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

Refer to NMFS No:
WCRO-2020-00112

June 25, 2020

Laura Boerner
PlanningChief
Environmental and Cultural Resources Branch
Corps of Engineers, Seattle District
Post Office 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 U.S. Army Corps of Engineers' Proposed Maintenance Dredging of the Kenmore Federal Navigation Channel in King County, Washington, HUC: 171100120400 – Lake Washington.

Dear Ms. Boerner:

Thank you for your letter of January 28, 2020, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the U.S. Army Corps of Engineers' (COE) proposed maintenance dredging of the Kenmore Federal Navigation Channel. 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.

This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016). The enclosed document contains the biological opinion (Opinion) prepared by the NMFS pursuant to section 7 of the ESA on the effects of the proposed action. In this Opinion, the NMFS concludes that the proposed action would adversely affect but is not likely to jeopardize the continued existence of Puget Sound (PS) Chinook salmon. The NMFS also concludes that the proposed action is likely to adversely affect designated critical habitat for PS Chinook salmon but is not likely to result in the destruction or adverse modification of that designated critical habitat. This document also documents our conclusion that the proposed action is not likely to adversely affect PS steelhead, southern resident (SR) killer whales and their designated critical habitat.

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

Section 3 of this document includes our analysis of the action's likely effects on EFH pursuant to Section 305(b) of the MSA. Based on that analysis, the NMFS concluded that the action would adversely affect designated EFH for Pacific Coast Salmon. Therefore, we have provided 2 conservation recommendations that can be taken by the COE to avoid, minimize, or otherwise offset potential adverse effects on EFH. We also concluded that the action would not adversely affect EFH for Pacific Coast groundfish and coastal pelagic species. Therefore, consultation under the MSA is not required for 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 COE must explain why the recommendations will not be followed, including the scientific justification for any disagreements over the effects of the action and recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we request that in your statutory reply to the EFH portion of this consultation you clearly identify the number of conservation recommendations accepted.

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

Sincerely,

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

cc: Mike Scuderi, COE
Fred Goetz, COE
Karen Walter, Muckleshoot Indian Tribe

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

U.S. Army Corps of Engineers' Proposed Maintenance Dredging of the Kenmore Federal Navigation Channel in King County, Washington, HUC: 171100120400 – Lake Washington

NMFS Consultation Number: WCRO-2020-00112

Action Agency: U.S. Army Corps of Engineers

Affected Species and NMFS' Determinations:

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

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

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

Consultation Conducted By: National Marine Fisheries Service
West Coast Region

Issued By:

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

Date: June 25, 2020

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LIST OF ACRONYMS

BA – Biological Assessment
BMP – Best Management Practices
CFR – Code of Federal Regulations
COE – Corps of Engineers, U.S. Army
DIP – Demographically Independent Population
DMMP – Dredged Material Management Program
DO – Dissolved Oxygen
DPS – Distinct Population Segment
DQA – Data Quality Act
EF – Essential Feature
EFH – Essential Fish Habitat
ESA – Endangered Species Act
ESU – Evolutionarily Significant Unit
FR – Federal Register
FMP – Fishery Management Plan
HAPC – Habitat Area of Particular Concern
HUC – Hydrologic Unit Code
ITS – Incidental Take Statement
mg/L – Milligrams per Liter
MCTA – Model Toxics Control Act (WDOE)
MLLW – Mean Lower Low Water
MPG – Major Population Group
MSA – Magnuson-Stevens Fishery Conservation and Management Act
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
NTU – Nephlometric Turbidity Units
PAH – Polycyclic Aromatic Hydrocarbons
PBF – Physical or Biological Feature
PCB – Polychlorinated Biphenyl
PCE – Primary Constituent Element
PFMC – Pacific Fishery Management Council
PS – Puget Sound
PSTRT – Puget Sound Technical Recovery Team
RL – Received Level
RPA – Reasonable and Prudent Alternative
RPM – Reasonable and Prudent Measure
SAV – Submerged Aquatic Vegetation
SEL – Sound Exposure Level
SL – Source Level
TSS – Total Suspended Sediments
USEPA – U.S. Environmental Protection Agency
VSP – Viable Salmonid Population
WCR – West Coast Region (NMFS)
WDFW – Washington State Department of Fish and Wildlife

WDNR – Washington State Department of Natural Resources
WDOE – Washington State Department of Ecology
WQC – Water Quality Certification
WQMP – Water Quality Monitoring Plan

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 January 28, 2020, the NMFS received a letter from the COE, requesting informal consultation for their proposed maintenance dredging of the Kenmore Federal Navigation Channel in Lake Washington (COE 2020a), with its enclosed biological assessment (BA) (COE 2019a). On February 28, 2020, NMFS sent an e-mail to inform the COE that formal consultation was required, and that additional information was required to initiate formal consultation. On March 9, 2020, the COE requested formal consultation and provided the requested information. Formal consultation was initiated on that date. On May 19, 2020, the COE included a supplemental determination that the proposed action may affect, but is not likely to adversely affect SR killer whales and their critical habitat (COE 2020b & c).

This Opinion is based on the information in the BA; supplemental materials and responses to NMFS questions; recovery plans, status reviews, and critical habitat designations for ESA-listed PS Chinook salmon; published and unpublished scientific information on the biology and ecology of that 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 the EFH definition of a federal action is any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).

The COE proposes to conduct routine maintenance dredging to remove accumulated sediments from the Kenmore Navigation Channel, at the north end of Lake Washington (Figure 1). The proposed action would re-achieve the authorized conditions of the existing navigation channel, and would cause no changes in the type or frequency of vessel traffic in the channel.

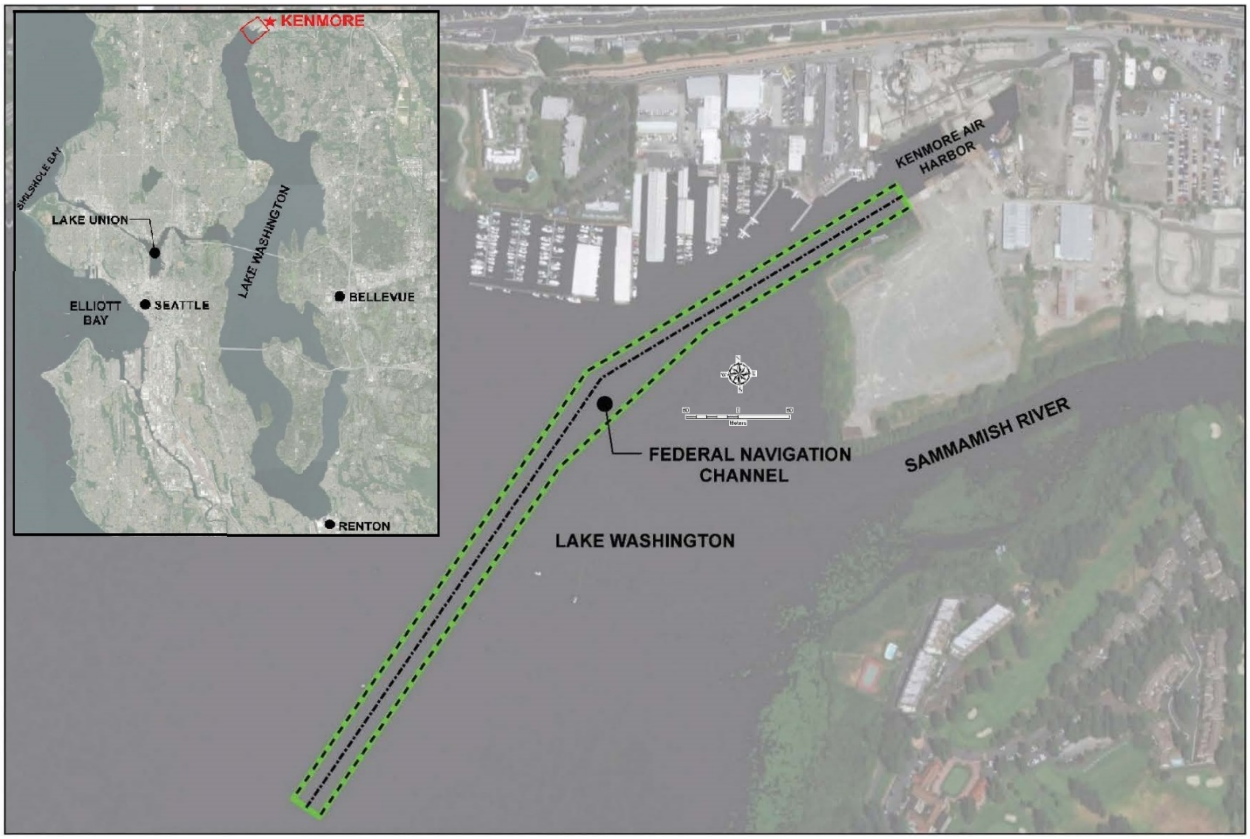

Figure 1. Google satellite images of the Kenmore Federal Navigation Channel project area in Lake Washington (Adapted from COE 2019a Figures 1-1 & 1-2).

The authorized channel is 2,900 feet long and 100 to 120 feet wide, with an authorized depth of 15 feet below Lake Washington's low lake level, which is 20 feet above mean lower low water (MLLW) for Puget Sound (+20 feet re. MLLW). The bottom of the authorized channel is +5 feet re. MLLW. The COE's dredging contractor (Contractor) would operate a barge-mounted mechanical clamshell dredge (Figure 2) to remove up to 45,000 cubic-yards accumulated sands and silts to achieve a maximum allowable over-depth of 17 feet below low lake level.

Dredged material would be placed in a barge for dewatering at the project site, and subsequent transportation to a shore-side location where it would be transferred to non-leaking containers or trucks that would be used to transport the material to an approved upland disposal site. All dredging and dewatering would comply with water quality requirements for turbidity, according to the water quality monitoring plan (WQMP) for this project.

Figure 2. Large clamshell dredge on a spud barge. A second a barge for sediment collection and transport is moored alongside.

Based on the bathymetric information in the BA, about 2/3 of the channel is shallower than 17 feet below low lake level, and is therefore likely to be dredged (Figure 3).

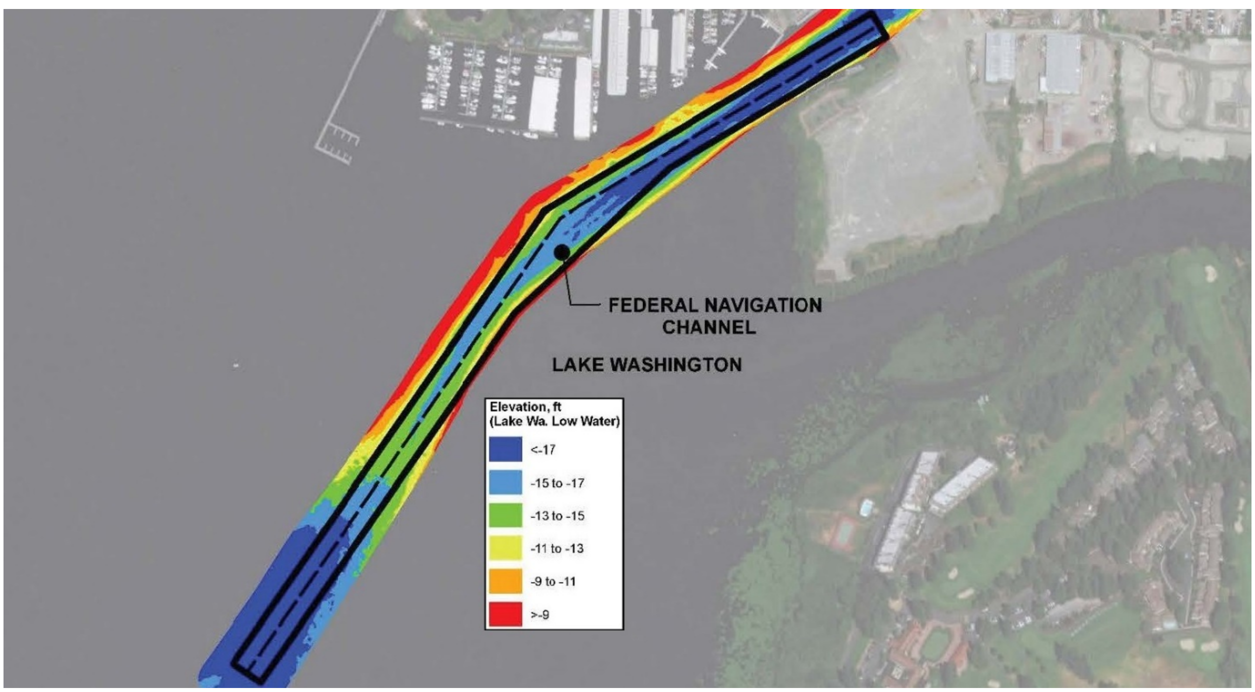

Figure 3 Google satellite image of the North end of Lake Washington, with data from a July 2018 bathymetric survey of the Kenmore Federal Navigation Channel superimposed. Areas shown in dark blue exceed the maximum allowable dredge depth (Adapted from COE 2019a Figure 2-1).

Work is expected to begin in November 2020, and to require 77 days of round the clock work (i.e. 24 hours per day, 7 days a week) to complete. Dredging would be limited to the November 16 through February 1 in-water work window for the area. The COE's contractors would be required to comply with the best management practices (BMPs) identified in the project BA, as well as the protocols and criteria in the WQMP for this project.

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

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS 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 COE determined that the proposed action is likely to adversely affect PS Chinook salmon and its designated critical habitat, is not likely to adversely affect PS steelhead, SR killer whales and their designated critical habitat, and would have no effect on designated critical habitat for PS steelhead because the action area has been excluded from that designation (Table 1). Because the proposed action is likely to adversely affect listed species, the NMFS has proceeded with formal consultation. Our concurrence with the COE's determination that their action is not likely to adversely affect PS steelhead and SR killer whales and their designated critical habitat is documented in the "Not Likely to Adversely Affect" Determinations section (2.12).

Table 1. ESA-listed species and critical habitats 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)
ESA-listed species and critical habitat not likely to be adversely affected (NLAA)				
Species	**Status**	**Species**	**Critical Habitat**	**Listed / CH Designated**
steelhead (*O. mykiss*) Puget Sound	Threatened	NLAA	N/A	05/11/07 (72 FR 26722) / 02/24/16 (81 FR 9252)
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 biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR402.02). 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).

Critical habitat designations prior to 2016 used the terms "primary constituent element" (PCE) or "essential feature" (EF) to identify important habitat qualities. However, the 2016 critical habitat regulations (50 CFR 424.12) replaced those terms with "physical or biological features" (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, EFs, or PBFs. In this biological opinion, we use the term PBF to mean PCE or EF, 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 essential PBFs that help to form that conservation value.

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

Listed Species

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

<u>Abundance and Productivity:</u> Available data on total abundance since 1980 indicate that abundance trends have fluctuated between positive and negative for individual populations, but productivity remains low in most populations, and hatchery-origin spawners are present in high

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

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

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

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

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

PS Chinook Salmon within the Action Area: The PS Chinook salmon that are most likely to occur in the action area would be fall-run Chinook salmon from the North Lake Washington / Sammamish River population (NWFSC 2015; WDFW 2020a). Both stream- and ocean-type Chinook salmon are present in this population, with the majority being ocean-types. The population is 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, and the trend is relatively flat to slightly negative (NWFSC 2015; WDFW 2020b).

Returning adults and out-migrating juveniles from this population are likely to pass through the action area. Adult Chinook salmon pass through Chittenden Locks (aka Ballard Locks) between mid-June through September, with peak migration occurring in mid-August (City of Seattle 2008). Spawning occurs well upstream of the action area between early August and late October. Juvenile Chinook salmon enter Lake Washington between January and July, primarily in the littoral zone (Tabor *et al*. 2006). Outmigration through the ship canal and through the locks occurs between late-May and early-July, with the peak occurring in June (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 3.

Table 3. 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

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

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

Diking, agriculture, revetments, railroads and roads in lower stream reaches have caused significant loss of secondary channels in major valley floodplains in this region. Confined main channels create high-energy peak flows that remove smaller substrate particles and LW. The loss of side-channels, oxbow lakes, and backwater habitats has resulted in a significant loss of juvenile salmonid rearing and refuge habitat. When the water level of Lake Washington was lowered 9 feet in the 1910s, thousands of acres of wetlands along the shoreline of Lake Washington, Lake Sammamish and the Sammamish River corridor were drained and converted to agricultural and urban uses. Wetlands play an important role in hydrologic processes, as they store water which ameliorates high and low flows. The interchange of surface and groundwater in complex stream and wetland systems helps to moderate stream temperatures. 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 LW to downstream areas (SSPS 2007). These actions tend to promote downstream channel incision and simplification (Kondolf 1997), limiting fish habitat. Water withdrawals reduce available fish habitat and alter sediment transport. Hydropower projects often change flow rates, stranding and killing fish, and reducing aquatic invertebrate (food source) productivity (Hunter 1992).

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

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

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

Critical Habitat within the Action Area: All of Lake Washington has been designated as freshwater critical habitat for PS Chinook salmon. The critical habitat within the action area primarily supports the Freshwater Migration PBF for juvenile and adult PS Chinook (NOAA 2020; WDFW 2020a).

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 COE's project site is located at the north end of Lake Washington (Figure 1). As described in sections 2.5, project-related water quality effects around dredging and tugboat operations would be the stressor with the greatest range of effects for fish. Those effects are expected to include the waters and substrates of north Lake Washington within 300 feet around the entire length of the Kenmore Federal Navigation Channel (Figure 4). 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.

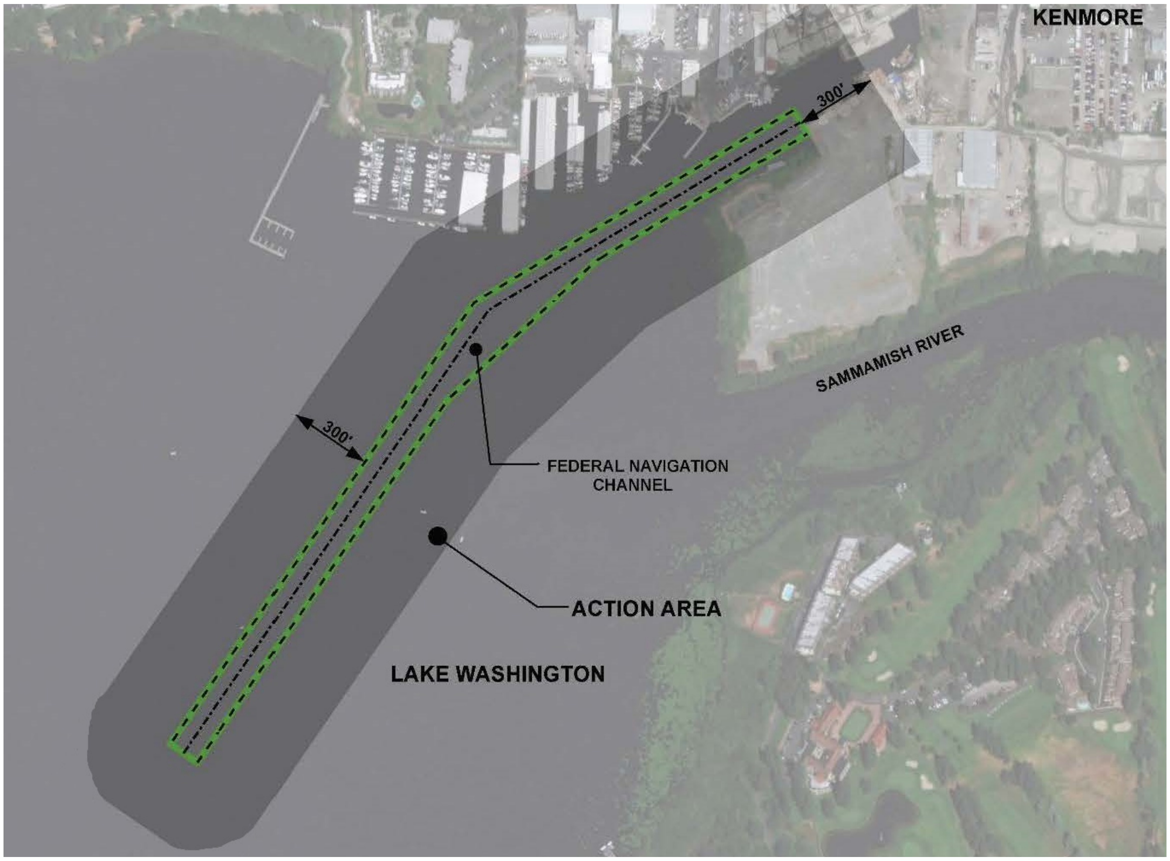

Figure 4. Google satellite image of the North end of Lake Washington, with the Kenmore Federal Navigation Channel superimposed, and the area where ESA-listed fish may be affected shaded in grey (Adapted from COE 2019a Figure 3-1).

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).

<u>Environmental conditions at the project site and the surrounding area:</u> The project site is located at the City of Kenmore, at the north end of Lake Washington where the Sammamish River enters

the lake (Figure 1). Although the action area includes the marine waters of Puget Sound, all detectable effects of the action would be limited to the area within 300 feet of the channel (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 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 Kenmore Federal Navigation Channel was completed in 1981. The channel is 2,900 feet long and 100 to 120 feet wide, with an authorized depth of 15 feet below Lake Washington's low lake level (+5 feet re. MLLW). It was most recently dredged in 1998. The shoreline surrounding the channel consist mostly of industrial and commercial properties that include the CalPortland Kenmore Aggregate Yard, which ships sand, gravel, and aggregate products via barge, Kenmore Air, which operates commercial floatplane flights and tours, and the North Lake and Harbour Village Marinas, each of which have more than 150 slips. The Inglewood Golf Club is located south of the mouth of the Sammamish River (Figure 1).

The State has identified no water quality issues within the action area. However, the portion of Lake Washington just south of the Sammamish River is included on the current WDOE 303(d) list of threatened and impaired water bodies for Polychlorinated Biphenyls (PCBs) and total phosphorus (WDOE 2020). The Sammamish River is also listed for dissolved oxygen (DO), bacteria, and temperature. The COE reports that summer water temperatures can exceed 20°C in the Sammamish River, and 25° C parts of Lake Washington (COE 2019a).

The aquatic substrate in and near the channel consists predominantly of very silty sand ranging in depth of less than 9 feet to over 17 feet and deeper near the center of the channel and/or with movement toward the center of the lake. Sampling of channel sediments was conducted during the first quarter of 2019. The sediments are very fine, composed of 28 to 40 percent sand, 42 to 50 percent silt, and 16 to 21 percent clay. Chemical analysis of the sediments also determined that some of the channel sediments are unsuitable for disposal in the aquatic environment because they were marginally above the State's Dredged Material Management Program (DMMP) screening levels for butylbenzyl phthalate, total chlordanes, and dioxin. However, they did not exceed Washington Department of Ecology's (WDOE) Model Toxics Control Act (MTCA) definition of contaminated material (COE 2019a & b). The DMMP is jointly administered by the COE, the US Environmental Protection Agency (USEPA), the WDOE, and the Washington State Department of Natural Resources (WDNR) to determine if dredged material is suitable for unconfined aquatic disposal in the marine environment. The chemical analyses also detected numerous other chemicals and metals, such as numerous Polycyclic Aromatic Hydrocarbons (PAHs), copper, and zinc at levels below state and federal thresholds (COE 2019 b). However, the DMMP screening levels are not necessarily protective of freshwater fish.

The nearby North Lake and Harbour Village marinas are designated as WDOE MTCA sites, and cleanup has started at both sites. Soil and groundwater at the Harbour Village Marina is being remediated for petroleum, and aquatic sediments are being remediated for dioxins, phenols, PCBs, and PAHs. Aquatic sediments at the North Lake Marina are being remediated for benzene, lead, and petroleum.

Aquatic and emergent noxious weeds, including Eurasian watermilfoil, Brazilian Egeria, and fragrant waterlily, as well as garden and purple loosestrife are widespread near the project area. The pelagic invertebrate community of Lake Washington is dominated by mysid shrimp, Daphnia species, and calanoid and cyclopoid copepods. The biodiversity of the benthic macroinvertebrate community is limited and primarily composed of hardy pollution-tolerant taxa such as chironomids, oligochaete worms, and several clam species that tolerate low oxygen levels. Prickly sculpin dominate the benthic fish community (COE 2019a).

The past and ongoing anthropogenic impacts described above have reduced the action area's ability to support migrating PS Chinook salmon. However, the action area continues to provide migratory habitat for adults and juveniles, and the area has also been designated as critical habitat for this species.

<u>Climate Change:</u> Climate change has affected the environmental baseline of aquatic habitats across the region and within the action area. However, the effects of climate change have not been homogeneous across the region, nor are they likely to be in the future. During the last century, average air temperatures in the Pacific Northwest have increased by 1 to 1.4° F (0.6 to 0.8º C), and up to 2° F (1.1º 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 5.6º C), with the largest increases predicted to occur in the summer (Mote et al. 2014).

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

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

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

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

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

2.5 Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. 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).

As described in Section 1.3, the COE proposes to conduct 77 days of around the clock mechanical dredging at the north end of Lake Washington with a clamshell dredge. Work would be completed between November 16 and February 1, and is expected to begin in 2020.

As described in Section 2.2, PS Chinook salmon inhabit the action area, which has been designated critical habitat for that species. The proposed timing of the work avoids the typical migration periods for both juvenile and adult PS Chinook salmon, and some juveniles are known to remain in the system year-round. Therefore, the planned dredging may cause direct effects on juvenile PS Chinook salmon and/or the PBFs of their critical habitat through exposure to elevated noise, entrainment or bucket strike, degraded water quality, and propeller wash. It may also cause indirect effects on juvenile PS Chinook salmon and/or the PBFs of their critical habitat through exposure to contaminated forage, and the effects of altered benthic habitat.

2.5.1 Effects on Listed Species

Elevated Noise

Exposure to dredging-related noise would cause minor effects in PS Chinook salmon. Elevated in-water noise at levels capable of causing detectable effects in exposed fish would be caused by the in-water dredging and tugboat operations, including spud deployment.

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

The NMFS uses two metrics to estimate the onset of injury for fish exposed to high intensity impulsive sounds. The metrics are based on exposure to peak sound level and sound exposure level (SEL), respectively. Both are expressed in decibels (dB). The metrics are: 1) exposure to 206 dB_{peak}; and 2) exposure to 187 dB SEL_{cum} for fish 2 grams or larger, or 183 dB SEL_{cum} for fish under 2 grams. Any received level (RL) below 150 dB_{SEL} is considered "Effective Quiet". The distance from a source where the RL drops to 150 dB_{SEL} is considered the maximum distance from that source where fishes can be affected by the noise, regardless of accumulation of the sound energy (Stadler and Woodbury 2009). Therefore, when there is a difference between the ranges to the isopleths for effective quiet and SEL_{cum}, the shorter range shall apply. The discussion in Stadler and Woodbury (2009) makes it clear that the thresholds likely overestimate the potential effects of exposure to impulsive sounds. Further, the assessment did not consider non-impulsive sound because it is believed to be less injurious to fish than impulsive sound. Therefore, any application of the criteria to non-impulsive sounds is also likely to overestimate the potential effects in fish. However, this assessment applies the criteria to both impulsive and non-impulsive sounds for continuity, and as a tool to gain a conservative idea of the sound energies that fish may be exposed to during the majority of this project.

The estimated in-water source levels (SL, sound level at 1 meter from the source) used in this assessment are based on the best available information, as described in a recent acoustic assessment for a similar project (NMFS 2016), and in other sources (Blackwell and Greene 2006; COE 2011a; Dickerson et al. 2001; Reine et al. 2012 & 2014; Richardson et al. 1995). The best available information supports the understanding that all of the SLs would be below the 206 dB_{peak} threshold for the onset of instantaneous injury in fish.

In the absence of location-specific transmission loss data, variations of the equation RL = SL – #Log(R) are often used to estimate the received sound level at a given range from a source (RL = received level (dB); SL = source level (dB, 1 m from the source); # = spreading loss coefficient; and R = range in meters (m). Acoustic measurements in shallow water environments support the use of a value close to 15 for projects like this one (CalTrans 2009). This value is considered the practical spreading loss coefficient.

Application of the practical spreading loss equation to the expected SLs suggests that noise levels above the 150 dB_{SEL} threshold could extend to about 177 feet (54 m) around the barges when they deploy spuds, 72 feet (22 m) around tugboats, and about 13 feet (4 m) around dredging work (Table 4). Individuals that are beyond the 150 dB_{SEL} isopleth for any of these sources would be unaffected by the noise. However, fish within the 150 dB_{SEL} isopleth are likely to experience a range of impacts that would depend on their distance from the source and the duration of their exposure.

Table 4. 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
Spud Deployment	< 1.6 kHz Impulsive	201 dB_{peak}	206 @ N/A
		176 dB_{SEL}	150 @ 54 m
Tugboat Propulsion	< 1 kHz Combination	185 dB_{peak}	206 @ N/A
		170 dB_{SEL}	150 @ 22 m
Dredge Bucket Strike	< 370 Hz Impulsive	184 dB_{peak}	206 @ N/A
		167 dB_{SEL}	150 @ 4 m

Project-related dredging would likely require the use of a single spud-barge and the periodic use of a tugboat. Spud-barges typically have 2 or more spuds (steel pipes or girders) that they drop to the substrate and lock in place to hold their position (instead of using anchors). Each time a spud strikes the substrate, it would cause a brief sound impulse that would be fish-detectable up to 177 feet away. The exact per-day number spud deployments for this project is unknown and would be highly variable over time, but they would be relatively infrequent and too few in number to be a concern for accumulated sound energy impacting listed fish.

The frequency and duration of project-related tugboat operations is uncertain, but could consist of relatively continuous periods during any day they are used. However, their frequent movement is expected to preclude any concern for impacts on fish from accumulated sound energy. Similarly, although in-water dredging would be source of continuous noise during the project, is extremely unlikely that any fish would remain within 13 feet of that work long enough for accumulated sound energy to be a concern. Additionally, these three sound sources are very unlikely to have any additive effects with each other due the differences in the frequencies and other characteristics of their sound. At most, the combination of the various types of equipment noise during any given day would cause fish-detectable in-water noise levels across the entire workday.

Based on the best available information, the most likely effect of exposure to project-related noise would be minor behavioral disturbances, such as mild acoustic masking, brief startle responses and altered swimming patterns, and temporary avoidance of the source. These responses would cause no measurable effects on the fitness of the exposed individuals, nor would it prevent their migration past the areas or prevent access to important habitat resources.

Entrainment or Bucket Strike

The likelihood of PS Chinook salmon exposure to dredging-related entrainment or bucket strike is extremely low. The COE's contractors would conduct 77 days of dredging with a clamshell bucket at the north end of Lake Washington between November 16 and February 1.

Any fish that become captured within the digging bucket (entrainment) or that are struck by the bucket as it descends would likely be killed. However, the documented occurrence of these events for mobile fish species are extremely rare. In the Southeast Region of the US, where closely monitored heavy dredging operations occur regularly in areas inhabited by sturgeon and sea turtles, only two live sturgeon (NMFS 2012) and two live sea turtles (NMFS 2011) are known to have been taken by clamshell dredging since 1990.

The rarity of these occurrences is likely due to a combination of factors. In order to be entrained in a clamshell bucket, a fish must be directly under the bucket when it drops. The relatively small size of the bucket, compared against the scattered and low-density distribution of the fish across the available habitat within the project area make strongly suggest that the potential for overlap between fish and bucket presence is very low, and that potential would decrease after the first few bucket cycles because mobile organisms such as salmon are likely to move quickly away from the noise and turbid water. Further, mechanical dredges typically stay within an area limited to the range of the crane/excavator arm for many minutes to several hours before moving to an adjacent area. The risk of entrainment and bucket strike during the planned dredging would lowered further by conducting the work during a period when very few individuals are likely to be present anywhere within the action area. Therefore, based on the best available information, the NMFS considers it extremely unlikely that any PS Chinook salmon would be entrained or struck by the bucket during the planned maintenance dredging.

Degraded Water Quality

Exposure to construction-related degraded quality would cause minor effects in PS Chinook salmon. As stated above, the COE's contractors would conduct 77 days of dredging with a clamshell bucket at the north end of Lake Washington between November 16 and February 1, which would also include the operation of tugboats in relatively shallow-water areas. This work would temporarily affect water quality through increased turbidity. It may also temporarily affect water quality through reduced dissolved oxygen (DO) concentrations, and through the introduction of toxic materials from the mobilized sediments and from equipment-related spills and discharges.

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

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.

Mechanical dredging in areas containing high levels of fine-grained material is likely to cause suspended sediment plumes that could extend 200 to 500 feet down-current from the point of dredging, and may take hours after work has stopped to return to background levels. LaSalle et. al. (1991) reported suspended sediment concentrations of about 700 mg/L at the surface, and 1,100 mg/L near the bottom, about 300 feet from clamshell dredging in areas containing high levels of fine-grained material. During monitored clamshell dredging of inner Grays Harbor, the suspended sediment concentrations exceeded 500 mg/L in 23 of 600 samples, and seven of those samples were for tests of ambient conditions (COE 2011b). The single highest reported concentration was 3,000 mg/L when the ambient TSS concentration was 700 mg/L.

The COE’s contractors would be required to comply with the WQMP for this project, and to monitor and limit turbidity such that at 300 feet from the dredge turbidity would not exceed 5 NTU (~5 mg/L) above background levels of 50 NTU or less, and to 10% above background for background levels above 50 NTU (Appendix A in COE 2019a).

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 sediment that is likely to be mobilized. Fine material (silt) remains mobilized longer than coarse material (sand). The shallower the water, the more thrust energy that would reach the substrate. A recent study described the turbidly caused by large tugboats operating in Navy harbors (ESTCP 2016). At about 13 minutes, the plume extended about 550 yards (500 m), where the TSS concentration was about 80 mg/L. The plume persisted for hours and extended far from the event, but the TSS concentration fell to 30 mg/L within 1 hour and to 15 mg/L within 3 hours. At its highest concentration, the plume was below the concentrations required to elicit physiological responses reported by Newcombe and Jensen (1996). The exact extent of turbidly plumes from tugboat operations for this project are unknown, but it is extremely unlikely that would exceed those described above. Based on that information, and on the consultations for similar projects in the region, sediment mobilization from tugboat propeller wash would likely consist of relatively low-concentration plumes that could extend to about 300 feet from the site, and last a low number of hours hour after the disturbance.

Based on the best available information, construction-related turbidity concentrations would be too low and short-lived to cause more than temporary, 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. None of these potential responses, individually, or in combination would affect the fitness or meaningfully affect normal behaviors in exposed fish.

<u>Dissolved Oxygen (DO):</u> Mobilization of anaerobic sediments can decrease dissolved oxygen (DO) levels (Hicks et al., 1991; Morton 1976). The impact on DO is a function of the oxygen demand of the sediments, the amount of material suspended in the water, the duration of suspension, and the water temperature (Lunz and LaSalle 1986; Lunz et al. 1988). Reduced DO can affect salmonid swimming performance (Bjornn and Reiser 1991), as well as cause avoidance of water with low DO levels (Hicks 1999). The sediment analysis report (COE 2019b) indicated above average levels of organic material in the sediments, but said nothing about the expected biological or chemical oxygen demands (BOD or COD) that mobilization of those sediments would be likely to cause. Based on the knowledge that sediments have been accumulating for over 20 years, the reported high levels of organic material, and absence of information to the contrary, the NMFS considers it reasonably likely that sediment mobilization would lower DO levels enough to cause detectable behavioral effects in juvenile Chinook salmon that enter within the expected 300-foot radius of sediment mobilization around the dredge. Further, because the dredging is expected to continue non-stop once it starts, those conditions are likely to persist around the clock for 77 days. However, the most likely effects of salmonid exposure to the reduced DO would be limited to non-injurious behavioral effects such as avoidance of the turbidity plume, which would not affect the fitness of the exposed fish or meaningfully affect its normal behaviors beyond avoiding the 300-foot area around active dredging.

<u>Construction-related Spills:</u> Toxic materials may enter the water through construction-related spills and discharges and by the mobilization of contaminated sediments. 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). Many of the fuels, lubricants, and other fluids commonly used in motorized vehicles and construction equipment are petroleum-based hydrocarbons that contain PAHs, which are known to be injurious to fish. Other contaminants can include metals, pesticides, 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, and 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. 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.

Dredge-mobilized Pollutants: The sediments within the Kenmore channel were sampled and analyzed in 2019 to determine their suitability under the State's DMMP for open-water disposal at the Elliott Bay non-dispersive site. The analyses determined that butylbenzyl phthalate, total chlordanes, and dioxin levels in some of the sediment samples were marginally above DMMP screening levels (COE 2019b). The analyses also detected numerous metals, including copper and zinc, as well as numerous PAHs. The planned dredging would mobilize these pollutants into the water column. The sediment analysis suggests that sediment contamination levels are low, with only a subset of the project area marginally exceeding the acceptable DMMP sediment screening levels for open ocean disposal. The exact in-water concentrations of contaminants that would be mobilized by the planned dredging is uncertain, but are likely to be very low.

The concentrations of contaminants that would be mobilized by the planned dredging would be proportional to the amount of dredging and the levels of contamination. The best available information suggest that sediment resuspension rates for clamshell dredging would somewhere between 1 and 3 percent (Bridges et al. 2008; COE 2016). The COE estimates that the project would remove up to 45,000 cubic yards of sediment. Assuming 3 percent resuspension suggests that up to 1,350 cubic yards of sediment would be re-suspended into the water column over the life of the project. Based on the expectation that 77 days of non-stop dredging would be done, about 0.73 cubic yards of sediment would be mobilized per hour. Given the high levels of very fine sediment in the area, much of the material would remain suspended for hours after it is initially mobilized (Bridges et al. 2008). Therefore sediments are likely to accumulate in the water column. Assuming 0.73 cubic yards of sediment mobilization per hour and a 4-hour average suspension time for mobilized sediments, about 3 cubic yards could be suspended in the water around the dredge at any time.

The best understood contaminant exposure thresholds for salmon are those for exposure to dissolved copper and zinc. Exposure to dissolved copper at concentrations of 0.3 to 3.2 μg/L above background levels has been shown to cause avoidance of an area, to reduce salmonid olfaction, and to induce behaviors that increase juvenile salmon's vulnerability to predators in freshwater (Giattina et al. 1982; Hecht et al. 2007; McIntyre et al. 2012; Sommers et al. 2016; Tierney et al. 2010). 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).

The reported copper concentrations in the channel sediments ranged from 25.4 to 53.1 mg/kg (25,400 to 53,100 µg/kg). The reported zinc concentrations ranged from 102 to 191 mg/kg (102,000 to 191,000 µg/kg). Assuming a 300-foot radius (WDOE turbidity point of compliance for this project) and a 15-foot average depth around the dredge, the volume of affected water would be about 360,288,067 liters. Further assuming continuous suspension of 3 cubic yards of sediment (1,686 kg, Lee et al. 1976), full dissolution of the highest reported copper concentration, and even distribution, the dissolved copper concentration within the affected area would be about 0.25 µg/L. Applying the same assumptions to zinc suggests a dissolved zinc concentration of about 0.89 µg/L. In reality, full dissolution would not occur, and the concentrations would highest close to the dredge and decrease with distance away from it. Based on the available information the dissolved copper and zinc concentrations would be too low to cause any detectable fitness or behavioral effects in exposed individuals.

PAHs can cause reduced growth, increased susceptibility to infection, and increased mortality in juvenile salmonids (Eisler 1987; Meador et al. 2006; Varanasi et al. 1993). Gill tissues are highly susceptible to damage because they actively pass large volumes of water and are thereby exposed to PAHs present in water (COE 2016). Other effects include damage to the skin, fins, and eyes, as well as damage to internal organs as liver tumors. The reported total PAH concentrations in the channel sediments ranged from 933.6 to 3,825 µg/kg. Based on the same volumetric assumption give above, the maximum in-water PAH concentrations would be about 0.00001 µg/L during dredging, but they would likely be lower. No specific thresholds of effect are available for salmonid exposure to PAHs, and the effects identified above were documented in rearing juveniles migrating through a highly contaminated river reach. Based on the available information the in-water PAH concentrations are likely to be too low to cause any detectable fitness or behavioral effects in exposed individuals.

Dioxins and dioxin-like Polychlorinated Biphenyls (PCBs) are highly toxic pollutants that can cause cancer, reproductive and developmental problems, damage to the immune system, and can interfere with hormones in nearly every vertebrate species, at nearly every stage of development (CHE 2020; Eisler 1986; EPA 2020; Meador et al. 2002; NIEHS 2020; Singh et al. 2016). The specific effects of salmonid exposure to dioxins, and to the many other pollutants identified in the sediment analysis report are poorly understood, and no thresholds of effect are available. However, the available information suggests that the in-water concentrations of dioxin and the other pollutants are likely to be too low to cause any detectable fitness or behavioral effects in exposed individuals.

Propeller Wash

Dredge-related propeller wash is likely to adversely affect juvenile PS Chinook salmon. Spinning boat propellers kill fish and small aquatic organisms (Killgore et al. 2011; VIMS 2011). Spinning propellers also generate fast-moving turbulent water that is known as propeller wash. Exposure to propeller wash can displace and disorient small fish. It can also mobilize sediments and dislodge aquatic organisms and submerged aquatic vegetation (SAV), particularly in shallow water and/or at high power settings. This is called propeller scour.

Dredge-related tugboat operations would cause propeller wash within the action area. No adult Chinook salmon are likely to be present in the action area during the dredging project. However, should they be present, they would avoid the dredge-related noise and activity. Further, they would be able to swim against most propeller wash they may be exposed to without any meaningful effect on their fitness or normal behaviors. Conversely, the juvenile Chinook salmon that would be present within the area are likely to be relatively close to the surface and too small to effectively swim against the propeller wash. Individuals that are struck or very nearly missed by the propeller would be injured or killed by the exposure. Farther away, propeller wash may displace and disorient fish. Depending on the direction and strength of the thrust plume, displacement could increase energetic costs, reduce feeding success, and may increase the vulnerability to predators for individuals that tumble stunned and/or disoriented in the wash.

The number of juvenile PS Chinook salmon that would be affected by propeller wash attributable to this action is unquantifiable with any degree of certainty. As stated above, the best available information indicates that very few juvenile Chinook salmon over-winter at the north end of lake Washington, and those individuals represent an extremely small subset of their year's cohort. Further, the relatively small size of the affected area would limit the exposure risk to a small subset of those over-wintering individuals. Therefore, the number of juvenile PS Chinook salmon that would be affected by propeller wash would be extremely low, and too small to cause detectable population-level effects.

Project-related propeller scour may also reduce SAV and diminish the density and diversity of the benthic community at the project sites. However, most the substrate vulnerable to propeller scour would be within the dredging footprint, the impacts of which are described below under altered benthic habitat. Outside of the channel, the total propeller scoured area would likely comprise a tiny portion of the SAV-supporting substrate within and the action area, and the disturbed benthic organisms would likely recover very quickly after the project is complete. Therefore, the effects of propeller scour on SAV and other benthic resources would be too small to cause any detectable effects on the fitness and normal behaviors of Chinook salmon in the action area.

Contaminated Forage

Exposure to contaminated forage is likely to adversely affect juvenile PS Chinook salmon. As described under degraded water quality, the planned dredging would mobilize about 1,350 cubic yards of marginally contaminated sediment. Those sediments would settle onto the top layer of the substrate within about 300 feet of the channel, where the contaminants would remain biologically available for years.

The sediment analysis report indicates that contamination levels in the channel are below the WDOE MTCA definition of contaminated material (COE 2019a), which means they are relatively low as compared to heavily contaminated areas such as portions of the Duwamish Waterway and other waterways near heavily industrialized areas. However, the channel sediments contain harmful contaminants including PAHs, metals, and dioxins (COE 2019b).

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

In addition to direct uptake of contaminants through their gills, salmonids can absorb contaminants through dietary exposure (Meador et al. 2006; Varanasi et al. 1993). 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. Varanasi et al. (1993) found high levels of PAHs in the stomach contents of juvenile Chinook salmon in a contaminated waterway (Duwamish). They also reported reduced growth, suppressed immune competence, as well as increased mortality in juvenile Chinook salmon that was likely caused by the dietary exposure to PAHs. Meador et al. (2006) demonstrated that dietary exposure to PAHs caused "toxicant-induced starvation" with reduced growth and reduced lipid stores in juvenile Chinook salmon. The authors surmised that these impacts could severely impact the odds of survival in affected juvenile Chinook salmon.

Over the 77 days of dredging, most of the mobilized sediment, and therefore the highest concentrations of contaminants, would likely settle back to the lakebed in or close to the channel where the dredging would be done. However, currents and tugboat propeller wash may act to spread contaminated sediments as far away as 300 feet from the dredging (WDOE turbidity point of compliance for this project). Within that area, contaminants such as PAHs and dioxin would be biologically available for years, at steadily decreasing levels as they become covered by incoming river sediments. While present, some of those contaminants are likely to be taken up by some of the invertebrate prey organisms within the affected area.

Some subset of the juvenile Chinook salmon that out-migrate from the Sammamish River watershed 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 within the action area, some of which may be contaminated by dredge-mobilized sediments. The annual number of juvenile PS Chinook salmon that may be exposed to contaminated forage attributable to this action is unquantifiable with any degree of certainty, as is the amount of contaminated prey that any individual fish may consume, or the intensity of any effects that an exposed individual may experience.

However, the affected area would be narrow and oriented mostly away from the shore (Figure 3), and the shoreline-obligated out-migrating juvenile Chinook salmon that would pass through it would do so mostly across its narrow axis close to shore, making the size of the area of intersection between migrating juveniles and potentially contaminated prey very small. Further, based on to the migratory behavior of the fish in this life stage, the time any individual would spend in the affected area would likely be very limited, and there would be a high degree of uncertainty that any individual invertebrate that is consumed within the affected area would be contaminated. Based on this information, the juvenile Chinook salmon that would be measurably affected annually by consumption of dredging-attributable contaminated prey would likely comprise an extremely small subset of their cohort, and the numbers of affected fish would be too low to cause detectable population-level effects.

<u>Altered Benthic Habitat</u>

Alteration of benthic habitats is likely to adversely affect juvenile PS Chinook salmon. The COE's contractors would dredge portions of the channel that are shallower than 17 feet below Lake Washington's low lake level (+3 feet re. MLLW). Based on the available bathymetric information, about 2/3 of the channel meets that threshold (Figure 3). Most of that area is centered southwest of the bend in the channel, but some shallow areas are located near the north end of the channel. The proposed dredging would alter the benthic habitat within the channel.

By design, maintenance dredging maintains areas of artificially deep water areas with steep slopes by removing accumulated sediments. Along its shoreward-most portions, the Kenmore Channel presents a100-foot wide swath of deep water habitat that cuts across a migratory route for juvenile Chinook salmon that annually leave the Sammamish River. Those juveniles would be in a shoreline obligated stage of their life cycle. This means that they are biologically compelled to follow the shoreline. For the individuals that turn right upon leaving the river, this means that they must cross over the channel to continue their migration to saltwater.

The predatory fish that feed on juvenile salmon typically occur in waters deeper than the shallow gently sloping shoreline waters preferred by shoreline-obligated juvenile salmonids. Swimming across the channel would place the migrating juveniles in deeper water where larger predatory fish are more likely to occur. Therefore, swimming across the channel would increase the risk of predation for out-migrating juvenile Chinook salmon. The NMFS knows of no specific figures for freshwater, but Willette (2001) found that marine piscivorous predation of juvenile salmon increased fivefold when juvenile salmon left shallow nearshore habitats. Additionally, foraging in deeper water typically has higher energetic costs for juvenile salmon than foraging in shallow shoreline waters (Heerhartz and Toft 2015). Therefore, the juvenile PS Chinook salmon that swim across the channel may also experience reduced fitness due to increased energetic costs.

Based on the information above, the NMFS believes that during any given year, a low number of juvenile PS Chinook salmon are likely to experience mortality, or reduced fitness that could reduce their overall likelihood of survival due to some combination of stress-related effects related to predator avoidance behaviors and/or increased energetic costs that would be attributable to the channel.

The annual number of juvenile PS Chinook salmon that may be affected by these stressors is unquantifiable with any degree of certainty. However, it is likely to be very low. At any given time, the numbers of predatory fish within the channel are likely to be low, and they are most likely to be widely scattered. This, combined with the relatively narrow channel width suggests that the probability that an individual juvenile Chinook salmon would be exposed to a predator interaction that would be attributable to the channel would be extremely low, and that the affected individuals would comprise an extremely small subset of those that cross the channel.

Further, only a subset of any year's cohort are likely to cross the channel. Based on this information, the number of juvenile Chinook salmon that would experience mortality or measurably reduced fitness attributable to crossing the channel would be too low to cause detectable population-level effects.

Channel dredging would also reduce the abundance of benthic organisms within the channel, and alter the area's population structure as compared to what would occur in the absence of dredging. Dredging removes benthic infaunal and epifaunal invertebrate organisms (Armstrong et al. 1981). It also removes SAV, which provides important structural environments that form the base of detrital-based food webs that are a source of secondary production by supporting epiphytic plants, animals, and microbial organisms that in turn are grazed upon by other invertebrates and by larval and juvenile fish (NMFS 1997). The removal of the resident benthic invertebrates reduces the availability of their larvae, as well as the availability of copepods, daphnids, and larval fish that prey on them, and in turn are prey for juvenile salmon (NMFS 2006). The loss of SAV also reduces the availability of structural habitat that juvenile salmon use to avoid predators.

The available information to describe ecosystem responses to dredging indicates that little recovery occurs during the first seven months after dredging. After that, early successional fauna would begin to dominate over the next six months (Jones and Stokes 1998). The rate and degree of SAV recovery is uncertain, but could also take more than a year. Therefore, the proposed dredging would temporarily reduce the availability of benthic organisms and SAV within the channel, and full recovery of dredged areas may take years.

The relatively small size of the affected area as compared to the amount of undisturbed benthic habitat nearby, combined with the mixing that is caused by the normal water movements in the action area, suggests that any reduction in the availability of planktonic prey for juvenile salmonids would likely be undetectable. Similarly, we expect that the amount of SAV likely to be removed by the dredging, and the corollary effects that may have on prey and shelter availability, would be too small to cause detectable effects on PS Chinook salmon.

2.5.2 Effects on Critical Habitat

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

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

1. Freshwater spawning sites – None in the action area.

2. Freshwater rearing sites – None in the action area.

3. Freshwater migration corridors:
   a. Free of obstruction and excessive predation – The proposed action would cause long-term minor adverse effects on this attribute. Maintenance of the channel across a migration corridor would maintain habitat conditions that elevate the predation risk for the juveniles that must cross it.
   b. Water quantity – The proposed project would cause no effect on this attribute.
   c. Water quality – The proposed action would cause long-term adverse effects on this attribute. Dredging would increase turbidity, mobilize contaminants, and may slightly reduce DO. Detectable effects are expected to be limited to the area within about 300 feet of the channel and to persist for 77 days once dredging begins. The action would cause no measurable changes in water temperature or salinity.
   d. Natural Cover – The proposed action would cause long-term minor adverse effects on this attribute. Dredging would reduce SAV availability in the channel for a year or more.

4. Estuarine areas – None in the action area.

5. Nearshore marine areas – None in the action area.

6. Offshore marine areas – None in the action area.

7. Offshore marine areas – None in the action area.

2.6 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to 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.

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

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

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

2.7 Integration and Synthesis

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

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

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

2.7.1 ESA-listed Species

PS Chinook salmon

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

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 North Lake Washington / Sammamish River population. Abundance in this population is relatively low, with a total annual abundances fluctuating between about 33 and 2,223 individuals since 1983, a slightly negative average abundance trend, and a high hatchery component.

The project site is located at the north end of Lake Washington adjacent to the Sammamish River's entrance to the lake. The environmental baseline within the action area has been degraded by the effects shoreline development and vessel activities. The baseline has also been degraded by nearby and upstream industry, urbanization, agriculture, forestry, water diversion, and road building and maintenance.

Dredging-related impacts are likely to cause a range of effects that both individually and collectively would cause altered behaviors, reduced fitness, and possible mortality in some juveniles. However, the annual numbers of individuals that are likely to be impacted 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 population. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

2.7.2 Critical Habitat

Chinook salmon critical habitat

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

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 PBFs for PS Chinook salmon critical habitat in the action area are limited to freshwater rearing sites and freshwater migration corridors free of obstruction and excessive predation. The site attributes of those PBFs that would be affected by the action are limited to obstruction and predation, water quality, natural cover, and forage. As described above, the proposed action would cause long-term minor adverse effects on the site attributes of those PBFs within about 300 feet along both sides of the navigation channel.

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 any of the site attributes of critical habitat PBFs in the action area. Therefore, the 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 or destroy or adversely modify its designated critical habitat.

2.9 Incidental Take Statement

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

2.9.1 Amount or Extent of Take

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

Harm of juvenile Puget Sound Chinook salmon from exposure to:

- propeller wash,
- contaminated forage, and
- altered benthic habitat.

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

Therefore, the NMFS cannot predict with meaningful accuracy the number of juvenile PS Chinook salmon that are reasonably certain to be injured or killed annually by exposure to the stressors identified above. 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 as surrogates 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 in-water work is the best available surrogate for the extent of take of juvenile PS Chinook salmon from exposure to action-related propeller wash because the planned work window was selected to reduce the potential for juvenile salmonid presence at the project site. Working longer or outside of the planned work window would increase the number of fish likely to be exposed to propeller wash despite the low density and random distribution of juvenile Chinook salmon in the action area.

The total volume of dredged sediment and the lateral extent of the visible turbidity plume around the dredge are the best available surrogates for the extent of take of juvenile PS Chinook salmon from exposure to action-related contaminated forage. The total volume of dredged sediment is appropriate because the amount of contaminated sediment that would settle to the lake floor after resuspension during dredging is directly related to the total volume of the removed material, and the amount of biologically available contaminants would increase as the amount of mobilized contaminated sediments increases. The lateral extent of the turbidity plume is appropriate because the numbers of contaminated prey organisms and/or exposed fish would be positively correlated with the size the affected area. Therefore, as the amount of mobilized contaminated sediment and/or the size of the visible turbidity plumes increase, the number of prey organisms that may become contaminated and then eaten by juvenile PS Chinook salmon would increase, despite the low density and random distribution of these juveniles in the action area.

The length and width of the currently authorized federal channel is the best available surrogate for the extent of take of juvenile PS Chinook salmon from exposure to action-related altered benthic habitat. The length and width of the currently authorized federal channel is an appropriate surrogate because exceeding the boundaries of the authorized channel would increase the size of the area where supportive habitat features would be reduced or eliminated from the action area, which in-turn would increase the number of exposed individuals and/or increase the intensity of effect caused by the reduce habitat value in the area, despite the low density and random distribution of these juveniles in the action area.

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

- A total of 77 days of dredging between November 16 through February 1;
- A maximum removal of 45,000 cubic yards of sediment; and
- Dredging within the authorized federal channel (i.e. 2,900 feet long by 100 to 120 feet wide, within the existing footprint).

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 still function as effective reinitiation triggers because the Corps has authority to conduct compliance inspections and to take actions to address non-compliance (33 CFR 326.4).

2.9.2 Effect of the Take

In the 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" (RPMs) are nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02).

The COE shall require the applicant to:

1. Minimize incidental take of PS Chinook salmon from exposure to propeller wash.

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

3. Minimize incidental take of PS Chinook salmon from exposure to altered benthic habitat.

4. 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

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

1. To implement RPM Number 1, Minimize incidental take of PS Chinook salmon from exposure to project-related propeller wash, the COE shall require their contractors to limit dredging-related vessel operations to no more than 77 days between November 16 and February 1.

2. To implement RPM Number 2, Minimize incidental take of PS Chinook salmon from exposure to contaminated forage, the COE shall require their contractors to:
   a. Limit sediment removal to no more than 45,000 cubic yards; and
   b. Adjust dredging and tugboat operations to ensure that visible turbidity plumes do not exceed 300 feet from the project site, and to halt work should the visible turbidity plume approach and that range.

3. To implement RPM Number 3, Minimize incidental take of PS Chinook salmon from exposure to altered benthic habitat, the COE shall require their contractors to limit dredging to the currently authorized channel as described in this biological opinion (i.e. 2,900 feet long by 100 to 120 feet wide, within the existing footprint).

4. To implement RPM Number 4, Implement a monitoring and reporting system to confirm that the take exemption for the proposed action is not exceeded, the COE shall develop and implement a plan to collect and report details about the take of listed fish. That plan shall:
   a. Require the contractor to maintain and submit logs to verify:
      i. The dates and description(s) of the vessel operations;
      ii. The dates and GPS location(s) of dredging;
      iii. The lateral extent of the visible turbidity plume and measures taken to maintain it within 300 feet; and
      iv. The daily and cumulative sediment removal totals.
   b. Require the contractor to establish procedures for the submission of the dredging logs and other materials to the COE; and
   c. Require the COE to submit an electronic post-construction report to NMFS within six months of project completion. Send the report to: projectreports.wcr@noaa.gov. Be sure to include Attn: WCRO-2020-00112 in the subject line.

2.10 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

1. The COE should require their contractors to install full-depth sediment curtains as close as reasonably possible around dredging operations to limit the spread of suspended sediments.

2. The COE should require their contracted tugboat and other vessel operators to use the lowest safe speeds and power settings when maneuvering in shallow waters close to the shoreline to minimize propeller wash and mobilization of sediments.

2.11 Reinitiation of Consultation

This concludes formal consultation for the U.S Army Corps of Engineers' proposed maintenance dredging of the Kenmore Federal Navigation Channel in Lake Washington.

As 50 CFR 402.16 states, 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 if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the 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 (4) a new species is listed or critical habitat designated that may be affected by the 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 would be not likely to adversely affect PS steelhead, and southern resident (SR) killer whales and their designated critical habitat. Detailed information about the biology, habitat, and conservation status and trends of PS steelhead and 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 /fish/, 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

PS steelhead are very rare in the Lake Washington watershed. Fewer than 10 adults from the North Lake Washington and Lake Sammamish population returned to the watershed between 1994 and 1999 when the last WDFW survey was done. Similarly, 50 adults from the Cedar River population have returned to the watershed since 2000, with 10 or less returning since 2007 (WDFW 2020c). Given the timing and relatively small spatial scale of the in-water work that would be done for this project, combined with very low numbers of PS steelhead that may be in the watershed, it is extremely unlikely that any individuals from either population would be exposed to any of the stressors identified in Section 2.5. Therefore, the action is not likely to adversely affect PS steelhead.

SR killer whales are limited to marine water habitats, and would not be directly exposed to any project-related effects, but they could possibly be exposed to indirect effects through the trophic web. As described in Section 2.1 the PS Chinook population that would be affected by the proposed action is extremely small. Further, as described in Section 2.5, the proposed action would annually affect too few individuals to cause detectable population-level affects. Therefore, any project-related reduction in Chinook salmon availability for SR killer whales would be undetectable. Similarly, although some juvenile Chinook salmon would be exposed to contaminated prey at the project site, their individual levels of contamination as well as the total numbers of annually exposed individuals would be too low to cause any detectable trophic link between the sediment contaminants and SR killer whales. Therefore, the 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 PBFs from their baseline conditions, and the severity of each effect, considered in terms of the time required to recover from the effect. Ephemeral effects are those that are likely to last for hours or days, short-term effects would likely to last for weeks, and long-term effects are likely to last for months, years or decades.

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

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

2. Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth
   The proposed action would cause long-term undetectable effects on prey availability and quality. Action-related impacts would annually injure extremely low numbers of individual juvenile Chinook salmon (primary prey), including exposing some individuals to contaminated prey. However, their numbers and levels of contamination would be too small to cause detectable effects on prey availability, or to create any detectable trophic link between the sediment contaminants and SR killer whales. Therefore, it would cause no detectable reduction in prey availability and quality.

3. Passage conditions to allow for migration, resting, and foraging
   The proposed dredging 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 concurs with the COE's determination that the proposed action is not likely to adversely affect ESA-listed PS steelhead, and SR killer whales and their designated critical habitat.

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

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

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

3.1 Essential Fish Habitat Affected by the Project

The project site is located at the north end of Lake Washington (Figure 1). The waters and substrates of the project site 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. The action area also overlaps with marine waters that have been designated, under the MSA, as EFH for Pacific Coast groundfish, and coastal pelagic species. However, the action would cause no detectable effects on any components of estuarine or marine EFH. Therefore, the effects of the action would be limited to impacts on freshwater EFH for Pacific Coast Salmon, and it would not adversely affect EFH for Pacific Coast groundfish and coastal pelagic species.

Freshwater EFH for Pacific Coast Salmon is identified and described in Appendix A to the Pacific Coast salmon fishery management plan (PFMC 2014), and consists of four major components: (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors and holding habitat.

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

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. Based on the analysis of effects presented in Section 2.5 the proposed action will cause long-term minor adverse effects on EFH for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species as summarized below.

1. Water quality: – The proposed action would cause long-term minor adverse effects on water quality. The action would cause no meaningful changes in water temperature, and no changes in salinity, but dredging would increase suspended solids and may slightly reduce DO, it may also temporarily introduce very low levels of contaminants. Detectable effects would be limited to the area within about 300 feet of dredging and tugboat operations, and would persist continuously for 77 days.

2. Water quantity, depth, and velocity: – The proposed action would cause a long-term minor increase in the water depth within the channel footprint. No changes in water quantity or velocity are 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 long term minor adverse effects on prey availability. In-water excavation and installation of gravel would slightly reduce prey availability for about a year following the end of work by removing and/or covering benthic organisms and SAV within the channel footprint.

6. Cover and habitat complexity: – The proposed action would cause long-term minor adverse effects on this attribute. Dredging would reduce SAV availability for about a year following the end of the project.

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: – The proposed action would cause long-term minor adverse effects on substrate composition in that relatively small quantities of marginally contaminated subsurface sediments would settle on top of the lakebed where the contaminants would be biologically available for years. Detectable effects would be limited to the area within about 300 feet of channel.

3.3 Essential Fish Habitat Conservation Recommendations

Full implementation of the following EFH conservation recommendations would protect about 11.25 acres of designated EFH for Pacific Coast salmon by avoiding or minimizing the adverse effects described in section 3.2 above.

To reduce adverse impacts on water quality, the Corps should require:

1. The installation of full-depth sediment curtains as close as reasonably possible around dredging operations; and

2. The use of the lowest safe speeds and power settings when maneuvering tugboats and other vessels in shallow waters close to the shoreline.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the COE must provide a detailed written response in 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 COE must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations (50 CFR 600.920(l)).

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this Opinion is the COE. Other users could include WDFW, King County, the government and citizens of the City of Kenmore, and Native American tribes. Individual copies of this Opinion were provided to the COE, and the Muckleshoot Indian Tribe. 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 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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