this assessment assumes that pier-related in-water vessel noise levels above the 150 dB_{SEL} threshold could routinely extend up to 72 feet (22 m) around the piers when larger vessels moor or transit near the piers. Vessel noise levels would be non-injurious. However, juvenile Chinook salmon and steelhead that are within the 150 dB_{SEL} isopleth, are likely to experience behavioral disturbances, such as acoustic masking, startle responses, altered swimming patterns, avoidance, and increased risk of predation. Further, the intensity of these effects would increase with increased proximity to the source and/or duration of exposure. Response to this exposure would be non-lethal in most cases, but some individuals may experience stress and fitness effects that could reduce their long-term survival, and individuals that are eaten by predators would obviously be killed.

The annual numbers of juvenile PS Chinook salmon and PS steelhead that would be exposed to this stressor are unquantifiable with any degree of certainty and are likely to vary greatly over time. However, they would be very low. Based on the relatively small affected areas, the multiple routes available to emigrating juveniles of both species, and because the majority of their typical emigration seasons are well outside of the typical summer boating season when marina-related vessel operations would be highest, the PS Chinook salmon and PS steelhead that would annually migrate near the piers would be small subsets of their cohorts. Further, the typically episodic and short-duration of vessel operations at the piers combined with the juvenile salmonids typical migratory behavior in the lake, suggest that the probability and duration of exposure would be very low for any individual fish. Therefore, the PS Chinook salmon and PS steelhead that may be exposed to pier-related elevated noise would represent extremely small subsets of their respective cohorts, and the annual numbers of individuals that would be meaningfully affected by this stressor would be too low to cause detectable population-level effects.

Pier-related Water Contamination

Juvenile PS Chinook salmon and juvenile PS steelhead are likely to be adversely affected through exposure to the contaminants from the ACZA treated beams, stringers, and lagging in the repaired piers and bulkhead, and the use of the recreational vessels near the piers.

Copper: ACZA-treated timber piles that support each pier and comprise the face of the repaired bulkhead would maintain persistent low level inputs of contaminants at each project site for the extended life of the structures. The applicants would install a combined total of about 972 square feet of new stringers and decking supports for the repaired piers and 304 square feet of bulkhead lagging that would be built with ACZA-treated timber. Wet ACZA-treated wood leaches some of the metals used for wood preservation. Of these metals, dissolved copper is of most concern to fish because of its higher leaching rate compared to arsenic and zinc (Poston 2001). The dissolved copper concentrations that would be attributable to action-related installation of ACZA-treated timber is uncertain. Post-treatment BMPs reduce the intensity and duration of copper leaching from ACZA-treated wood, though some leaching still occurs. Copper leaching from ACZA-treated wood is highest in the water column when the treated wood is immersed in freshwater, but decreases sharply to low levels during the first few days to weeks after installation. However, higher copper concentrations have been found to persist for longer in sediment adjacent to ACZA-treated wood as compared to in the water column (Poston 2001). The above-water treated timber also episodically releases very small amounts of copper when it is exposed to waves and stormwater. However, the treated timber in the new bulkhead would be immersed in freshwater and is expected to contribute a higher concentration of dissolved copper to the area adjacent to the bulkhead, and elevated concentrations may persist for months.

In freshwater, exposure to dissolved copper at 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 (Giattina et al. 1982; Hecht et al. 2007; McIntyre et al. 2012; Sommers et al. 2016; Tierney et al. 2010). In this case, concentrations are expected to be very low, episodic, brief, and becoming dilute beyond the areas immediately adjacent to the repaired piers because all treated timber would be installed above the water and not permanently immersed. However, the treated timber lagging comprises the front of the bulkhead and would be permanently immersed in the water, and leaching may occur over a prolonged period of time. Any dissolved copper from the ACZA-treated timber would be additive to the copper from hull paints described below.

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 with high boat occupancy and restricted water flows (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. The dissolved copper concentrations that would be attributable to action-related copper-based anti-fouling paints are uncertain, but may exceed the threshold for the onset of adverse effects in salmonids. Since there will be only one or two vessels moored at each residential pier and the piers are located along a section of open shoreline, the concentration of dissolved copper is likely to be low and below 0.5 µg/L. However, the residence is located adjacent to other properties with moored vessels, which may create a localized additive effect over time.

Although neither action-related source of copper is expected to be very high, those sources would be additive to each other, and the NMFS expects that action-related dissolved copper concentrations in the area immediately adjacent to the applicants' piers and bulkhead would episodically exceed the threshold for the onset of detectable effects. Therefore, over the life of the applicants' repaired piers, some juvenile Chinook salmon and juvenile steelhead are likely to be exposed to pier- and bulkhead-related dissolved copper at levels high enough to measurably alter their normal behaviors and increase their risk of predation.

<u>Zinc</u>: The galvanized steel piles used for the repaired piers would be uncoated, and therefore likely to leach zinc into the water and sediment. Zinc binds to fish gills and can cause suffocation (WDOE 2008). Exposure to dissolved zinc at 5.6 µg/L has been shown to cause strong avoidance of in rainbow trout, and at 560 µg/L to cause mortality (Sprague 1968). Dietary exposure to high levels of zinc from consuming contaminated prey has been shown to cause reduced growth rates (Brooks and Mahnken 2003).

<u>PAHs</u>: Toxic materials may enter the water through the periodic discharge of petroleum-based fuels and lubricants into the water from the applicants' recreational vessels as small unnoticed drips, and from exhaust. Pollutants from the vessel are co-located with the vessel's movement and are likely to be highest around the pier. Petroleum-based fuels and lubricants contain Polycyclic Aromatic Hydrocarbons (PAHs) that are known to be harmful to fish and other aquatic organisms during development and during adulthood, specifically for cardiac development and function (Incardona et al. 2004; Incardona et al. 2005). However, vessel discharges near the project site are likely to occur relatively infrequently, with the majority being very small. Additionally, some of the pollutants may evaporate relatively quickly (Werme et al. 2010), and currents would help to disperse the pollutants. 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). 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 (Beitinger and Freeman 1983; Brette et al. 2014; Feist et al. 2011; Gobel et al. 2007; Incardona et al. 2004, 2005, 2006; Mcintyre et al. 2012; Meadore et al. 2006; Sandahl et al. 2007; Spromberg et al. 2015).

Therefore, over the decades-long life of the repaired piers, some juvenile PS Chinook salmon and juvenile PS steelhead are likely to be directly exposed to pier-related petroleum-based and other pollutants at concentrations capable of causing some combination of behavioral disturbances, reduced growth, increased susceptibility to infection, and increased mortality.

<u>Pier-related Propeller Wash and Scour</u>

Exposure to pier-related propeller wash would adversely affect juvenile PS Chinook salmon, but it is extremely unlikely that adult PS Chinook salmon or adult PS steelhead would be exposed to this stressor. Recreational vessel use associated with the repaired piers would produce propeller wash within the project area. The prop wash related effects are expected to be within a 300-foot radius of each pier, with the highest intensity, frequency, and duration of this effect within proximity of the piers. Spinning boat propellers kill fish and small aquatic organisms (Killgore et al. 2011; VIMS 2011). Spinning propellers also generate fast-moving turbulent water (propeller wash) that can displace and disorient small fish, as well as dislodge benthic aquatic organisms and submerged aquatic vegetation (SAV), particularly in shallow water and/or at high power settings (propeller scour, described above). Juvenile fish that are near the propeller when it is started, or in the transit route of the boat while the propeller is operating can be injured. Juvenile Chinook salmon and steelhead in the action area are likely to remain close to the surface where they may be exposed to spinning propellers and powerful propeller wash near the piers. Juvenile salmonids do not have the swim strength or speed of adult fish which are able to quickly maneuver away from the vortex of an operating boat motor.

Although the likelihood of this interaction is very low for any individual juvenile fish or individual boat trip, it is very likely that over the extended life of the piers, at least some juvenile PS Chinook salmon and juvenile PS steelhead would experience injury or mortality from exposure to spinning propellers and/or propeller wash at the pier. Such an even could occur multiple times per year, though the number of fish harmed in any given episode is expected to be very low (single digits). Therefore, the numbers of juvenile PS Chinook salmon that may be exposed to pier-related propeller wash would represent such a small subset of their respective cohorts that their loss would cause no detectable population-level effects.

Propeller scour may also reduce SAV and diminish the density and diversity of the benthic community at the project site. However, the disturbances would be brief, the affected areas would likely consist of a tiny portion of the SAV- and invertebrate-supporting substrate in the immediate area, and the disturbed SAV and invertebrates would likely recover very quickly after each disturbance. The expectation that low power settings would be used when maneuvering near the piers suggest that propeller scour would have negligible effects on benthic resources at the two sites. Therefore, the effects of pier-related propeller scour would be too small to cause any detectable effects on the fitness and normal behaviors of juvenile Chinook salmon and juvenile steelhead in the action area.

Pier-related Diminished Prey Base

Juvenile PS Chinook salmon and steelhead are likely to be adversely affected through a reduction in prey from pier-related activities and the structure itself. Salmonid prey would be reduced in quantity and quality by exposure to pollutants from the ACZA treated pilings and lagging, and PAHs from the recreational vessels. Prey will be diminished through the operation of the recreational vessels and from the shade caused by the pier and covered moorage. Large portions of the repaired structures and moored vessels would cast shadows over water and substrate that would otherwise be supportive of SAV and benthic invertebrates, the shade would continue to reduce the quantity and diversity of natural cover and prey organisms for juvenile salmonids. Pier-related contaminants that settle to the bottom would accumulate on the substrate under and adjacent to the pier and be biologically available for years (Romberg 2005). Amphipods and copepods can 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. The normal behaviors of juvenile Chinook salmon in the freshwater emigration phase of their life cycle includes a strong tendency toward shoreline obligation, which means that they are biologically compelled to follow and stay close to streambanks and shorelines, and likely to pass through and forage within the project area. The normal behaviors of out-migrating juvenile steelhead is much less tied to shoreline habitats. However, over the decades-long life of the repaired piers and bulkhead, some out-migrating juvenile steelhead are likely to pass through and forage within the project area. For these reasons we believe both Juvenile PS Chinook salmon and juvenile PS steelhead are likely to be exposed to pollutants in the water column and through indirect exposure to pollutants through the trophic 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. Meadore 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.

Increased levels of contaminants from pier-related vessel activity may diminish the number, size, and species diversity of prey types available to foraging juvenile salmonids. When juvenile fish encounter areas of diminished prey, competition for those limited resources increases, and less competitive individuals are forced into suboptimal foraging areas (Auer et al. 2020). Further, individuals with an inherently higher metabolism tend to be bolder and competitively dominant, and may outcompete other individuals for resources within a microhabitat, potentially increasing interspecific mortality (Biro and Stamps 2010).

Some subset of the juvenile PS Chinook salmon and juvenile PS steelhead that emigrate through Lake Washington are likely to pass through the action area each year. During their transit through the action area, at least some of those juveniles are likely to feed on the invertebrate resources near the piers, some of which would be affected by pier-related contaminants. Based on the available information, the NMFS expects that over the decades-long life of the repaired piers and bulkhead, some juvenile Chinook salmon and juvenile steelhead are likely to be exposed to pier-related reduced forage capable of causing some combination of reduced growth, increased susceptibility to infection, and increased mortality.

The number of years that detectable amounts of contaminants would be biologically available, as well as the annual numbers of juvenile PS Chinook salmon and juvenile PS steelhead that may be exposed to pier-related contaminated forage is unquantifiable with any degree of certainty. Similarly, the amount of contaminated prey that any individual fish may consume, or the intensity of any effects that an exposed individual may experience is uncertain, and would be highly variable over time. Therefore, the numbers of juvenile Chinook salmon and juvenile PS steelhead that would be annually exposed to project-related contaminated prey would likely comprise such small subsets of their respective cohorts that their loss would cause no detectable population-level effects.

Pier-related Altered Lighting

Pier-related altered lighting is likely to adversely affect juvenile PS Chinook salmon and juvenile PS steelhead, but cause minor effects in adults of both species. At the end of the project, the repaired J. Sabey pier would be comprised of 100 percent grated decking and the new D. Sabey pier would also be 100 percent grated decking with a new 100 percent grated platform boatlift. Depending on the dock, the water depths under the new structures range from the OHWL along the shoreline to about 8 to 9.5 feet deep at the offshore ends, with the D. Sabey dock being in the shallowest water. The repaired structures would shade the water and substrate under them, and the vessels that moor against them would add to the size and intensity of the shade. The shade of the repaired piers and the vessels moored to them would maintain conditions that modify juvenile salmonid migratory behaviors, and increase juvenile salmonids' exposure and vulnerability to predators. The intensity of shadow effects 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. During the day, the reconstructed piers and the boats moored to them would create unnatural daytime shade over the water and aquatic substrate along the eastern side of Lake Washington on the western shore of Hunt's Point. At night, those structures and vessels would also create over-water artificial illumination.

Shade: The project replaces solid decking with grated decking which reduces, but does not eliminate, the shade. Shade as a long-term effect occurs for the duration that each pier remains in place. This condition adds obstruction and decreases safety of the migration corridor. Although the existing wood plank decking on both piers would be replaced with light-penetrating decking, the docks would continue to cast a shadow over the water and the substrate beneath them, and the solid-roofed boat canopies and any boats that would moor along the sides of the piers would add to the size and intensity of the shade. Shade limits primary productivity and can reduce the diversity of the aquatic communities under over-water structures (Nightingale and Simenstad 2001; Simenstad et al. 1999). This effect occurs below each of the piers and the covered moorage.

As described above under contaminated forage, some subset of each year's cohort of out-migrating juvenile Chinook salmon, and to a lesser extent, out-migrating juvenile steelhead, would pass through the action area. If situated alone along a stretch of undisturbed shoreline, the piers' impacts on aquatic productivity might not be expected to measurably affect the fitness of migrating juvenile salmonids. However, because the applicants' piers are situated among many long-standing bankside over-water structures that line Lake Washington, their shadows, in combination with the shadows of the adjacent structures, act to maintain long stretches of migratory habitat with inadequate shelter and forage resources for juvenile salmonids. Therefore, juvenile Chinook salmon and steelhead within the action area are likely to experience some degree of reduced fitness due to reduced availability of cover and prey that would be attributable to the applicants' piers.

Shade limits primary productivity and can reduce the diversity of the aquatic communities under over-water structures (Nightingale and Simenstad 2001; Simenstad et al. 1999). Juvenile salmon feed on planktonic organisms such as amphipods, copepods, and euphausiids, as well as the larvae of many benthic species and fish (NMFS 2006). Because large portions of the repaired structures and moored vessels would cast shadows over water and substrate that would otherwise be supportive of SAV and benthic invertebrates, the shade would continue to reduce the quantity and diversity of natural cover and prey organisms for juvenile salmonids.

The shade of over-water structures also negatively affects juvenile salmonid migration. Numerous studies demonstrate that juvenile salmonids, in both freshwater and marine habitats, are more likely to avoid an overwater structure's shadow 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; Tabor 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).

Although the piers' shade intensity would be reduced compared to the existing conditions, the shade of the repaired piers is likely to continue to alter the migratory behavior for at least some of the juvenile Chinook salmon that pass through the action area, and inhibit them from migrating along the shoreline, which is typical for juvenile Chinook salmon passing through Lake Washington. The shade would delay passage under the structure for some, and or induce some individuals to swim around the structure, effectively forcing them into open and relatively deep waters. The off-bank migration of these small fish increases migration distance and time, and increases the energetic costs (Heerhartz and Toft 2015). Additionally, shade and deep water both favor 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), and deep water increases the risk of predation for migrating juvenile salmonids (Willette 2001). Shade-related altered migratory behaviors would mostly affect juvenile PS Chinook salmon, because the juvenile PS steelhead that pass through this waterway are relatively large and shoreline independent, as are the adults of both species.

Artificial Illumination: Artificial illumination is likely to have long-term adverse effects on juvenile PS Chinook salmon and juvenile PS steelhead, but cause minor effects in adults of both species. The repaired docks and the vessels that use them would have lighting systems that would create nighttime artificial illumination of lake waters. Nighttime artificial illumination of the water's surface attracts fish (positive phototaxis) in marine and freshwater environments, it often shifts nocturnal behaviors toward more daylight-like behaviors, and it can affect light-mediated behaviors such as migration timing (Becker et al. 2013; Celedonia and Tabor 2015; Ina et al. 2017; Tabor and Piaskowski 2002; Tabor et al. 2017).

Tabor and Piaskowski (2002) report that juvenile Chinook salmon in lacustrine environments typically feed and migrate during the day, and are inactive at night, residing at the bottom in shallow waters. They tend to move off the bottom and become increasingly active at dawn when light levels reach 0.8 to 2.1 lumens per square meter. Tabor et al. (2017) found that sub-yearling Chinook, coho, and sockeye salmon exhibit strong nocturnal phototaxic behavior when exposed to levels of 5.0 to 50.0 lumens per square meter, with phototaxis positively correlated with light intensity. Celedonia and Tabor (2015) found that juvenile Chinook salmon in the Lake Washington Ship Canal were attracted to artificially lit areas at 0.5 to 2.5 lumens per square meter. The authors also reported that attraction to artificial lights may delay the onset of morning migration by up to 25 minutes for some juvenile Chinook salmon migration through the Lake Washington Ship Canal.

The proposed lighting system for each of the two piers consists of six dock lights on each pier, with each light not to exceed 450 lumens, for a total of 2,700 lumens per pier. Each light would be angled towards the pier surface to reduce illuminating the surface of the lake. However, the reported intensity of the pier lighting fixtures is well above the reported intensities at which detectable effects have been reported in juvenile salmon, and some of that light will spill over the sides of the piers and through the deck grating. Private vessels moored at the piers are likely to be episodically illuminated at night, and add to the over-water illumination around the applicants' piers. Most incidences of vessel-related illumination are likely to be episodic and brief (measured in minutes to a low number of hours per event) and to occur during the summer boating season after juvenile salmon have departed the lake. However, over the lives of the two piers, it is likely that at least some juvenile salmonids individuals would be exposed to vessel-related illumination capable of causing some level of phototaxis in exposed in exposed fish.

Therefore, the NMFS expects that juvenile salmonids that are near the piers are likely experience some level of nocturnal phototaxis, and may experience other altered behaviors, such as delayed resumption of migration in the morning. Over the life of the piers, it is likely that a small subset of the exposed individuals would experience reduced fitness and/or altered behaviors that could reduce their overall likelihood of survival.

In summary, pier-related altered lighting 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 numbers are likely to be very low because relatively small subsets of each annual cohort are likely to pass through the project area, and the probability of exposure would be very low for any individual fish that enters the project area, 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 artificial illumination 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.

The PBFs for PS Chinook salmon in the action area are those for migration habitat, specifically, 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 that support juvenile and adult mobility and survival. Water quantity, rocks and undercut banks, and side channels are features not relevant to this consultation. We present here the effects listed above for their influence on the affected PBFs.

Migration areas free from obstruction and excessive predation – The proposed action would cause long-term minor adverse effects on this feature of critical habitat by two of the effects described above: Noise (ephemeral during pile installation and removal and construction, and long-term episodic over the life of the project) and shade, for the life of the project. The proposed piers' shade intensity would be reduced compared to the existing conditions. However, the continued presence and altered light of the piers and of moored vessels would maintain degraded conditions at the sites that prevent normal migration behaviors, slightly increase the migration pathway, and increase the risk of predation for juvenile Chinook salmon. In summary, this feature of critical habitat would be maintained at a slightly degraded level.

Water quantity – The proposed project would cause no effect on this attribute.

Water quality – The proposed action would cause both short- and long-term adverse effects on this attribute. Vessel propeller scour would occur during construction and during the operation of the recreational vessels and would cause small areas of ephemeral increases in turbidity within the project area. The ACZA-treated timber at the replaced pier and bulkhead would maintain persistent low level inputs of contaminants in the project area. Installation of new, galvanized cylindrical and H-piles will impart low levels of contaminants for the life of the bulkhead and repaired pier. Creosote-treated wood pile removal would reduce ongoing PAH contamination at the site, but would also cause both short- and long-term adverse effects by temporarily increasing contaminants in the water column, and increasing sediment contamination adjacent to the pier. The use of recreational vessels would episodically introduce PAHs for the life of the project. This feature of critical habitat would be maintained at a degraded level.

Natural cover – The baseline condition is a lack of natural cover due to the presence of the docks and the moorage cover. Extending the useful life of both piers does not alter and would perpetuate these conditions that act to limit the growth of SAV, especially underneath the opaque moorage cover. However, the conversion of solid plank decking to fully grated decking would increase some light penetration through and under the affected structures. This feature of critical habitat would be maintained at a slightly degraded level.

The proposed action will have no effect on the following PBFs because they are not present in the action area: freshwater spawning sites; freshwater rearing sites; estuarine areas free of obstruction and excessive predation; nearshore marine areas free of obstruction and excessive predation; and offshore marine areas.

2.6 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02 and 402.17(a)). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

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

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

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

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

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in 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) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

As described in more detail above in Section 2.4, climate change is likely to increasingly affect the abundance and distribution of the ESA-listed species considered in the opinion. It is also likely to increasingly affect the PBF of designated critical habitats. The exact effects of climate change are both uncertain, and unlikely to be spatially homogeneous. However, climate change is reasonably likely to cause reduced instream flows in some systems, and may impact water quality through elevated in-stream and in-lake water temperatures and reduced dissolved oxygen, as well as by causing more frequent and more intense flooding events.

Climate change may also impact coastal waters through elevated surface water temperature, increased and variable acidity, increasing storm frequency and magnitude, and rising sea levels. The adaptive ability of listed-species is uncertain, but is likely reduced due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation. The proposed action will cause direct and indirect effects on the ESA-listed species and critical habitats considered in the opinion well into the foreseeable future. However, the action's effects on water quality, substrate, and the biological environment are expected to be of such a small scale that no detectable effects on ESA-listed species or critical habitat through synergistic interactions with the impacts of climate change are expected.

2.7.1 ESA-listed Species

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

PS Chinook salmon

The long-term abundance trend of the PS Chinook salmon ESU is slightly negative. Reduced or eliminated accessibility to historically important habitat, combined with degraded conditions in available habitat due to land use activities appear to be the greatest threats to the recovery of PS Chinook salmon. Commercial and recreational fisheries also continue to impact this species.

The PS Chinook salmon most likely to occur in the action area would be fall-run Chinook salmon from the Cedar River and the North Lake Washington/Sammamish River populations, which are part of the South Puget Sound MPG. Both populations are considered at high risk of extinction due to low abundance and productivity.

The project site is located along the eastern shores of Lake Washington on the western side of Hunts Point, which serves as a freshwater migration route to and from marine waters for adult and juvenile PS Chinook salmon from both affected populations. The environmental baseline within the action area has been degraded by the effects of nearby intense bankside development and maritime activities, and by nearby and upstream industry, urbanization, agriculture, forestry, water diversion, and road building and maintenance.

The number of juvenile Chinook salmon that would be impacted by the construction-related effects described above is unquantifiable with any degree of certainty. However, the number would be extremely low. The timing of the proposed work avoids the normal migration season for returning adult PS Chinook salmon, but any work occurring between December 31 and March 15 could overlap with the early part of emigration season for juveniles. The work would occur well before the peak emigration season for juvenile Chinook salmon, and the individuals that would be present in the lake during the work would comprise extremely small subsets of two very small populations. Further, the probability that any individual fish would enter the project area would be very low, and only a subset of the individuals that enter the project area would be measurably affected. Therefore, the proportion of the project year's cohorts that would be killed or experience measurably reduced fitness due to exposure to one or more of the construction-related effects would be too low to cause any detectable population-level effects.

Additionally, over the next several decades, low numbers of out-migrating juveniles that pass through the project sites and may be exposed to pier-related contaminated water and/or forage are unquantifiable with any degree of certainty and are likely to vary greatly over time, but the annual numbers are expected to be very low. Exposure to low levels of contaminated forage, reduced prey availability, and other altered habitat conditions, that both individually and collectively, would cause some combination of altered behaviors, reduced fitness, and mortality in some of the exposed individuals. Similarly, the contaminant concentration levels that any individual fish may be directly or indirectly exposed to, and the intensity of any effects that an exposed individual may experience, would be highly variable over time, but typically very low.

The annual numbers of individuals that would be detectably affected by action-related stressors would be extremely low.

Based on the best available information, the scale of the direct and indirect effects of the proposed action, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to cause detectable effects on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for the affected PS Chinook salmon populations. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

PS Steelhead

The long-term abundance trend of the PS steelhead DPS is negative, especially for natural spawners. Growth rates are currently declining at 3 to 10% annually for all but a few DIPs. The extinction risk for most DIPs is estimated to be moderate to high, and the DPS is currently considered “not viable”. 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 PS steelhead most likely to occur in the action area would be winter-run fish from the Cedar River and North Lake Washington/Lake Sammamish DIPs. The abundance trends between 1984 and 2016 were strongly negative for both DIPs, and ten or fewer adult natural-spawners are estimated to return to the DIPs annually.

The project site is located along the eastern shores of Lake Washington on the western side of Hunts Point, which serves as a freshwater migration route to and from marine waters for adult and juvenile PS steelhead from both affected DIPs. The environmental baseline within the action area has been degraded by the effects of nearby intense bankside development and maritime activities, and by nearby and upstream industry, urbanization, agriculture, forestry, water diversion, and road building and maintenance.

It is extremely unlikely that any PS steelhead would be directly exposed to the proposed work. However, over the next several decades, low numbers of out-migrating juveniles that pass through the project sites would be exposed to noise, low levels of contaminated forage, reduced prey availability, and other altered habitat conditions, that both individually and collectively, would cause some combination of altered behaviors, reduced fitness, and mortality in some of the exposed individuals. The annual numbers of individuals that would be detectably affected by action-related stressors would be extremely low.

Based on the small affected area and the multiple routes available to emigrating juveniles, the numbers of juvenile steelhead that would annually pass through the project areas would be small subsets of their cohorts. Additionally, the majority of their typical emigration season is well outside of the typical summer boating season when pier-related contamination levels would be highest. Further, the infrequency and small-scale of discharges combined with the migratory nature of juvenile salmonids in the area suggest that the probability and duration of exposure would be very low for any individual fish. Therefore, the annual numbers of PS steelhead that may be exposed to pier-related effects would represent extremely small subsets of their respective cohorts, and the numbers of exposed fish that would be meaningfully affected would be too low to cause detectable population-level effects.

Based on the best available information, the scale of the direct and indirect effects of the proposed action, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to cause detectable effects on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for the affected PS steelhead DIPs. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

2.7.2 Critical Habitat

Critical habitat was designated for PS Chinook salmon to ensure that specific areas with PBFs that are essential to the conservation of that listed species are appropriately managed or protected. The critical habitat for PS Chinook salmon will be affected over time by cumulative effects, some positive – as restoration efforts and regulatory revisions increase habitat protections and restoration, and some negative – as climate change and unregulated or difficult to regulate sources of environmental degradation persist or increase. Overall, to the degree that trends are negative, the effects on the PBFs of critical habitat for PS Chinook salmon are also likely to be negative. In this context we consider how the proposed action's impacts on the attributes of the action area's PBFs would affect the designated critical habitat's ability to support the conservation of PS Chinook salmon as a whole.

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 more environmentally acceptable land use practices, by the implementation of non-federal plans that are intended to benefit salmonids, and by efforts to address the effects of climate change.

The 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 obstruction and excessive predation, water quality, and natural cover. As described above, the project sites are located along a heavily impacted waterway, and both of these sites' attributes currently function at reduced levels as compared to undisturbed freshwater migratory corridors. The extended life of the docks, along with the continuation of dock-related vessel operations would cause minor long term adverse effects on the identified site attributes. On the positive side, the proposed work would also reduce ongoing PAH contamination, and increase light penetration under the repaired structures.

Based on the best available information, the scale of the proposed action's effects, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to cause any detectable long-term negative changes in the quality or functionality of the freshwater migration corridors PBF in the action area. Therefore, this critical habitat will maintain its current level of functionality, and retain its current ability for PBFs to become functionally established, to serve the intended conservation role for PS Chinook salmon.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is the NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of PS Chinook salmon and PS steelhead, nor is it likely to destroy or adversely modify designated critical habitat for 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). "Harass" is further defined by interim guidance as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement (ITS).

2.9.1 Amount or Extent of Take

In the biological opinion, 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 and scour,
- Construction-related water contamination,
- Construction-related diminished prey base,
- Pier-related altered lighting,
- Pier-related water contamination,
- Pier-related diminished prey base,
- Pier-related noise, and
- Pier-related propeller wash and scour.

Harm of PS steelhead from exposure to:

- Construction-related diminished prey base,
- Pier-related altered lighting,
- Pier-related water contamination,
- Pier-related diminished prey base,
- Pier-related noise, and
- Pier-related propeller wash and scour.

The NMFS cannot predict with meaningful accuracy the number of PS Chinook salmon and PS steelhead that are reasonably certain to be injured or killed annually by exposure to any of these stressors. The distribution and abundance of the fish that occur within the project 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 project area cannot be attributed entirely to habitat conditions, nor can the NMFS precisely predict the number of fish that are reasonably certain to be injured or killed if their habitat is modified or degraded by the proposed action. Additionally, the NMFS knows of no device or practicable technique that would yield reliable counts of individuals that may experience these impacts. In such circumstances, the NMFS uses the causal link established between the activity and the likely extent and duration of changes in habitat conditions to describe the extent of take as a numerical level of habitat disturbance. The most appropriate surrogates for take are action-related parameters that are directly related to the magnitude of the expected take.

For this action, the timing and duration of work is an appropriate surrogate for the extent of take of juvenile PS Chinook salmon from exposure to construction-related noise, propeller wash and scour, and water contamination because the planned work window was selected to reduce the potential for juvenile salmonid presence at the project sites. Therefore, working outside of the planned work window and or working for longer than planned would increase the number of fish likely to be exposed to these construction-related impacts.

In addition to timing and duration, pile type, size, and method of installation are appropriate surrogates for construction-related noise because the intensity of effect from sound exposure is positively correlated with the loudness of the sound. Pile installation would be the loudest construction-related sound source, and its loudness is determined by the type and size of the pile and the method of installation. Further, the number of fish that would be exposed to pile-installation 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 juvenile Chinook salmon that would be exposed to the sound would increase despite the low density and random distribution of individuals in the action area. Based on the best available information about the planned pile extraction and installation, as described in Section 2.5, the intensity and applicable ranges of effect for this project are driven by the type and size of the piles, the method of their installation, and the total number of days of pile work, but not by the daily duration of vibratory work or the number of piles. Therefore, the daily number of piles and daily duration of vibratory pile installation are not considered measures of take for this action.

In addition to timing and duration, the pile removal method and the lateral extent of the visible turbidity plumes around the project sites are appropriate surrogates for the extent of take of juvenile PS Chinook salmon from exposure to construction-related contaminated water. The method of removal is appropriate because turbidity and related in-water contaminant concentrations would be positively correlated with the amount of contaminated subsurface sediments that would be mobilized into the water column, which is positively correlated with the extraction method. The proposed vibratory removal and pulling of piles would minimize sediment mobilization compared to other methods such as the use of excavators or water-jetting. As the turbidity and contaminant concentrations increase, the intensity of the resulting effects would increase in the exposed individuals. The lateral extent of the visible turbidity plumes around the project sites is appropriate because the size the affected water volume would be positively correlated with the extent of the plumes, and as the size of the affected water volume increases, the number of exposed individuals would increase.

The pile removal method and the extent of the visible turbidity plumes around the project sites are appropriate surrogates for the extent of take of juvenile PS Chinook salmon and juvenile PS steelhead from exposure to construction-related diminished prey base. As stated above, the amount of contaminated subsurface sediments that would be brought to the surface and mobilized into the water column is positively correlated with the extraction method. Utilization of extraction methods, such as excavators and water-jetting would mobilize more contaminated sediments than would be mobilized by the proposed vibratory extraction and direct pull. As the amount of mobilized contaminated sediments increase, the amount of biologically available contaminants would increase. As amount of biologically available contaminants increase, the contamination levels in the exposed prey organisms and or the mortality of those prey organisms would increase, both of which would increase the intensity of the impacts on exposed juvenile Chinook salmon and juvenile steelhead. The lateral extent of the visible turbidity plumes is again appropriate because the numbers of contaminated prey organisms and or exposed fish would be positively correlated with the size the affected area. Therefore, any increase in the size of the visible turbidity plumes would increase the number of contaminated prey organisms as well as the number of exposed listed fish.

The size and configuration of the proposed piers are appropriate surrogates for exposure to pier-related altered lighting, water contamination, diminished prey base, noise, and propeller wash and scour. Pier size and configuration are appropriate for altered lighting because, salmonid avoidance and the distance required to swim around the structures would both increase as the size and opacity of the structures increase. Similarly, any increase in the artificial illumination at the piers would increase nighttime phototaxis. Size and configuration are appropriate for pier-related water contamination, diminished prey base, noise, and propeller wash because those stressors are all positively correlated with the number of boats that moor at a structure, which is largely a function of the structure's size. As the size of piers increases, the number of boats that can moor there would increase. As the number of boats increase, boating activity increases. As boating activity increases, the potential for, and the intensity of exposure to the related pollutants, noise, and propeller wash and scour would also increase for juvenile PS Chinook salmon and juvenile PS steelhead.

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

- A combined total of up to 8 weeks of in- and overwater work to be completed between July 16 and March 15 (Up to 4 weeks each at the D. Sabey and J. Sabey project sites);
- A combined total of up to 24 days of vibratory pile extraction and installation work, with a minimum 12-hour period of no pile driving between consecutive work days;
- The installation of no more than 14 6-inch and 2 8-inch galvanized steel pipe piles, and 14 14-inch epoxy-coated steel H-piles;
- Visible turbidity plumes not to exceed 300 feet from either project site; and
- The post-construction size and configuration of the applicants' piers and bulkhead as described in the proposed action section of this biological opinion.

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

Although these take surrogates could be construed as partially coextensive with the proposed action, they nevertheless function as effective reinitiation triggers. If any of these take surrogates exceed the proposal, it could still meaningfully trigger reinitiation because the USACE has authority to conduct compliance inspections and to take actions to address non-compliance, including post-construction (33 CFR 326.4).

2.9.2 Effect of the Take

In the biological opinion, the NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.9.3 Reasonable and Prudent Measures

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

The USACE shall require the applicant to:

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

2.9.4 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. The USACE or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement reasonable and prudent measure 1:
    a. The USACE shall require the applicant to develop and implement plans to collect and report details about the take of listed fish. That plan shall:
        i. Require the applicant and/or their contractor to maintain and submit records to verify that all take indicators are monitored and reported. Minimally, the records should include:
            1. Documentation of the timing and duration of in- and over-water work to ensure that no more than about 4 weeks of that work is done at either pier (a combined total of no more than 8 weeks), and that the work is accomplished between July 16 and March 15;
            2. Documentation of the dates, method of pile extraction and installation, and the pile types and sizes;
            3. Documentation to confirm the 12-hour period of no pile extraction or installation occurs between consecutive pile extraction and installation work days;
            4. Documentation of the lateral extent of the turbidity plumes, and measures taken to maintain them within 300 feet; and
            5. Documentation of the location, size, and configuration of the repaired and/or replaced piers and bulkhead to confirm that they do not exceed the characteristics described in this opinion.

b. Require the applicant to establish procedures for the submission of the construction records and other materials to the appropriate USACE office and to submit and 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-2021-01742 and WCRO-2021-02012 in the subject line of the email.

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 USACE should encourage the applicant to limit all in- and overwater work to the period between July 16 and December 31 to reduce the likelihood of exposing juvenile Chinook salmon to the direct effects of construction.

2.11 Reinitiation of Consultation

This concludes formal consultation for the U.S. Army Corps of Engineers' authorization of the D. Sabey and J. Sabey repair and maintenance projects in Lake Washington, King County, Washington.

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

2.12 "Not Likely to Adversely Affect" Determinations

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

As described in Section 1.2 and below, the NMFS has concluded that the proposed action is not likely to adversely affect southern resident (SR) killer whales and their designated critical habitat. Detailed information about the biology, habitat, and conservation status and trends of SR killer whales can be found in the listing regulations and critical habitat designations published in the Federal Register, as well as in the recovery plans and other sources at:

https://www.fisheries.noaa.gov/species-directory/threatened-endangered, and are incorporated here by reference.

The applicable standard to find that a proposed action is not likely to adversely affect listed species or critical habitat is that all of the effects of the action are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. The effects analysis in this section relies heavily on the descriptions of the proposed action and project site conditions discussed in Sections 1.3 and 2.4, and on the effects analyses presented in Section 2.5.

2.12.1 Effects on Listed Species

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

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

First, as described in Section 2.5, the action would annually affect an extremely low number of juvenile Chinook salmon. The project's detectable effects on fish would be limited to an area no more than 300 feet around the project site, where small subsets of each year's juvenile PS Chinook salmon cohorts from the Cedar River and North Lake Washington populations could be briefly exposed to project-related impacts during the final portion their freshwater migration lifestage, and only very small subsets of the individuals that pass through the area are likely to be detectably affected by the exposure.

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

Second, as described in Sections 1.3, 2.2, and 2.5, the only PS Chinook populations that would be affected by the project would be the two Lake Washington populations that migrate through the Lake Washington ship canal, and both populations are small. Adult returns in 2019 for the Cedar River and North Lake Washington populations were 855 and 365 individuals, respectively (WDFW 2021c; 2021d). Consequently, the two populations, combined, make up a very small portion of the adult Chinook that are available to SR killer whales in marine waters. Therefore, based on the best available information, the proposed action is not likely to adversely affect SR killer whales.

2.12.2 Effects on Critical Habitat

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

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

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

2. Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth
   The proposed actions would cause long-term undetectable effects on prey availability and quality. Action-related impacts would annually injure or kill extremely low numbers of individual juvenile Chinook salmon (primary prey), during the final portion their freshwater migration lifestage. However, the numbers of affected juvenile Chinook salmon would be too small to cause detectable effects on the numbers of available adult Chinook salmon in marine waters. Therefore, it would cause no detectable reduction in prey availability and quality.

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

Therefore, the proposed action is not likely to adversely affect SR killer whale critical habitat.

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

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

Section 305(b) of the MSA directs Federal agencies to consult with the NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) of the MSA also requires the NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)].

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

3.1 Essential Fish Habitat Affected By the Project

The project sites are located in Seattle, along the eastern shore of Lake Washington (Figure 1). The waters and substrate of Lake Washington are designated as freshwater EFH for various life-history stages of Pacific Coast Salmon, which within the Lake Washington watershed include Chinook and coho salmon. Due to trophic links between PS Chinook salmon and SR killer whales, the project's action area also overlaps with marine waters that have been designated, under the MSA, as EFH for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species. However, the action would cause no detectable effects on any components of marine EFH. Therefore, the action's effects on EFH would be limited to impacts on freshwater EFH for Pacific Coast Salmon, and it would not adversely affect marine EFH for Pacific Coast Salmon, or EFH for Pacific Coast groundfish and coastal pelagic species.
Freshwater EFH for Pacific salmon is identified and described in Appendix A to the Pacific Coast salmon fishery management plan, and consists of four major components: (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors and holding habitat.

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

As part of Pacific Coast Salmon EFH, five Habitat Areas of Particular Concern (HAPCs) have been defined: 1) complex channels and floodplain habitats; 2) thermal refugia; 3) spawning habitat; 4) estuaries; and 5) marine and estuarine submerged aquatic vegetation. The action area provides no known HAPC habitat features.

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 minor short- and long-term adverse effects on EFH for Pacific Coast Salmon as summarized below.

1. Water quality – The proposed action would cause minor short- and long-term adverse and long-term beneficial effects on this attribute. Demolition of the existing piers and bulkhead and construction of the new piers and bulkhead would cause short-term adverse effects on water quality that would be mostly contained within full-depth sediment curtains, and would persist no more than a low number of hours after work stops. ACZA-treated timber and continued vessel operations at the piers would maintain persistent low level inputs of contaminants at the piers. The permanent removal of 13 creosote-treated timber piles would initially reduce water quality locally, but over the long-term would reduce ongoing PAH contamination at the sites. Detectable water quality impacts are expected to be limited to the areas within 300 feet around the project sites. The action would cause no measurable changes in water temperature or salinity.

2. Water quantity, depth, and velocity – No changes expected.

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 minor long-term adverse effects on this attribute. The replacement of the overwater structures would limit SAV growth and reduce the density and diversity of the benthic and planktonic communities under those structures, such as amphipods, copepods, and larvae of benthic species that are important prey resources for juvenile salmonids. Additionally, any contaminants that are mobilized during pile removal, combined with continued low-level input of contaminants from the residential pier structures and related vessel operations would contaminate or kill some of the available prey resources. Detectable effects would be limited to the area within about 300 feet around each of the piers.

6. Cover and habitat complexity – The proposed action would cause minor long-term adverse effects on this attribute. The replacement of the overwater structures would limit SAV growth under those structures despite the conversion of solid plank decking to fully-grated decking that would increase light penetration as compared to the existing piers. Detectable effects would be limited to the combined 2,288-square foot area under the repaired/replaced overwater structures at the two piers.

7. Water quantity – No changes expected.

8. Space – No changes expected.

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

10. Groundwater-stream interactions – No changes expected.

11. Connectivity with terrestrial ecosystems – No changes expected.

12. Substrate composition – No changes expected.

3.3 Essential Fish Habitat Conservation Recommendations

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

To reduce adverse impacts on water quality and prey availability, the USACE should:

1. Encourage the applicant to limit all in- and overwater work to the period between July 16 and December 31 to reduce the likelihood exposing juvenile Chinook salmon to the direct effects of construction.

The NMFS knows of no practical measures that are available to further reduce the action's expected effects on cover and habitat complexity.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2, above, for Pacific Coast salmon.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the USACE must provide a detailed written response to the NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of the NMFS' EFH Conservation Recommendations unless the NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with the NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

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

3.5 Supplemental Consultation

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

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this opinion is the USACE. Other interested users could include the applicant, WDFW, the governments and citizens of King County and the City of Seattle, and Native American tribes. Individual copies of this opinion were provided to the USACE. The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adheres to conventional standards for style.

4.2 Integrity

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

4.3 Objectivity

Information Product Category: Natural Resource Plan

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