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

Refer to NMFS No:
WCRO-2021-00773

February 15, 2022

William Abadie
Chief, Regulatory Branch
Department of the Army
U.S. Army Corps of Engineers, Portland District
P.O. Box 2946
Portland, Oregon 97208-2946

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the East Mooring Basin Causeway Replacement, Astoria, Oregon (HUC 170800060500)

Dear Mr. Abadie:

Thank you for your letter of April 9, 2021, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the East Mooring Basin Causeway Replacement.

NMFS also reviewed the likely effects of the proposed action on essential fish habitat (EFH), pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)) and concluded that the action would adversely affect the EFH of Pacific Coast Salmon, Groundfish and Coastal Pelagic Species. Therefore, we have included the results of that review in Section 3 of this document.

NMFS concluded that the proposed action is not likely to jeopardize the continued existence or recovery of or adversely modify the critical habitat of:

1. Chinook salmon (*Oncorhynchus tshawytscha*)
    a. Lower Columbia River Chinook
    b. Upper Willamette River Chinook
    c. Upper Columbia River spring-run Chinook
    d. Snake River spring-run Chinook
    e. Snake River fall-run Chinook
2. Columbia River chum salmon (*Oncorhynchus keta*)
3. Lower Columbia River coho salmon (*Oncorhynchus kisutch*)
4. Snake River sockeye salmon (*Oncorhynchus nerka*)
5. Steelhead (*Oncorhynchus mykiss*)
    a. Lower Columbia River steelhead
    b. Upper Willamette River steelhead
    c. Middle Columbia River steelhead
    d. Upper Columbia River steelhead
    e. Snake River Basin steelhead

NMFS concluded that the proposed action is not likely to adversely affect the following species or their designated critical habitat:

1. North American green sturgeon (*Acipenser medirostris*)
2. Eulachon (*Thaleichthys pacificus*)

Please contact Tom Hausmann in Portland, Oregon, at Tom.Hausmann@noaa.gov, or 503-231-2315 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: Brad Johnson
Kristen Hafer

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

East Mooring Basin Causeway Replacement

NMFS Consultation Number: WCRO-2021-00773

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?
Lower Columbia River Chinook Salmon (*Oncorhynchus tshawytscha*)	T	Yes	No	Yes	No
Upper Willamette River Chinook	T	Yes	No	Yes	No
Upper Columbia River Spring-run Chinook	E	Yes	No	Yes	No
Snake River Spring/Summerrun Chinook	T	Yes	No	Yes	No
Snake River Fall-run Chinook	T	Yes	No	Yes	No
Columbia River Chum Salmon (O. keta)	T	Yes	No	Yes	No
Lower Columbia River coho (*O. kisutch*)	T	Yes	No	Yes	No
Snake River Sockeye (*O. nerka*)	E	Yes	No	Yes	No
Lower Columbia River steelhead (*O. mykiss*)	T	Yes	No	Yes	No
Upper Willamette River steelhead	T	Yes	No	Yes	No
Middle Columbia River steelhead	T	Yes	No	Yes	No
Upper Columbia River steelhead	T	Yes	No	Yes	No
Snake River Basin steelhead	T	Yes	No	Yes	No
Green Sturgeon *Acipenser medirostris*)	T	No	N/A	No	N/A
Eulachon (*Thaleichthys pacificus)*	T	No	N/A	No	N/A

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes
Coastal Pelagic Species	Yes	Yes
Groundfish	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: February 15, 2022

TABLE OF CONTENTS

1. INTRODUCTION

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

1.1. Background

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

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

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available 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 in Portland, Oregon.

1.2. Consultation History

The proposed action is the repair of a Port of Astoria (Port) overwater structure (OWS) in the Columbia River estuary. The presence of the OWS in the baseline affects Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*), Upper Willamette River (UWR) Chinook salmon, Upper Columbia River (UCR) spring-run Chinook salmon, Snake River (SR) spring/summer-run Chinook salmon, SR fall-run Chinook salmon, Columbia River (CR) chum salmon (*O. keta*), LCR coho salmon (*O. kisutch*), SR sockeye salmon (*O. nerka*), LCR steelhead (*O. mykiss*), UWR steelhead, MCR Steelhead, UCR steelhead, and SR Basin steelhead, that migrate through and forage in the estuary. It also affects their respective critical habitats. The proposed OWS repair actions affects all salmon and steelhead listed above and their critical habitat.

The estuary is also EFH for Pacific Coast salmon, coastal pelagic species and groundfish.

There was no pre-consultation for this project. NMFS received request for formal Section 7 and EFH consultation along with a memorandum for the service and a biological assessment (BA) on April 7, 2021.

On June 7, 2021, NMFS requested by email three appendices referenced in the BA and the U.S. Army Corps of Engineers (USACE) attached those appendices in their June 7, 2021, reply.

1.3.Proposed Federal Action

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

The USACE proposes to issue a permit under Section 10 of the Rivers and Harbors Act to the Port of Astoria (Port) to rehabilitate their East Mooring Basin causeway. The need for this work is the deterioration of the causeway that poses a threat to public safety. The proposed action is to rehabilitate the causeway in sections of 200-275 feet per year over a period of 4 years (See Figure 1), in order to retain the structure in serviceable order on the site for the foreseeable future.

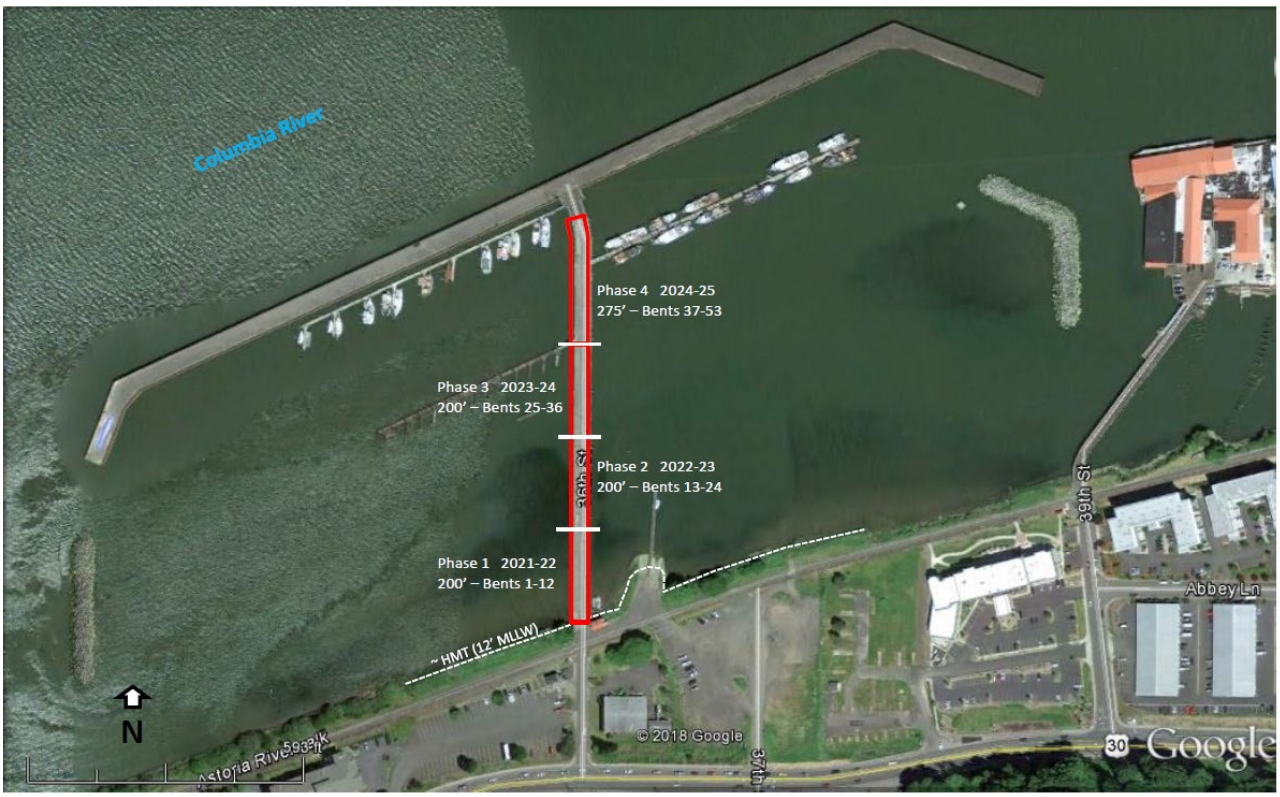

Figure 1. Construction phases

The proposed action has three components: 1) replacement of causeway structures above the ordinary high water (OHW); 2) replacement of causeway structures below OHW, and 3) Minimization Measures and Best Management Practices (BMPs). The Port proposes to do the construction between September 1 and December 31.

1) Replacement of causeway structural elements above OHW.

The Port will replace the existing 875-foot by 34-foot-wide concrete causeway deck with an 875-foot by 28-foot-wide deck. The narrower width reduces the horizontal plane surface area by 18 percent. The deck will be made from 950 4-inch by 12-inch by 28-foot boards. The Port will also replace up to 587 girders and up to 53 caps (Figure 3). The boards, girders and caps will be made of ammoniacal copper zinc arsenate (ACZA) pressure-treated wood (Chemonite®) coated with Arch® H2O Water Block to reduce the leaching of metals from the treated wood (see Appendix 1). The surface area of structural elements above the OHW that will be replaced each year for four years is shown in Table 1. The Port chose pressure-treated wood to allow the causeway to be maintained by their staff.

2) Replacement of causeway structural elements below OHW.

The Port may replace structural components including up to 53 sill plates and up to 380 cross members (Figure 3) with elements made from ACZA pressure-treated wood (Chemonite®) coated with Arch® H2O Water Block. The surface area of structural elements below OHW that will be replaced each year for four years is shown in Table 1.

The Port will replace up to 212 deteriorated (12-inch by 12-inch by 8-foot) timber posts with high density polyethylene (HDPE) dimensional plastic posts. The Port may replace up to 20 untreated timber pilings (5 per year over four years) along the causeway with 16-inch diameter steel pipe piles using a vibratory pile driver followed by up to 20 strikes per pile with an impact pile driver to fully seat the piles (Figure 2). Construction crews and equipment will access the project site from the shoreline, the existing causeway, and a floating barge.

Table 1. Area of ACZA treated lumber above and below OHW.

	Element	**Number**	**Length (ft)**	**Width (ft)**	**Depth (ft)**	**Area (ft^2)**	**Area (cm^2)**	**Total Area (cm^2/year)**
Elements above OHW (exposed to rain)	Deck	950.00	28.00	1.00	0.30	26,600	24,712,209	11,430,790
	Girders	587.00	24.00	1.50	0.50	21,132	19,632,270	
	Caps	53.00	28.00	1.00	1.00	1,484	1,378,681	
Elements below OHW (submerged)	Cross member	380.00	24.00	0.66	0.25	6,019	5,592,020	1,742,675
	Sill plate	53.00	28.00	1.00	0.50	1,484	1,378,681	

Construction contractors may use a hydraulic underwater chainsaw using vegetable oil for the hydraulics to remove OWS elements and a floating boom to contain wood debris.

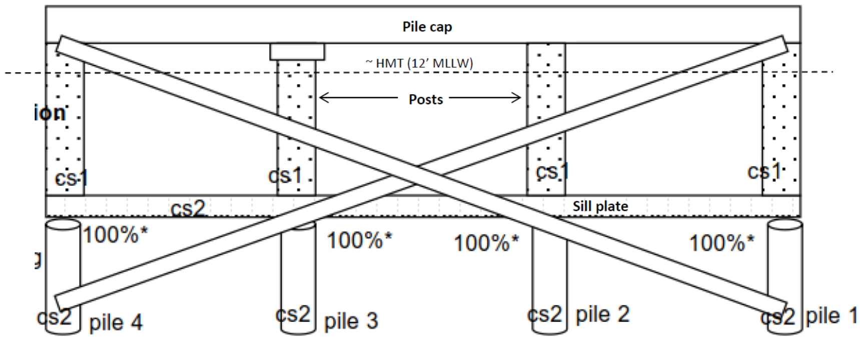

Figure 2. Cross section drawing showing cap, post, plate, cross member and piles.

3) Best Management Practices

i. All heavy equipment (i.e., crane) will access the project site via existing roadways and floating barges.

ii. All pilings will be removed and installed with a vibratory hammer. In the event that the vibratory hammer cannot fully embed the piles to the necessary depth, the contractor will use an impact hammer to seat the piles. Use of an impact hammer will be limited to daylight hours between 7 a.m. and 7 p.m.

iii. The contractor will initiate daily "soft-start" procedures to provide a warning and/or give species near piling installation activities a chance to leave the area prior to a vibratory hammer (or impact driver) operating at full capacity; thereby, exposing fewer species to loud, underwater and airborne sounds.

   a. A soft-start procedure will be used at the beginning of in-water piling removal and installation, or any time piling removal/installation has ceased for more than 30 minutes.

   b. For vibratory hammer operation, the contractor will initiate noise from vibratory hammers for 15 seconds at reduced energy followed by a 30-second waiting period. The procedure shall be repeated two additional times.

   c. For impact pile driving (if necessary), the contractor will provide an initial set of strikes from the impact hammer at reduced energy, followed by a 30-second waiting period, then two subsequent sets. (The reduced energy of an individual hammer cannot be quantified given the variations between individual drivers. In addition, the number of strikes will vary at reduced energy given that raising the hammer at less than full power and then releasing it results in the hammer bouncing as it strikes the pile, resulting in multiple strikes).

1. During the use of an impact hammer (if required) a multi-level bubble curtain will be installed to reduce sound pressure levels. The bubble curtain system shall conform to the following:

    a) If water velocity is greater than 1.6 feet per second, surround the piling being driven by a confined bubble curtain (e.g., a bubble ring surrounded by a fabric or non-metallic sleeve) that will distribute air bubbles around 100% of the piling perimeter for the full depth of the water column.

    b) Piling shall be completely engulfed in bubbles over the full depth of the water column at all times when an impact pile driver is in use. Bubbles are not required during vibratory pile driving.

iv. During piling removal, the Port of Astoria or its contractor will take the following steps to minimize sediment disturbance and sediment resuspension:

    a. Install a floating surface boom to capture floating surface debris.

    b. Consider the best tidal condition for piling removal, try to remove in the dry.

    c. Keep all equipment (e.g., bucket, cable, vibratory hammer) out of the water, grip piles above the waterline, and complete work during low water and low current conditions.

    d. Dislodge piling with a vibratory hammer, when possible; never intentionally break a pile.

    e. "Wake" the piling by vibrating to break the friction bond between the piling and sediment.

    f. Slowly lift the pile from the sediment and through the water column.

    g. Place the pile in a containment basin on a barge deck, pier, or shoreline without attempting to clean or remove any adhering sediment.

    h. Dispose of all removed piles, floating surface debris, any sediment spilled on work surfaces, and all containment supplies at a permitted upland disposal site.

v. When a pile breaks or is intractable during removal, removal will continue as follows:

    a. Every attempt short of excavation will be made to remove each piling, if a pile in uncontaminated sediment is intractable, breaks above the surface, or breaks below the surface cut the pile or stump off at least 3 feet below the surface of the sediment.

vi. A Pollution Control Plan (PCP) will be prepared by the Contractor and carried out commensurate with the scope of the project that includes the following:

    a. Best management practices to confine, remove, and dispose of construction waste.

    b. Procedures to contain and control a spill of any hazardous material.

vii. All conditions of Oregon DEQ's 401 Water Quality Certification will be followed.

viii. Only enough supplies and equipment to complete the project will be stored on site.

ix. All equipment will be inspected daily for fluid leaks. Any leaks detected will be repaired before operation is resumed.

x. Stationary power equipment (i.e., cranes) operated within 150 feet of the river will be diapered to prevent leaks.

xi. All construction with treated wood will comply with the best management practices (BMPs) established by the Western Wood Preservers Institute (WWPI).

xii. The procedures outlined in American Wood Protection Association (AWPA) Standard M4, Standard for the Care of Preservative-Treated Wood Products will be followed.

    a. Only BMP-compliant material will be used on the project.

    b. Project will be designed so that maximum amount of cutting, prefabrication and framing is performed prior to treatment.

    c. Materials will be stored away from water until it is needed for installation.

    d. Material designated for use will remain covered until used.

    e. When field treating/coating by brushing, spraying, dipping or soaking, it will be done in such a manner that the preservative does not drip or spill into the environment.

    f. Whenever possible, field treatments/coatings will be applied prior to assembling the structure over the body of water or wetland environment.

    g. When field cutting, drilling or fabrication is necessary, it will be done away from the water to the degree practical, and all waste, including sawdust, will be collected and disposed of appropriately.

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that repairing the causeway sustains commercial and recreational vessel traffic and moorage. While maintenance dredging will be needed to allow for continued commercial and recreational vehicle usage, it is not considered a consequence of this proposed action for the purposes of this proposed action. This is because the Port is applying for a USACE permit authorizing a 10-year dredging program. That project will undergo a separate ESA Section 7 consultation.

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.

2.1. Analytical Approach

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

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

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

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

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

- Evaluate the rangewide 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.
  - Effects associated with the present and historical existence of the OWS are considered part of the environmental baseline.
- Evaluate the effects of the proposed action on species and their habitat using an exposure-response approach.
  - NMFS based it analysis on biological opinions for similar projects including 2020_07_29_NWAlloys Dock_WCRO-2015-00006 and COE_WCR-2015-2157_Aldrich Point Dock Replacement; the Wood Preserver Institute General Risk Assessment Model Aquatic Guide 4.10 (Brooks, 2011); the NMFS spreadsheet model of pile driving noise and sound pressure levels (SPL); and the other books and technical papers listed in the reference section of this opinion.
  - Because the proposed action meaningfully extends the life of the structure, future effects associated with the presence of the OWS are considered consequences of the proposed action.
- 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” for the jeopardy analysis. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the PBFs that are essential for the conservation of the species.

One factor affecting the status of ESA-listed species considered in this opinion, and aquatic habitat at large, is climate change. Climate change is likely to play an increasingly important role in determining the abundance and distribution of ESA-listed species, and the conservation value of designated critical habitats, in the Pacific Northwest. These changes will not be spatially homogeneous across the Pacific Northwest. The largest hydrologic responses are expected to occur in basins with significant snow accumulation, where warming decreases snow pack, increases winter flows, and advances the timing of spring melt (Mote et al., 2016; Mote et al., 2014). Rain-dominated watersheds and those with significant contributions from groundwater may be less sensitive to predicted changes in climate (Mote et al., 2014; Tague et al., 2013).

During the last century, average regional air temperatures in the Pacific Northwest increased by 1-1.4°F as an annual average, and up to 2°F 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., 2014). Warming is likely to continue during the next century as average temperatures are projected to increase another 3 to 10°F, with the largest increases predicted to occur in the summer (Mote et al., 2014).

Decreases in summer precipitation of as much as 30 percent 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; USGCRP, 2009). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB, 2007; USGCRP, 2009). 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 3.5-5.3ºC increases in Columbia Basin streams and a peak temperature of 26ºC 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 (USGCRP, 2009).

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

In addition to changes in freshwater conditions, predicted changes for coastal waters in the Pacific Northwest as a result of climate change include increasing surface water temperature, increasing but highly variable acidity, and increasing storm frequency and magnitude (Mote et al., 2014). Elevated ocean temperatures already documented for the Pacific Northwest are highly likely to continue during the next century, with sea surface temperature projected to increase by 1.0-3.7°C by the end of the century (IPCC, 2014). Habitat loss, shifts in species' ranges and abundances, and altered marine food webs could have substantial consequences to anadromous, coastal, and marine species in the Pacific Northwest (Reeder et al., 2013; Tillmann and Siemann, 2011).

Moreover, as atmospheric carbon emissions increase, increasing levels of carbon are absorbed by the oceans, changing the pH of the water. A 38 percent to 109 percent increase in acidity is projected by the end of this century in all but the most stringent CO_2 mitigation scenarios, and is essentially irreversible over a time scale of centuries (IPCC, 2014). Regional factors appear to be amplifying acidification in Northwest ocean waters, which is occurring earlier and more acutely than in other regions and is already impacting important local marine species (Barton et al., 2012; Feely et al., 2012). Acidification also affects sensitive estuary habitats, where organic matter and nutrient inputs further reduce pH and produce conditions more corrosive than those in offshore waters (Feely et al., 2012; Sunda and Cai, 2012).

Global sea levels are expected to continue rising throughout this century, reaching likely predicted increases of 10 to 32 inches by 2081-2100 (IPCC, 2014). These changes will likely result in increased erosion and more frequent and severe coastal flooding, and shifts in the composition of nearshore habitats (Reeder et al., 2013; Tillmann and Siemann, 2011). Estuarine-dependent salmonids such as chum and Chinook salmon are predicted to be impacted by significant reductions in rearing habitat in some Pacific Northwest coastal areas (Glick et al., 2007).

Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of salmon and steelhead, while cooler ocean periods have coincided with relatively high abundances, and therefore these species are predicted to fare poorly in warming ocean conditions (Scheuerell and Williams, 2005; USGCRP, 2009; Zabel et al., 2006). This is supported by the recent observation that anomalously warm sea surface temperatures off the coast of Washington from 2013 to 2016 resulted in poor coho and Chinook salmon body condition for juveniles caught in those waters (NWFSC, 2015). Changes to estuarine and coastal conditions, as well as the timing of seasonal shifts in these habitats, have the potential to impact a wide range of listed aquatic species (Reeder et al., 2013; Tillmann and Siemann, 2011). Siegel and Crozier (2019) observe that a newer study projects nearly complete loss of existing tidal wetlands along the U.S. West Coast, due to sea level rise (Thorne et al., 2018). California and Oregon showed the greatest threat to tidal wetlands (100%), while 68% of Washington tidal wetlands are expected to be submerged. Coastal development and steep topography prevent horizontal migration of most wetlands, causing the net contraction of this crucial habitat.

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 evolutionarily significant units (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.

2.2.1 Status of ESA-Listed Fish Species

For Pacific salmon, steelhead, and certain other species, we commonly use the four "viable salmonid population" (VSP) criteria (McElhany et al., 2000) to assess the viability of the populations that, together, 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 (McElhany et al., 2000).

"Abundance" generally refers to the number of naturally-produced adults (i.e., the progeny of naturally-spawning parents) in the natural environment (e.g., on spawning grounds).

"Productivity," as applied to viability factors, refers to the entire life cycle (i.e., 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 declining. McElhany et al. (2000) use the terms "population growth rate" and "productivity" interchangeably when referring to production over the entire life cycle. They also refer to "trend in abundance," which is the manifestation of long-term population growth rate.

For species with multiple populations, once the biological status of a species' populations has been determined, we assess the status of the entire species 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. Additional information (e.g., abundance estimates) that has become available since the latest status reviews and technical support documents also comprises the best scientific and commercial data available and has also been summarized in the following sections.

Table 2. Status of ESA-listed species affected by the proposed action.

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Lower Columbia River Chinook salmon	Threatened 6/28/05	NMFS 2013	NWFSC 2015	This ESU comprises 32 independent populations. Twenty-seven populations are at very high risk, 2 populations are at high risk, one population is at moderate risk, and 2 populations are at very low risk. From 2011 to 2015 there was little change in the biological status of this ESU, although there were some positive trends. Increases in abundance were noted in about 70% of the fall-run populations and decreases in hatchery contribution were noted for several populations. Relative to baseline VSP levels identified in the recovery plan, there was an overall improvement in the status of a number of fall-run populations, although most were still far from the recovery plan goals. *Since the 2015 status review, data indicates a mix of recent population abundance increases, decreases, and relatively static numbers of natural-origin and total spawners between 2014 to 2018 compared to the 2009 to 2013 with the direction of "percent change" between 5-year geometric means mixed within run types. Therefore, the degree to which abundance has been driven by below-average ocean survival or by a variety of environmental conditions and management actions in freshwater spawning and rearing habitat, appears to vary between populations.*	• Reduced access to spawning and rearing habitat • Hatchery-related effects • Harvest-related effects on fall Chinook salmon • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Contaminant

Upper Willamette River Chinook salmon	Threatened 6/28/05	NMFS 2011	NWFSC 2015	This ESU comprises seven populations. Five populations are at very high risk, one population is at moderate risk (Clackamas River) and one population is at low risk (McKenzie River). Consideration of data collected since the status review in 2010 indicates the fraction of hatchery origin fish in all populations remained high (even in Clackamas and McKenzie populations). The proportion of natural origin spawners improved in the North and South Santiam basins, but was still well below identified recovery goals. Abundance levels for five of the seven populations remained well below their recovery goals. Of these, the Calapooia River may be functionally extinct and the Molalla River remained critically low. Abundances in the North and South Santiam rivers increased from 2010 to 2015, but still range only in the high hundreds of fish. The Clackamas and McKenzie populations had previously been viewed as natural population strongholds, but both experienced declines in abundance despite having access to much of their historical spawning habitat. Overall, populations appeared to be at either moderate or high risk. There was likely little net change in the VSP score for the ESU since the last review, so the ESU remained at moderate risk. *The most recent data shows that the 2015 to 2019 5-year geometric mean for returning adults declined relative to the 2010 to 2014 5-year geometric mean. Observations of coastal ocean conditions indicate that recent out migrant year classes have experienced below-average ocean survival during a marine heatwave and its lingering effects. Some of the negative impacts on juvenile salmonids had subsided by spring 2018, but other aspects of the ecosystem (e.g., temperatures below the 50-m surface layer) had not returned to normal.*	• Degraded freshwater habitat • Degraded water quality • Increased disease incidence • Altered stream flows • Reduced access to spawning and rearing habitats • Altered food web due to reduced inputs of microdetritus • Predation by native and non-native species, including hatchery fish • Competition related to introduced salmon and steelhead • Altered population traits due to fisheries and bycatch

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Upper Columbia River spring-run Chinook salmon	Endangered 6/28/05	Upper Columbia Salmon Recovery Board 2007	NWFSC 2015	This ESU comprises four independent populations. Three are at high risk and one is functionally extirpated. 2015 estimates of natural origin spawner abundance increased relative to the levels observed in the 2010 review for all three extant populations, and 2015 productivities were higher for the Wenatchee and Entiat populations and unchanged for the Methow population. However, abundance and productivity remained well below the viable thresholds called for in the Upper Columbia Recovery Plan for all three populations. *Recent data indicates a substantial downward trend in the abundance of natural-origin spawners at the ESU level from 2015 to 2019 thought to be driven primarily by marine environmental conditions and a decline in ocean productivity because hydropower operations, the overall availability and quality of tributary and estuary habitat, and hatchery practices have been relatively constant or improving over the past 10 years. Recent outmigrant year classes have experienced below-average ocean survival during a marine heatwave and its lingering effects. Some of the negative impacts on juvenile salmonids had subsided by spring 2018, but other aspects of the ecosystem (e.g., temperatures below the 50-m surface layer) had not returned to normal. Increased abundance of sea lions in the lower Columbia River could also be a contributing factor.*	• Effects related to hydropower system in the mainstem Columbia River • Degraded freshwater habitat • Degraded estuarine and nearshore marine habitat • Hatchery-related effects • Persistence of non-native (exotic) fish species • Harvest in Columbia River fisheries

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Snake River spring/summer-run Chinook salmon	Threatened 6/28/05	NMFS 2017a	NWFSC 2015	This ESU comprises 28 extant and four extirpated populations. All expect one extant population (Chamberlin Creek) are at high risk. 2015 natural origin abundance increased over the levels reported in the 2010 review for most populations in this ESU, although the increases were not substantial enough to change viability ratings. Relatively high ocean survivals in this period were a major factor in these abundance patterns. While there were improvements in abundance and productivity in several populations relative to prior reviews, those changes have not been sufficient to warrant a change in ESU status. *The recent data indicates a substantial downward trend in the abundance of natural-origin spawners from 2014 to 2019. The past 3 years (2017 through 2019) have shown the lowest returns since 1999. This recent downturn in adult abundance is thought to be driven primarily by marine environmental conditions and a decline in ocean productivity, because hydropower operations, the overall availability and quality of tributary and estuary habitat, and hatchery practices have been relatively constant or improving over the past 10 years. Recent out migrant year classes have experienced below-average ocean survival during a marine heatwave and its lingering effects. Some of the negative impacts on juvenile salmonids had subsided by spring 2018, but other aspects of the ecosystem (e.g., temperatures below the 50-m surface layer) had not returned to normal. Increased abundance of sea lions in the lower Columbia River could also be a contributing factor.*	• Degraded freshwater habitat • Effects related to the hydropower system in the mainstem Columbia River, • Altered flows and degraded water quality • Harvest-related effects • Predation

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Snake River fall-run Chinook salmon	Threatened 6/28/05	NMFS 2017b	NWFSC 2015	This ESU has one extant population. Historically, large populations of fall Chinook salmon spawned in the Snake River upstream of the Hells Canyon Dam complex. The extant population is at moderate risk for both diversity and spatial structure and abundance and productivity. The overall viability rating for this population is 'viable.' In 2015 the status of Snake River fall Chinook salmon had clearly improved compared to the time of listing and compared to the 2010 status reviews. The single extant population in the ESU was meeting the criteria for a rating of 'viable' developed by the ICTRT, but the ESU as a whole was not meeting the recovery goals described in the recovery plan for the species, which required the single population to be "highly viable with high certainty" and/or will require reintroduction of a viable population above the Hells Canyon Dam complex. *The recent data indicates a substantial downward trend in the abundance of natural-origin spawners from 2013 to 2019. The recent downturn is thought to be driven primarily by marine environmental conditions and a decline in ocean productivity because hydropower operations and hatchery practices have been relatively constant or improving over the past 10 years. Recent out migrant year classes have experienced below-average ocean survival during a marine heatwave and its lingering effects. Some of the negative impacts on juvenile salmonids had subsided by spring 2018, but other aspects of the ecosystem (e.g., temperatures below the 50-m surface layer) had not returned to normal. Even with this decline, overall abundance has remained higher than before 2005.*	• Degraded floodplain connectivity and function • Harvest-related effects • Loss of access to historical habitat above Hells Canyon and other Snake River dams • Impacts from mainstem Columbia River and Snake River hydropower systems • Hatchery-related effects • Degraded estuarine and nearshore habitat.

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Columbia River chum salmon	Threatened 6/28/05	NMFS 2013	NWFSC 2015	Overall, the status of most chum salmon populations is unchanged from the baseline VSP scores estimated in the recovery plan. A total of 3 of 17 populations are at or near their recovery viability goals, although under the recovery plan scenario these populations have very low recovery goals of 0. The remaining populations generally require a higher level of viability and most require substantial improvements to reach their viability goals. Even with the improvements observed during from 2010 to 2015, the majority of populations in this ESU remained at a high or very high-risk category and considerable progress remained to be made to achieve the recovery goals. *Recent data indicates increasing trends in the abundance of both natural-origin and total spawners when compared to the 2009 to 2013, with the exception of the Upper Gorge Tributaries population, which decreased in abundance. The ocean survival of chum salmon was above average in 2016 through 2018, potentially due to their unique consumption of the types of gelatinous organisms (jellies, salps, larvaceans) that were abundant during the recent warm ocean conditions.*	• Degraded estuarine and nearshore marine habitat • Degraded freshwater habitat • Degraded stream flow as a result of hydropower and water supply operations • Reduced water quality • Current or potential predation • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants

Lower Columbia River coho salmon	Threatened 6/28/05	NMFS 2013	NWFSC 2015	Of the 24 populations that make up this ESU, 21 populations are at very high risk, 1 population is at high risk, and 2 populations are at moderate risk. Recent recovery efforts may have contributed to the observed natural production, but in the absence of longer-term data sets it is not possible to parse out these effects. Populations with longer term data sets exhibit stable or slightly positive abundance trends. Some trap and haul programs appear to be operating at or near replacement, although other programs still are far from that threshold and require supplementation with additional hatchery-origin spawners. Initiation of or improvement in the downstream juvenile facilities at Cowlitz Falls, Merwin, and North Fork Dam are likely to further improve the status of the associated upstream populations. While these and other recovery efforts have likely improved the status of a number of coho salmon populations, abundances are still at low levels and the majority of the populations remain at moderate or high risk. For the Lower Columbia River region land development and increasing human population pressures will likely continue to degrade habitat, especially in lowland areas. Populations in this ESU generally improved in the 2013/14 and 2014/15 return years. *The recent data available at the population level indicate a mix of recent increases, decreases, and relatively static numbers of natural-origin spawners in 2014 to 2018 compared to the 2009 to 2013. The degree which abundance has been driven by below average ocean survival or by environmental conditions and management actions in freshwater spawning and rearing habitat, appears to vary between populations. Since 2016, observations of coastal ocean conditions indicate that recent out migrant year classes have experienced below-average ocean survival during a marine heatwave. Expectations for marine survival are relatively mixed for juveniles that reached the ocean in 2019.*	• Degraded estuarine and near-shore marine habitat • Fish passage barriers • Degraded freshwater habitat: Hatchery-related effects • Harvest-related effects • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Snake River sockeye salmon	Endangered 6/28/05	NMFS 2015	NWFSC 2015	This single population ESU is at very high-risk dues to small population size. There is high risk across all four basic risk measures. Although the captive brood program has been successful in providing substantial numbers of hatchery produced fish for use in supplementation efforts, substantial increases in survival rates across all life history stages must occur to re-establish sustainable natural production In terms of natural production, the Snake River Sockeye ESU remains at extremely high risk although there has been substantial progress on the first phase of the proposed recovery approach – developing a hatchery based program to amplify and conserve the stock to facilitate reintroductions. *In 2015 the largest estimated number of SR sockeye salmon adults in recent history (4,093) arrived at Bonneville Dam. Elevated water temperatures resulted in only 1 percent survival from Bonneville to Lower Granite Dam. Agencies implemented a transportation program to capture sockeye at Lower Granite Dam and truck them to the Sawtooth Valley to avoid the high temperatures. The captive broodstock program provided adults to maintain the SR sockeye salmon hatchery program. Hatcheries had operational issues during 2015 to 2017 that resulted in high mortalities. The low return of adults to the Sawtooth Valley in 2015 and the hatchery juvenile production issues in 2015 to 2017, along with recent poor ocean conditions, lowered 2017 to 2019 SR sockeye salmon returns compared to previous years.*	• Effects related to the hydropower system in the mainstem Columbia River • Reduced water quality and elevated temperatures in the Salmon River • Water quantity • Predation

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Lower Columbia River steelhead	Threatened 1/5/06	NMFS 2013	NWFSC 2015	This DPS comprises 23 historical populations, 17 winter-run populations and six summer-run populations. Nine populations are at very high risk, 7 populations are at high risk, 6 populations are at moderate risk, and 1 population is at low risk. The majority of winter-run steelhead populations in this DPS continue to persist at low abundances. Hatchery interactions remain a concern in select basins, but the overall situation is somewhat improved compared to prior reviews. Summer-run steelhead populations were similarly stable, but at low abundance levels. The decline in the Wind River summer-run population is a source of concern, given that this population has been considered one of the healthiest of the summer-runs. The 2015 abundance estimate suggested that the decline was a single year aberration. Passage programs in the Cowlitz and Lewis basins have the potential to provide considerable improvements in abundance and spatial structure, but have not produced self-sustaining populations to date. Even with modest improvements in the status of several winter-run DIPs, none of the populations appear to be at fully viable status, and similarly none of the MPGs meet the criteria for viability. *The recent data indicate a mix of recent increases, decreases, and relatively static numbers of natural-origin and total spawners in 2014 to 2018 compared to the 2009 to 2013 period. In all cases where available, abundance estimates for 2019 were lower than the most recent 5-year geometric means indicating a common driver such as poor ocean conditions.*	• Degraded estuarine and nearshore marine habitat • Degraded freshwater habitat • Reduced access to spawning and rearing habitat • Avian and marine mammal predation • Hatchery-related effects • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Upper Willamette River steelhead	Threatened 1/5/06	NMFS 2011	NWFSC 2015	This DPS has four demographically independent populations. Three populations are at low risk and one population is at moderate risk. Declines in abundance noted in the 2010 review continued through the period from 2010-2015. While rates of decline appeared moderate, the DPS continued to demonstrate the overall low abundance pattern that was of concern during the 2010 review. The causes of those declines were not well understood, although much accessible habitat is degraded and under continued development pressure. The elimination of winter-run hatchery release in the basin reduces hatchery threats, but non-native summer steelhead hatchery releases are still a concern for species diversity and a source of competition for the DPS. *Since 2016 counts of adult UWR steelhead at Willamette Falls have declined dramatically, with 2017 and 2018 counts reaching only 15 to 30 percent of the 5-year geometric mean for the years 2010 through 2014. It is likely that any recent downturn is linked to poor ocean conditions, as described for other steelhead species. These conditions (e.g., temperature and salinity, coastal food webs) appeared to be more favorable to steelhead survival and adult returns in 2018, but were still impacted by recent warming trends.*	• Degraded freshwater habitat • Degraded water quality • Increased disease incidence • Altered stream flows • Reduced access to spawning and rearing habitats due to impaired passage at dams • Altered food web due to changes in inputs of microdetritus • Predation by native and non-native species, including hatchery fish and pinnipeds • Competition related to introduced salmon and steelhead • Altered population traits due to interbreeding with hatchery origin fish

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Middle Columbia River steelhead	Threatened 1/5/06	NMFS 2009b	NWFSC 2015	This DPS comprises 17 extant populations. The DPS does not currently include steelhead that are designated as part of an experimental population above the Pelton Round Butte Hydroelectric Project. Returns to the Yakima River basin and to the Umatilla and Walla Walla Rivers were higher over the 2010 to 2015 brood cycle, while natural origin returns to the John Day River decreased. There were improvements in the viability ratings for some of the component populations, but the DPS was not currently meeting the viability criteria in the MCR steelhead recovery plan. In general, the majority of population level viability ratings remained unchanged from 2010 reviews for each major population group within the DPS. *The recent data indicates a substantial downward trend in the abundance of natural-origin spawners from 2014 to 2019. This recent downturn is thought to be driven primarily by marine environmental conditions and a decline in ocean productivity, because hydropower operations, the overall availability and quality of tributary and estuary habitat, and hatchery practices have been relatively constant or improving over the past 10 years. Increased abundance of sea lions in the lower Columbia River could also be a contributing factor.*	• Degraded freshwater habitat • Mainstem Columbia River hydropower-related impacts • Degraded estuarine and nearshore marine habitat • Hatchery-related effects • Harvest-related effects • Effects of predation, competition, and disease

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Upper Columbia River steelhead	Threatened 1/5/06	Upper Columbia Salmon Recovery Board 2007	NWFSC 2015	This DPS comprises four independent populations. Three populations are at high risk of extinction while 1 population is at moderate risk. Upper Columbia River steelhead populations have increased relative to the low levels observed in the 1990s, but natural origin abundance and productivity remain well below viability thresholds for three out of the four populations. The status of the Wenatchee River steelhead population continued to improve based on the additional year's information available for the 2015 review. The abundance and productivity viability rating for the Wenatchee River exceeded the minimum threshold for 5% extinction risk. However, the overall DPS status remained unchanged from the 2010 review, remaining at high risk driven by low abundance and productivity relative to viability objectives and diversity concerns. *The recent data indicates a substantial downward trend in the number of natural-origin spawners level from 2014 to 2019. This downward trend in adult abundance is thought to be driven primarily by marine environmental conditions and a decline in ocean productivity, as hydropower operations, the overall availability and quality of tributary and estuary habitat, and hatchery practices, were relatively constant or improving over this period of time. Increased abundance of sea lions in the lower Columbia River could also be a contributing factor.*	• Adverse effects related to the mainstem Columbia River hydropower system • Impaired tributary fish passage • Degraded floodplain connectivity and function, channel structure and complexity, riparian areas, large woody debris recruitment, stream flow, and water quality • Hatchery-related effects • Predation and competition • Harvest-related effects

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Snake River Basin steelhead	Threatened 1/5/06	NMFS 2017a	NWFSC 2015	This DPS comprises 24 populations. Two populations are at high risk, 15 populations are rated as maintained, 3 populations are rated between high risk and maintained, 2 populations are at moderate risk, 1 population is viable, and 1 population is highly viable. Four out of the five MPGs were not meeting the specific objectives in the draft recovery plan based on the updated status information available for the 2015 review, and the status of many individual populations remained uncertain. A great deal of uncertainty still remains regarding the relative proportion of hatchery fish in natural spawning areas near major hatchery release sites within individual populations. *The most recent data available with respect to the adult abundance indicates a substantial downward trend in the abundance of natural-origin spawners at the DPS-level from 2014 to 2019. The 2014 to 2018 5-year genetic stock identification (GSI) geometric means indicate large decreases in natural-origin abundance for most of the MPGs and numbers for 2019 were much lower than the 2014 to 2018 geomean. These data show that SRB steelhead MPGs generally increased in abundance after the 1990s, but experienced reductions during the more recent period when hydrosystem operations, the overall availability and quality of tributary and estuary habitat, and hatchery practices were relatively constant or improving, but ocean conditions were poor. Increased numbers of sea lions in the lower Columbia River in the last 10 years could also be a contributing factor to the recent reductions.*	• Adverse effects related to the mainstem Columbia River hydropower system • Impaired tributary fish passage • Degraded freshwater habitat • Increased water temperature • Harvest-related effects, particularly for B-run steelhead • Predation • Genetic diversity effects from out-of-population hatchery releases

2.2.2 Status of the Critical Habitat

This section describes the status of designated critical habitat affected by the proposed action by examining the condition and trends of the essential physical and biological features of that habitat throughout the designated areas. These features are essential to the conservation of the ESA-listed species because they support one or more of the species' life stages (e.g., sites with conditions that support spawning, rearing, migration and foraging).

For most salmon and steelhead, NMFS's critical habitat analytical review teams (CHARTs) ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC5) in terms of the conservation value they provide to each ESA-listed species that they support (NMFS 2005). The conservation rankings were high, medium, or low. To determine the conservation value of each watershed to species viability, the CHARTs evaluated the quantity and quality of habitat features, the relationship of the area compared to other areas within the species' range, and the significance to the species of the population occupying that area. Even if a location had poor habitat quality, it could be ranked with a high conservation value if it were essential due to factors such as limited availability, a unique contribution of the population it served, or is serving another important role.

A summary of the status of critical habitats, considered in this opinion, is provided below.

Table 3. **Status of critical habitat**

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Lower Columbia River Chinook salmon	9/02/05 70 FR 52630	Critical habitat encompasses 10 subbasins in Oregon and Washington containing 47 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PBFs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some, or high potential for improvement. We rated conservation value of HUC5 watersheds as high for 30 watersheds, medium for 13 watersheds, and low for four watersheds.
Upper Willamette River Chinook salmon	9/02/05 70 FR 52630	Critical habitat encompasses 10 subbasins in Oregon containing 56 occupied watersheds, as well as the lower Willamette/Columbia River rearing/migration corridor. Most HUC5 watersheds with PBFs for salmon are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some, or high, potential for improvement. Watersheds are in good to excellent condition with no potential for improvement only in the upper McKenzie River and its tributaries (NMFS 2005). We rated conservation value of HUC5 watersheds as high for 22 watersheds, medium for 16 watersheds, and low for 18 watersheds.
Upper Columbia River spring-run Chinook salmon	9/02/05 70 FR 52630	Critical habitat encompasses four subbasins in Washington containing 15 occupied watersheds, as well as the Columbia River rearing/migration corridor. Most HUC5 watersheds with PBFs for salmon are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some, or high, potential for improvement. We rated conservation value of HUC5 watersheds as high for 10 watersheds, and medium for five watersheds. Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Snake River spring/summer-run Chinook salmon	10/25/99 64 FR 57399	Critical habitat consists of river reaches of the Columbia, Snake, and Salmon rivers, and all tributaries of the Snake and Salmon rivers (except the Clearwater River) presently or historically accessible to this ESU (except reaches above impassable natural falls and Hells Canyon Dam). Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Migratory habitat quality in the lower Snake River and Columbia River has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Snake River fall-run Chinook salmon	10/25/99 64 FR 57399	Critical habitat consists of river reaches of the Columbia, Snake, and Salmon rivers, and all tributaries of the Snake and Salmon rivers presently or historically accessible to this ESU (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams). Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Migratory habitat quality the lower Snake River and Columbia River has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Columbia River chum salmon	9/02/05 70 FR 52630	Critical habitat encompasses six subbasins in Oregon and Washington containing 19 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PBFs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 16 watersheds, and medium for three watersheds.
Lower Columbia River coho salmon	2/24/16 81 FR 9252	Critical habitat encompasses 10 subbasins in Oregon and Washington containing 55 occupied watersheds, as well as the lower Columbia River and estuary rearing/migration corridor. Most HUC5 watersheds with PBFs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 34 watersheds, medium for 18 watersheds, and low for three watersheds.
Snake River sockeye salmon	10/25/99 64 FR 57399	Critical habitat consists of river reaches of the Columbia, Snake, and Salmon rivers; Alturas Lake Creek; Valley Creek; and Stanley, Redfish, Yellow Belly, Pettit and Alturas lakes (including their inlet and outlet creeks). Water quality in all five lakes generally is adequate for juvenile sockeye salmon, although zooplankton numbers vary considerably. Some reaches of the Salmon River and tributaries exhibit temporary elevated water temperatures and sediment loads that could restrict sockeye salmon production and survival (NMFS 2015b). Migratory habitat quality in the lower Snake River and Columbia River has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Lower Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses nine subbasins in Oregon and Washington containing 41 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PBFs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 28 watersheds, medium for 11 watersheds, and low for two watersheds.
Upper Willamette River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses seven subbasins in Oregon containing 34 occupied watersheds, as well as the lower Willamette/Columbia River rearing/migration corridor. Most HUC5 watersheds with PBFs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. Watersheds are in good to excellent condition with no potential for improvement only in the upper McKenzie River and its tributaries (NMFS 2005). We rated conservation value of HUC5 watersheds as high for 25 watersheds, medium for 6 watersheds, and low for 3 watersheds.
Middle Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses 15 subbasins in Oregon and Washington containing 111 occupied watersheds, as well as the Columbia River rearing/migration corridor. Most HUC5 watersheds with PBFs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of occupied HUC5 watersheds as high for 80 watersheds, medium for 24 watersheds, and low for 9 watersheds.
Upper Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses 10 subbasins in Washington containing 31 occupied watersheds, as well as the Columbia River rearing/migration corridor. Most HUC5 watersheds with PBFs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 20 watersheds, medium for eight watersheds, and low for three watersheds.
Snake River basin steelhead	9/02/05 70 FR 52630	Critical habitat encompasses 25 subbasins in Oregon, Washington, and Idaho. Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Migratory habitat quality in the lower Snake River and Columbia River has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.

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 action area is bounded by the point in the water column up to 2,000 feet from the pile driver where sound from impact pile driving decreases below 150 decibels (root mean square) (dB_{RMS}). This is the threshold where the behavior of fish is no longer affected by noise. The action area is bounded by the breakwater where it blocks sound pressure waves and their effects. The action area is shown in Figure 3. Although the action area is a small part of the Columbia River estuary, the water flowing through the action area has background concentrations of pollutants (including metals) that are added to stressors from the proposed action and analyzed in Sections 2.4 and 2.5 take place within this action area. In this way the small action area encompasses all of the effects of the proposed action while acknowledging that the water in the action area has accumulated stressors from outside the action area.

Figure 3. East mooring basin causeway repair action area.

The action area is within designated critical habitat, providing migration and foraging conservation values for all salmon and steelhead listed in Table 2. The action area is also EFH for multiple species, including Pacific salmonids, and this is presented more fully in section 3 of this document.

2.4. Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or their 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).

2.4.1 ESA-Listed Species in the Action Area

The action area is in the Columbia River estuary which extends from the mouth of the Columbia River to Bonneville Dam. Columbia River estuary habitat is important to the survival of all Columbia Basin salmon and steelhead during rearing and migration because it provides the food-rich environment where they grow and transition to saltwater. Ocean-type fall Chinook and chum salmon spend weeks to months in the estuary and make use of shallow, vegetated habitats such as marshes and tidal swamps. Stream-type coho salmon, spring Chinook salmon, and steelhead spend less time in the estuary and use mostly deeper, main channel estuarine habitats.

2.4.2 Designated Critical Habitat in the Action Area

The action area contains designated critical habitat for all of the ESA-listed species considered in this opinion. More specifically, the action area provides migratory and rearing habitat for these listed species. The current baseline condition of the action area has been impacted by human activities both within and upstream of the action area, and is described in more detail below.

The amount and accessibility of both in-channel and off-channel estuary habitat has been reduced as a result of habitat conversion for agricultural, urban, and industrial uses, hydroregulation and flood control, channelization, and higher bankfull elevations. Overbank flooding that would aid juveniles in accessing off-channel refugia and food resources has been virtually eliminated. Sediment transport processes that structure habitat have been impaired. Up to 77 percent of historical tidal swamps have been eliminated and the surface area of the estuary has decreased by approximately 20 percent. The annual mean river flow through the estuary has declined by about 16 percent and peak spring flows have declined about 44 percent. Irrigation and other water use withdrawals have reduced flows of the Columbia River by 7 percent (NMFS, 2013).

The quality of the habitat available to salmon and steelhead in the estuary has also been compromised. Water temperatures above the upper thermal tolerance range for salmon and steelhead are occurring earlier and more often and are likely to continue to climb as a result of global climate change. A variety of toxic contaminants have been found in water, sediments, and salmon tissue in the estuary at concentrations above the estimated thresholds for health effects in juvenile salmon. These contaminants include polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), DDT and copper. Pesticides, pharmaceuticals, personal care products, and brominated fire retardants appear to pose risks to salmonid development, health, and fitness through endocrine disruption, bioaccumulative toxicity, or other means (NMFS, 2013).

The sediment in the action area has been analyzed for chemicals prior to dredging in 1994, 1998 and 1999. In 1994, sediment samples had low concentrations of 2 or more PAHs, butyltin and metals below screening levels for flow lane disposal. In 1998, one sample core had total DDT detected at 9.69 micrograms per kilograms from the surface to a depth of 4 feet and 7 micrograms per kilogram from a depth of 4 feet to 11 feet. Subsequent bioassays required the dredge sediment to be disposed of at an upland facility. In 1999, one sediment sample detected 0.7 micrograms per liter tributyltin near the Northwest corner of the marina.

The elimination of vegetated wetlands in the estuary have altered the diet of juvenile salmon in the estuary by reducing the supply of insect prey and macrodetrital inputs to the estuarine food web. Increased microdetrital inputs to the estuary from decaying phytoplankton produced in upstream reservoirs and nutrient inputs from urban, industrial, and agricultural development may support of a food web that favors other fish species such as American shad. The presence of native and exotic fish, introduced invertebrates, invasive plant species, and thousands of over-water and instream structures, which alter habitat in their immediate vicinity also alter the salmon food web. Habitat in the estuary supports predation on salmonids by northern pikeminnow, pinnipeds, Caspian terns, and cormorants. Juvenile salmon and steelhead in the estuary are subject to mechanical hazards from dredging activities, ship ballast intake, and beach stranding as a result of ship wakes (NMFS, 2013).

The degraded habitat conditions in the estuary affect the abundance, productivity, spatial structure, and diversity of ESA-listed salmon and steelhead. Estuarine habitat issues limit the viability of Lower Columbia River Chinook, coho, and steelhead and Columbia River chum salmon. Recovery planners estimated baseline anthropogenic mortality in the estuary, excluding mortality attributable to predation, at between 9 and 50 percent, depending on species and population. For most populations, the estimates range from 10 to 32 percent (NMFS, 2013).

Federal and state agencies permitted the construction of the East Mooring Basin Causeway and the USACE breakwater around the causeway before salmon and steelhead were ESA listed. The East Mooring Basin causeway was constructed after World War II and is used by fishermen and other commercial boat owners to reach their vessels in the mooring basin. The Port repaired the causeway in 2010 using untreated timber and shut down the causeway in 2018 because of its severely rotting substructure. The causeway contributes to degraded habitat conditions in the action by partially obstructing fish passage, contributing to excessive predation, and reducing benthic forage in the area. Without repair or maintenance, this OWS would deteriorate over time and effects associated with its presence would ultimately cease to exist.

We searched for and did not find any future proposed Federal projects in the action area that have undergone ESA consultation but have not been implemented.

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).

2.5.1 Effects to Salmon and Steelhead

The proposed action is likely adversely affect the following species and their designated critical habitats:

1. Lower Columbia River (LCR) Chinook salmon
2. Willamette River spring Chinook salmon
3. Snake River basin (SR) fall-run Chinook salmon
4. Snake River spring/summer run Chinook salmon
5. Upper Columbia River spring-run Chinook salmon
6. SR steelhead
7. Middle Columbia River (MCR) steelhead
8. Columbia River chum salmon
9. LCR steelhead
10. Willamette River steelhead
11. Upper Columbia River (UCR) steelhead
12. LCR coho salmon
13. SR sockeye salmon

2.5.2 Effects to Designated Critical Habitat

The action area is migration and forage critical habitat for all salmon and steelhead listed in Table 2. Because these salmon and steelhead species have similar estuarine habitat requirements for migration and foraging, the following analysis is applicable to all of the salmon and steelhead critical habitat designations. The essential PFBs of migration corridors and forage habitat are freedom of obstruction and excessive predation, and water quantity and quality, natural cover, side channels, and undercut banks that support foraging, mobility and survival. The proposed action will affect designated critical habitat as a result of construction activities. In addition, repairing the causeway will meaningfully extend the life of the structure; therefore, future effects associated with the presence of the OWS are also considered here. These future effects will hereinafter be referred to as "intrinsic effects" that are associated with the OWS. These intrinsic effects are expected to persist through the design life of this OWS.

The proposed action extends the life of the overwater structure (OWS) for decades. It's presence in the estuary is a partial passage obstruction to individual salmon and steelhead adults and smolts migrating along the Oregon shoreline. Although some species are more likely to migrate along the shoreline than others, every species has sufficient life history variance that we can assume that individuals from all 13 ESUs will encounter and be obstructed by the OWS at some time (Kreitman and Fisher, 2013; ODFW, 2008). OWS are a particular impediment to the outmigration of smolts that must swim beneath or around the structure and the boats moored at the structure (Anderson et al., 2005; Kemp et al., 2005), slightly increasing the length of their migration and the energy required to reach the ocean.

The presence of the OWS also benefits salmon and steelhead predators (Celedonia et al., 2008). The East Mooring Basin is a haul out for California sea lions that migrate to the Columbia River in late summer and stay until May. From 2010 to 2015, the median number of sea lions observed in the East Mooring Basin on a single day in the last two weeks of May increased from 126-137 to 375-576 (Rub et al., 2019). California sea lions prey on salmon and steelhead in the estuary and about 10 percent of the sea lions swim upriver to prey on fish as they migrate towards the Bonneville Dam or Willamette Falls (Rub et al., 2019). Rub and Sandford (2020) estimate that 467 sea lions decrease the probability that adult salmon will survive to Bonneville Dam by 32 percent. Caspian terns, double crested cormorants, glaucous winged/wester gull hybrids, California gulls and ring-billed gulls that hunt for smolts in the estuary roost and rest on the OWS (Anderson et al., 2007; NMFS, 2013). Salmon and steelhead smolts migrate in spring pulses past colonies with more than 100 breeding pairs of California gulls, ring-billed gulls, glaucous winged western gull hybrids, Caspian terns or Double Crested cormorants on East Sand Island at river mile 5 and Rice Island at river mile 21. Caspian terns disproportionately consume smolts in the estuary within 19 miles of their breeding colony (Lyons et al., 2007) and double-crested cormorants have a foraging range of around 18 miles (Anderson et al., 2007) so the OWS benefits both predators.

The presence of the OWS reduces benthic forage in the estuary. Shade from the OWS reduces primary production, although the EMB causeway is oriented north-south so the shade effect is less than it would be for an east-west oriented OWS and the overhead area of the OWS is 18 percent smaller than the area of the existing causeway. OWS piles take up space where benthic macroinvertebrates could grow (Haas et al., 2002). Metals from ACZA treated wood that partition to suspended sediment in the water column that deposits to the substrate contributes to metal toxicity to benthic invertebrates (Campana et al., 2012). The lost benthic forage beneath the OWS as a result of shade and space displaced by piles has a small direct effect on smolts foraging in the action area. Juvenile salmon that search for and fail to find suitable estuarine rearing habitat and sufficient forage experience higher risk of mortality (ISAB, 2015). NMFS (2013) expresses concern that the carrying capacity of the estuary cannot always support the annual number of natural and hatchery fish dependent upon it for growth before they enter the ocean. However, there is insufficient information to determine whether available forage in the estuary limits the existence and recovery of ESA-listed salmon and steelhead (ISAB, 2015).

The presence of the OWS reduces water quality. Boats that use the OWS can leak or spill fuel into the water. Boat props create suspended sediment in shallow water. Metals from ACZA treated wood partitions to the water column over time, adding to the background concentration of metals in the water column.

The proposed action construction also affects critical habitat PBFs. Piles will be removed and replaced with a vibratory pile driver during each of the four construction years. Vibratory pile driver noise spreads through the water, degrading water quality and creating a passage obstruction, until it reaches a solid barrier. Vibratory pile driver noise will exist in the water for up to two hours per pile or 10 hours for five piles spread over two weeks of the proposed work window. The September 1 to December 31 work window overlaps the migration of salmon and steelhead smolts through the action area (Morrice et al., 2020), particularly smolts that remain in the estuary through the winter to grow (Bottom et al., 2005; Connor et al., 2005). It also overlaps the upstream migration time of adult fall Chinook salmon, chum salmon and winter steelhead through the estuary. We used the NMFS Pile Driver Calculator to estimate that vibratory pile driving noise is greater than 150 dB_{RMS} threshold that affects fish behavior within 2000 feet of the pile (Buehler et al., 2015) but is blocked by the breakwater around the marina as shown in Figure 5.

Vibratory pile driving also transports sediment around the pile up into the water column further degrading water quality while the pile driver is operating and for a time after the pile driver stops. As above, suspended sediment will exist in the water column for up to four hours per pile or 20 hours for five piles spread over two weeks of the proposed work window. The September 1 to December 31 work window overlaps the migration of salmon and steelhead smolts through the action area, particularly smolts that remain in the estuary through the winter to grow. It also overlaps the upstream migration time of adult fall Chinooks salmon, chum salmon and winter steelhead through the estuary. The concentration of suspended sediment depends on the sediment size distribution around the pile but is generally less than 100 milligrams per liter (Weston Solutions, 2006).

Impact pile driving to complete installation of the vibratory driven piles also degrades water quality. Like vibratory pile driver noise, impact pile driver sound pressure waves spreads through the water until they reach a solid barrier. Twenty impact pile driver strikes over a few minutes per pile for five piles per year will create less than one hour of sound pressure over up to two weeks of the September 1 to December 31 work window. The September 1 to December 31 work window overlaps the migration of salmon and steelhead smolts through the action area, particularly smolts that remain in the estuary through the winter to grow. It also overlaps the upstream migration time of adult fall Chinooks salmon, chum salmon and winter steelhead through the estuary. We used the NMFS pile driver noise calculator to estimate that impact pile driving sound pressure is greater than 187 dB_{SEL} threshold that injures of kills fish greater than 2 grams within 22 meters of the pile.

Metals in ACZA treated lumber leach out of the wood and into surrounding water, degrading water quality. Metals will leach out of the wood after each of the four annual construction phases. Approximately 40 square meters of submerged treated wood will leach copper and zinc for several days until the labile metal supply is exhausted (NOAA Fisheries, 2009). About 275 square meters of treated wood above OHW will leach copper and zinc during rain events for weeks to months following construction. Copper and zinc leaching for several months following construction overlaps the presence of salmon and steelhead smolt migration in or past the action area (Daly et al., 2014; Morrice et al., 2020; Weitkamp et al., 2012) and the migration of spring Chinook adults past the action area (Kreitman and Fisher, 2013). In the 58,000 cubic foot box beneath the replaced decking each year, 0.006 micrograms per liter of copper from submerged elements and 0.03 micrograms per liter of copper from decking during rainstorms will add to the background 0.6 micrograms per liter copper in the water column for a concentration of 0.64 micrograms per liter. The model does not report any increase in dissolved zinc from leaching. See Appendix 1 for calculations.

Construction equipment can spill hazardous fluids into the water, degrading water quality. Hazardous fluids may be spilled during each of the four annual construction phases. If an accidental spill does occur, BMPs require that on site spill kits be used to recover spilled fluids immediately if possible. If spilled fluids are unable to be recovered, chemicals may be in the action area water column for up to several hours while they are physically dispersed. Chemicals that partition to sediments may be present in the action area for decades. The September 1 to December 31 work window overlaps the migration of individual smolts in the action area (Morrice et al., 2020) and the migration of adult fall Chinook, chum, and winter steelhead past the action area (Kreitman and Fisher, 2013). Fuels, lubricants and some fluids used in construction equipment have constituent chemicals that are acutely toxic such as benzene, toluene, ethyl benzene and xylene (BTEX) to fish or contribute to chronic toxicity effects such as polynuclear aromatic hydrocarbon (PAH) (Johnson et al., 2007a; Johnson et al., 2007b; Logan, 2007). However, it is extremely unlikely that contamination of surface water will occur during construction because BMPs to prevent a spill during in water/over water construction will be implemented, and spill response equipment will be onsite and available for immediate use in the event of a spill.

In summary, reconstructing the OWS sustains permanent (decades) impacts to critical habitat PBFs. These impacts are: a small increase in the downstream migration length for smolts that migrate along the shoreline; a small benefit to salmon and steelhead predators; the loss of a small area of estuary benthic forage beneath the OWS; and a small degradation of water quality from boats that use the OWS. OWS construction creates transient impacts to critical habitat PBFs. These impacts are: short periods (hours) of degraded water quality from of noise loud enough to alter salmon and steelhead behavior and partially obstruct their migration; suspended sediment concentrations up to 100 milligrams per liter; and small sound pressure level zones around piles sufficient to injure or kill exposed smolts. OWS construction also degrades water quality with longer periods (months) of metals from treated wood that add to the background concentration of metals in the water flowing through the action area.

2.5.3 Direct Effects to Salmon and Steelhead

Implementation of the proposed action may affect individuals of ESA-listed species that occur in the action area. More specifically, individual fish will be impacted by construction activities that create noise (pile driving), SPL (impact pile driving), and increase suspended sediment and chemical contaminants (removal and installation of the causeway). In addition, individual fish will be impacted by the intrinsic effects of the OWS as described in the Section 2.5.1 above.

The effects of vibratory and impact pile driving on critical habitat water quality are transient, that is water quality is degraded while the pile driver is operating and returns to normal when the pile driver is off. Therefore, pile driving effects to critical habitat only directly affect individual fish if the fish is sufficiently near the pile driver while it is operating. The September 1 to December 31 work window overlaps the upstream migration of adult fall Chinook, chum and winter steelhead and the downstream migration of smolts from all 13 ESU/DSPs past the action area. The density of smolts in the estuary drops dramatically in September, from 1,000s of fish per 1,000 square meters to 10s of fish per 1,000 square meters (Roegner et al., 2016). Vibratory pile driving creates noise greater than 150 dB_{RMS} (re: 1μPa) within 2,000 feet of the pile (Buehler et al., 2015). The Fisheries Hydroacoustic Working Group (FHWG, 2008) determined that SPLs in excess of 150 dB_{RMS} are likely to cause temporary behavioral changes, including a startle response or other behaviors indicative of stress. Popper et al. (2003) reports that behavioral response of fishes to sounds may include “freezing”, increasing the vulnerability of individual fish to predation. Proposed action vibratory pile driving BMP (three sequences of operating the pile driver at reduced energy for 15 seconds and then turning the driver off for 30 seconds whenever the pile driver has been silent for more than 30 minutes) may increase the likelihood that any individual fish that have entered the action area will leave before they are exposed to noise greater than 150 dB_{RMS}. The BMPs combined with the blocking of noise by the breakwaters around the marina and the low density of fish in the estuary during the work window are likely to minimize the number of individual fish exposed to the effects of vibratory pile driver noise.

The contractor will use up to 20 impact pile driving strikes to complete installation of each pile. BMPs dictate that the contractor start with three sequences of an initial set of strikes at reduced energy followed by 30 seconds of waiting to encourage fish to leave the action area before the pile is driven. Impact pile driving within a bubble curtain will create sound pressure greater than 187 dB_{SEL} within 22 meters of the pile (Buehler et al., 2015). Adult salmon exposed to 187 dB_{SEL} for one hour may be injured by SPL (Oestman et al., 2009) and smolts exposed to 187 dB_{SEL} for one hour may be killed by SEL. BMPs combined with the low density of fish in the action area are likely to minimize the number of fish exposed to injurious or lethal SPL.

Pile driving will also result in elevated concentrations of suspended sediment. Any individual fish near the pile-substrate interface will be exposed to up to 100 milligrams per liter of suspended sediment during and for a short time following vibratory pile driving. Wilber and Clarke (2001) report that adults exposed to 10-100 milligrams per liter of suspended sediment for less than 2 hours will result in behavioral effects such as reduced visual acuity and altered swimming either toward or away from suspended sediment and that juvenile fish exposed to 10 to 100 milligrams per liter for 8 hours would experience sublethal physiological effects such as reduced feeding and behavioral effects such as alarm followed by relocation. They note that these effects are somewhat offset by the ability of smolts to hide from predators in the turbidity associated with suspended sediment. Again, BMPs and the low density of fish in the estuary during the work window are likely to minimize the number of individual fish exposed to suspended sediment from vibratory pile driving.

The effects of ACZA treated wood metals leaching on critical habitat water quality are, like pile driving effects to water quality, transient except they last for months instead of hours and so they can overlap the upstream migration timing of all 13 adult salmon and steelhead ESU/DSPs and the downstream migration timing of smolts from all 13 salmon and steelhead ESU/DSPs. BMPs dictate that treated wood is not cut, drilled, field treated or stored near the water so that only metals from the final OWS assembly can reach the water. As described above, we estimate that the concentration of copper beneath the OWS can reach 0.64 micrograms copper per liter. Hecht et al. (2007) report mean acute, 96-hour, freshwater lethal concentration that kills fifty percent of exposed fish (LC50) values range from 19-108.1 microgram copper per liter for *Oncorhynchus* species and that acute copper toxicity typically decreases with increasing salinity that impairs the transport of dissolved copper across the gill membrane. Dissolved copper concentrations from 0.79 – 2.1 micrograms per liter added to background concentration of 3 micrograms per liter reduce olfactory sensitivity approximately 29.3 – 57 percent. Behavioral impacts (growth, reproduction and predator avoidance) from dissolved copper effects to olfaction do not seem to be reduced by increasing hardness of freshwater because the olfactory rosette is in direct contact with the aquatic environment but we lack of information on dissolved copper olfaction impairment in the marine environment. Therefore, BMPs combined with the low leaching rates from treated wood with H2O Block are likely to minimize the effect of copper from the treated wood on all life stages of salmon and steelhead in the action area. As described above, we believe that the concentration of zinc in the water beneath the OWS will remain at the background concentration of 2.4 micrograms per liter. The 96-hour dissolved zinc LC50 for adult coho and steelhead are 905 and 1,755 micrograms per liter respectively (Chapman, 1978b). A three month exposure of adult sockeye salmon to 30 milligrams per liter zinc had no effect on survival, fecundity, fertility or growth (Chapman, 1978a). Adult salmon exposed to 2.8 micrograms per liter zinc beneath the OWS for minutes are unlikely to experience any adverse effects. Sockeye smolts exposed to 242 micrograms per liter dissolved zinc experienced no adverse effects on survival, fertility, fecundity, or growth (Chapman, 1978a). Therefore, BMPs combined with the low leaching rate of zinc from treated wood with H2O Block are likely to minimize the effect of zinc on all life stages of salmon and steelhead in the action area.

Salmon and steelhead smolts that migrate in shallow water along the shoreline and swim beneath the OWS may be exposed to construction stressors including noise, suspended sediment and sound pressure from pile driving, and metals leached from treated lumber resulting in behavioral changes, injuries or death. As described in the previous section, reconstructing the OWS sustains permanent (decades) impacts to critical habitat PBFs and, as result, will negatively impact individual fish. Individual fish may: (1) expend more energy to reach the ocean due to the longer migration lengths; (2) experience greater predation pressures; (3) have few foraging opportunities; (4) and be exposed to chemical concentrations in the water column and prey. suitable estuarine rearing habitat and sufficient forage experience higher risk of mortality.

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. It is clear however that climate change presents an array of specific threats that can act synergistically with other threats, dramatically increasing the impacts of each. In particular, the loss of population spatial structures, as well as habitat heterogeneity and connectivity, removes the means by which salmon have historically persisted through frequent disturbances and climate extremes. Recent analyses in terrestrial environments found a correlation between habitat loss and climate stress and it is possible that, due to past adaptation or recent stressors, adaptive capacity may already be at its lowest levels precisely where salmon need it most (Crozier et al., 2019) , as warming temperatures, decreasing salinity, increasing acidity, rising sea level, and shifting food webs intensify over the period of years that this project will exist within the action area.

As with all projects in the estuary, the quality of the water that flows through the action area is affected by many city, county and private activities that are regulated by the states. For example, multiple upstream stormwater and wastewater sources deliver chemicals to the Columbia River that are be carried through the action area. Two chemicals of concern are copper and zinc because the proposed action uses treated wood. We've accounted for these cumulative effects by referencing the copper and zinc concentrations reported upstream, adjusted those concentrations to account for tidal mixing and added them to the concentrations expected to be leached from the wood.

We searched for other relevant activities that may affect ESA species in the action area and found none. It is very likely however that upland uses will intensify over the next 75 years as human population growth continues in all areas adjacent to the Columbia River, increasing water withdrawals, storm and waste water inputs, and recreational and commercial boating, each of which incrementally adds to degrading habitat conditions necessary for viability and recovery in the action area.

2.6. Integration and Synthesis

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

With the exception of UCR spring-run Chinook salmon and SR sockeye salmon, which are already considered endangered, each species of salmon and steelhead considered in this opinion is at risk of becoming endangered in the foreseeable future. These species are EA-listed due to a combination of low abundance and productivity, reduced spatial structure, and decreased genetic (and in some cases, life history) diversity. Recent adult returns have been substantially below averages for many populations/MPGs. We expect that abundance could further decrease and extinction risk increase for many ESUs and DPSs due to factors associated with climate change.

The status of all designated critical habitats considered in this opinion varies, with habitat conditions being excellent in wilderness and roadless areas to severely degraded habitat conditions in areas subject to intense human activities such as agricultural and urban development. There are a number of common limiting factors, including altered flow regimes, reduced access to off-channel rearing habitat in the lower Columbia River, impaired water quality and reduced habitat complexity.

The current baseline condition of the action area has been impacted by human activities both within and upstream of the action area. Under the environmental baseline, the fish from the component populations of each ESU and DPS that move through and use the action area will encounter habitat conditions degraded by a modified flow regime; reduced water quality (chemical contamination and elevated summer and fall temperatures); loss of functioning floodplains; and loss of vegetated riparian areas and associated shoreline cover; and high predation rates.

We translate the effects of the proposed action on individuals into their effects on the abundance, productivity, spatial structure and diversity (APSSD) parameters that summarize the survival and recovery of each species. In the Columbia River estuary action area, there are 13 species of salmon and steelhead that are exposed to the effects of the action. Salmon and steelhead smolts that migrate in shallow water along the shoreline and swim beneath the OWS may be exposed to construction stressors including noise, suspended sediment and sound pressure from pile driving, and metals leached from treated lumber resulting in behavioral changes, injuries or death. As described in the previous section, reconstructing the OWS sustains permanent (decades) impacts to critical habitat PBFs and, as result, will negatively impact individual fish. Individual fish may: (1) expend more energy to reach the ocean due to the longer migration lengths; (2) experience greater predation pressures; (3) have few foraging opportunities; (4) and be exposed to chemical concentrations in the water column and prey. suitable estuarine rearing habitat and sufficient forage experience higher risk of mortality.

Most of the individuals in the 13 species are not going to be affected by the construction activities because the vast majority of adults and smolts migrate past the action area outside of the proposed in water work window. Indeed, this is the intent of in water work windows, to dramatically reduce exposure to proposed action stressors. However, to be conservative, we've assumed that some individuals from each ESU population will migrate past the project during the proposed work window and be exposed to construction-related impacts. Furthermore, because the OWS will be present year-round, we have assumed individual fish will be exposed to intrinsic effects associated with the OWS.

The very presence of the OWS provides a benefit to salmon and steelhead predators because they can use it to roost, rest or hide. The proposed action extends this benefit into the future. However, the predators are not present in the action area because this OWS exists; even if the OWS was removed, these predators would presumably find substitute structures and continue to hunt salmon and steelhead. Therefore, the OWS benefit to predators is relatively unimportant to the recovery goal of reducing the impact of the predation limiting factor to ESU survival and recovery. The OWS displaces a small area of benthic forage that salmon and steelhead use to grow while they are in the estuary. This displaced forage may affect a few individual fish but because of its small size, it does not affect the forage limiting factor to recovery of ESUs which is driven by lost estuarine tidal wetlands and competition for forage with hatchery fish.

We expect few, if any, smolts to be killed by impact pile driving because the density of smolts in the estuary is very low during the IWWW and the proposed action includes best management practices shown to keep fish away from the area around the pile where sound pressure forces are lethal. Similarly, noise and suspended sediment from vibratory pile driving may affect the behavior of individual fish and may even cause them to swim into an area where they may more likely be killed by a predator. The number of individuals whose behavior may be altered or who may be harmed or killed as a result of implementation of the proposed action is expected to be too small to translate into a reduction in future population abundance or the growth rate of the population. For example, if one individual smolt from any population is killed by impact pile driving sound pressure forces, the reduction in future abundance would be much less than 0.02 adults because the smolt to adult return ratio for salmon and steelhead is greater than (and for subyearlings much greater than) 50. Given the relatively short duration of the construction, implementation of BMPs to reduce impacts, and because the structure encompasses a very small proportion of the Lower Columbia River, implementation of the proposed action will affect far too few individual smolts to change future adult abundance or productivity.

Construction activities and extending the life of the OWS will not affect spatial structure because no populations originate in the action area and all populations must move through the estuary to reach the ocean. Similarly, construction activities and extending the life of the OWS will not affect diversity which is overwhelmingly driven by hatchery programs. Therefore, even though the proposed action may alter the behavior of or harm or even kill individuals from any of the 13 ESUs/DPSs, it will not change the survival or the recovery trajectory of any ESU/DPS.

When we consider the current status of the threatened and endangered salmon and steelhead ESU/DSPs and degraded environmental baseline within the action area, the proposed action itself is not expected to affect abundance, distribution, diversity, or productivity of any of the component populations of the ESA-listed species. The effects of the action will be too minor to have a measurable impact on the affected populations. Because the proposed action will not reduce the abundance, productivity, spatial structure, or diversity the affected populations, the action, when combined with a degraded environmental baseline and additional pressure from cumulative effects, will not appreciably reduce the survival or recovery any of the listed species considered in this opinion.

The action area is designated critical habitat for all 13 species of salmon and steelhead. Under the current environmental baseline, migration and rearing is functioning moderately. Proposed construction activities will add low-level, temporary effects on the migration and rearing PBFs. Extending the life of the OWS will add low-level effects on the migration and rearing PBFs in the long-term. The addition of these temporary and long-term effects to baseline and cumulative effects is not likely to appreciably diminish the value of designated critical habitat for the conservation of salmon and steelhead species.

2.7. 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 NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of LCR Chinook salmon, UWR Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, CR chum salmon, LCR coho salmon, SR sockeye salmon, LCR steelhead, UWR steelhead, MCR steelhead, UCR steelhead, SR Basin steelhead, or destroy or adversely modify their designated critical habitat.

2.8. Incidental Take Statement

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

2.9.1 Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur because the proposed construction and pile driving will take place when individual salmon and steelhead enter the action area.

Incidental take caused by the adverse effects of the proposed action will occur among individuals of the species identified above in the form of:

- injury or death from exposure to impact pile driver noise and sound pressure waves, and
- harm from exposure to suspended sediment.

A definitive number of ESA listed fish that will be killed, injured, or harmed cannot be estimated or measured because of the highly variable presence of species over time, and the inability to observe all injured or dead specimens. Instead, NMFS will use habitat–based surrogates that are causally related to harm to account for the take, which are called the "extent" of take.

For this proposed action, the extent of take from impact pile driving is related to the up to 400 impact blows needed to install the 5 piles per year over 4 years (i.e., 100 strikes per year).

The extent of take from suspended sediment from pile driving is related to the up to 150-foot radius from the suspended sediment source to the point where the suspended sediment concentration returns to background.

These are measurable and verifiable metrics by which the action agency or other observers can determine if the extent of take has been exceeded.

2.9.2 Effect of the Take

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

2.9.3 Reasonable and Prudent Measures

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

1. Minimize incidental take from pile driving.
2. Monitor to ensure the extent of take from pile driving and suspended sediment are not exceeded.

2.9.4 Terms and Conditions

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

1. The following term and condition implements RPM 1:
    a. Ensure that the Port does all impact pile driving during the ODFW recommended IWWW for the Columbia River estuary below Tongue Point, November 1 to February 28.

2. The following term and condition implements RPM 2:
    a. Prepare and provide NMFS with a plan before construction begins describing how impacts of the incidental take on listed species in the action area would be monitored and documented and a report within 90 days of the completion of construction documenting incidental take monitoring results. Provide the report to: projectreports.wcr@noaa.go. Include the WCR tracking number for this consultation (WCRO-2021-00773) in the regarding line when the report is submitted.

2.9. 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).

The estimated leached treated wood metal concentrations in the water column around the causeway are too low to adversely affect ESA listed species because Arch® H2O Water Block retards metal phase transfer. When causeway elements are replaced in the future, the Port should ensure that the new elements are also coated with Arch® H2O Water Block (or equivalent) or appropriately wrapped to minimize exposure of threated species to metals and minimize the addition of contaminants to critical habitat water quality.

2.10. Reinitiation of Consultation

This concludes formal consultation for the East Mooring Basin Causeway Replacement.

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

2.11. "Not Likely to Adversely Affect" Determinations

The proposed action is summarized is described in Section 1.3 of this opinion. The proposed action may affect the Southern DPS of Eulachon (*Thaleichthys pacificus*), Southern DPS of green sturgeon (*Acipenser medirostris*), and their designated critical habitats. Impacts to these species and their designated critical habitats are described in Sections 2.11.1 and 2.11.2, respectively.

<u>2.11.1 Eulachon</u>

Eulachon Critical Habitat - The essential PBFs of eulachon estuarine migration critical habitat are freedom of obstruction, habitat with water flow, quality and temperature conditions supporting larval and adult mobility, and abundant prey items supporting larval feeding after their yolk sac is depleted. The proposed action stressors on these PBFs are: the partial migration obstruction, reduced larval prey items and degraded water quality from the extended presence of the OWS; the degraded water quality and migration obstruction from vibratory pile driving noise and suspended sediment, partially obstructed passage from vibratory pile driving noise; the degraded water quality from impact pile driving sound pressure waves; the degraded water quality from metals leached from ACZA treated lumber; and the degraded water quality from hazardous materials accidentally spilled during construction.

Extending the life of the overwater structure sustains an insignificant obstruction to eulachon migration because adult eulachon are not shoreline dependent and can easily swim around or through the marina and larval eulachon are carried downstream by bedload or currents. The effect of OWS shade on the larval eulachon food web is insignificant because the OWS shades far too small of a fraction of the estuary to reduce the phytoplankton or copepods, copepod eggs, mysids, barnacle larvae, and worm larvae prey (76 FR 65323) of eulachon larvae. Fuel leaked from boats using the marina has an insignificant effect on eulachon critical habitat water quality because small spills are physically dispersed quickly by tides and currents and rare large spills are contained and recovered by Federal and State agencies (EPA, 2017). The proposed action construction stressors of vibratory pile driving noise and suspended sediment and impact pile driving sound pressure are a discountable effect to eulachon critical habitat water quality because these are transient effects that are only present during the in water work window before adult eulachon return to the action area in January and larval eulachon begin to reach the action area in March (NMFS, 2017). Metals leached from ACZA treated lumber are insignificant effects to eulachon critical habitat water quality because the treated lumber adds insignificant masses of copper and zinc to the baseline concentration of these metals in the action area resulting in concentrations that are orders of magnitudes lower than the concentrations that have toxic effects to adult or larval eulachon (Cao et al., 2010; Eisler, 1993; Eisler, 1998; Huang et al., 2010; Witeska et al., 2014). Fuels and hazardous fluids spilled from construction equipment are an insignificant effect to eulachon critical habitat water quality because proposed action BMPs to prevent (and rapidly clean up) spills render the likelihood of a spill insignificant.

The proposed action is not likely to directly adversely affect eulachon because all of the direct effects to eulachon are transmitted to them through effects to critical habitat PBFs which are shown above to be discountable or insignificant.

2.11.2 Green Sturgeon

Southern green sturgeon spawn and rear for up to three years in the Sacramento River in California but during the late summer and early fall, subadult and adult green sturgeon aggregate in estuaries along the Pacific coast including the action area. Their presence in the action area overlaps the start of the proposed action in water work window. The PBFs in estuarine areas include: a migratory pathway necessary for the safe and timely passage within estuarine habitats; abundant food items for sub adult and adult life stages; and water quality necessary for normal behavior, growth, and viability of sub adults and adults.

The proposed action stressors on critical habitat PBFs are: partial obstruction of the migration corridor, reduced food and degraded water quality from the extended presence of the OWS; degradation of water quality and partially obstructed passage from vibratory pile driving noise and suspended sediment; degraded water quality from impact pile driving sound pressure waves; degradation of water quality from metals leached from ACZA treated lumber; and degraded water quality from hazardous materials accidentally spilled during construction.

Extending the life of the overwater structure is not likely to obstruct green sturgeon migration because sub adults and adults are large fish that can easily swim around or through the marina without increased risk of predation. The effect of OWS on critical habitat food is insignificant because the OWS piles displace such a small amount of the estuary benthic surface where green sturgeon forage. Fuel leaked from boats in the marina has an insignificant effect on green sturgeon critical habitat water quality because small spills are physically dispersed quickly by tides and currents and rare large spills are rapidly contained and recovered by Federal or State agencies (EPA, 2017). Construction stressors such as vibratory pile driving noise and suspended sediment and impact pile driving sound pressure are an insignificant effect to green sturgeon critical habitat water quality because most of the work window is after green sturgeon have returned to the ocean and sub adult and adult green sturgeon in the estuary are large fish unaffected by noise or sound pressure waves. Metals leached from ACZA treated lumber are insignificant to green sturgeon critical habitat water quality because the treated lumber adds insignificant masses of copper and zinc to the baseline concentration of these metals in the action area that are an order of magnitude below the copper and zinc concentrations that show toxic effects to green sturgeon (Grossel et al. 2007, Bowen et al, 2006) and that are after green sturgeon have returned to the ocean. Fuels and hazardous fluids spilled from construction equipment are insignificant to green sturgeon critical habitat water quality because BMPs to prevent (and rapidly clean up) spills rendering the likelihood of a spill insignificant.

The proposed action is not likely to directly adversely affect green sturgeon because all of the direct effects to green sturgeon are transmitted through effects to critical habitat PBFs which are show above to be insignificant.

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

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

This analysis is based, in part, on the EFH assessment provided by the USACE and descriptions of EFH for Pacific Coast groundfish (Pacific Fishery Management Council [PFMC] 2005), coastal pelagic species (CPS) (PFMC 1998), and Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

The proposed action adversely affects salmon EFH and the salmon EFH estuary habitat of particular concern (HAPC) as identified in PFMC (2014), groundfish EFH and the groundfish EFH estuary HAPC as described in PFMC (2005) and coastal pelagic species EFH as described in PFMC (1998).

3.2. Adverse Effects on Essential Fish Habitat

The project elements that could potentially impact groundfish, pelagic, and salmon species' EFH and HAPCs are pile removal and installation, the use of treated wood, and general construction activities.

1. Vibratory pile removal and pile driving could result in temporary increases in noise and turbidity.

2. Impact driving/proofing may result in elevated sound levels for not more than 30 total minutes per day (in approximately five-minute intermittent intervals) for approximately 20 days over the 4 year Project. Potentially injurious sound pressure levels in water would be limited to areas within 22 meters.

3. There is potential for an unintentional release of fuel, lubricants, or hydraulic fluid from equipment that could lead to adverse impacts to the water column EFH if allowed to enter waters of the US (Columbia River).

4. There is potential for leaching of metals from treated wood into the water column.

3.3.Essential Fish Habitat Conservation Recommendations

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

1. Short-term impacts to water quality during construction will be minimized through adherence to BMPs.

2. The contractor will comply with applicable State water quality standards and implement corrective measures if temporary water quality standards are exceeded.

3. Piles will be installed to the extent possible with a vibratory hammer. Impact driving/proofing may only occur if driving conditions preclude the use of a vibratory hammer for float support pile and will be limited to the final five feet of embedment for pile.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in section 3.2, above, for the habitats of Pacific Coast salmon, Pacific Coast groundfish, and coastal pelagic species.

3.4. Statutory Response Requirement

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

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

3.5. Supplemental Consultation

The USACE 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 users of this opinion are the USACE. Other interested users could include the Port of Astoria. Individual copies of this opinion were provided to the USACE. The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adheres to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by 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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6. APPENDIX 1. ARCH®H2O TEST RESULTS

H2O Block to Prevent Preservative Leaching from Pressure Treated Wood

Method

Incised Douglas-fir 2x6 lumber was pressure treated with ACZA (0.40 pcf), CA-C (0.15 pcf), or CCA (0.40 pcf) and allowed to sit for a week. Twenty 1 foot sections were cut from boards from each type of wood. Ten sections were dipped in a 1:10 dilution of H2O Block (a silicon based water repellent) for 10 seconds; the other was left without the coating. The samples were leached by supporting them on edge 6 inches above the bottom of an open tank. Water was sprayed on top of the sample using a garden sprinkler until the water level in the tank reached 6 inches. The support and tank was rinsed with water after leaching each treatment. Lechate as well as the source water were sampled. The water samples were analyzed using ICP for metallic actives (As, Cu, Cr, Zn) and HPLC for azoles.

Results

The table below summarizes the analytical results and percent reduction in actives washed from each type of treated wood. The H2O Block consistently resulted in reduced levels of actives washed free from the pressure treated wood.

Sample	Cr (ppm)	Cu (ppm)	As (ppm)	Zn (ppm)
Source Water	0.03	0.35	0.11	1.05
ACZA	0.17	2.92	2.72	2.76
ACZA + H2O Block	0.04	0.92	0.89	0.32
Reduction (%)	**NA**	**-68**	**-67**	**-88**
CA-C	0.06	3.53	0.48	0.28
CA-C + H2O Block	0.02	1.97	0.23	0.15
Reduction (%)	**NA**	**-44**	**NA**	**NA**
CCA	0.67	1.04	1.60	0.11
CCA + H2O Block	0.26	0.79	0.99	0.11
Reduction (%)	**-61**	**-24**	**-38**	**NA**

NA = No analyte of this type.

Appendix-Calculations

We estimated the concentration of copper and zinc in the water column beneath the OWS from the background copper and zinc in the estuary and the copper and zinc that leach from the reconstructed section of the OWS as follows:

We populated the Wood Preserver Institute General Risk Assessment Model (Brooks, 2011) cells E7 and E9 with the above OHW and below OHW dimensions shown in *Table 1*.

We populated cells E28 and E29 with the 210 foot (6,400 centimeter) length and 28 foot (853 centimeter) width of OWS that will be replaced each year. We estimated the average depth of the water column beneath the OWS in cell E30 to be 10 feet (304 centimeters).

We estimate that copper and zinc enter the Columbia River at upstream urban areas such that the average background concentrations of copper and zinc in the Columbia River at River Mile 54 are 1.2 micrograms per liter and 4.8 micrograms per liter, respectively (Morace, 2006). We scaled these concentrations to the ratio of the maximum concentration of salt in the action area (10 ppt, cell E39) to the concentration of salt at the Columbia River mouth (20 ppt) to account for tidal mixing with clean ocean water (Chadwick et al., 2004). This results in average action area background concentrations of 0.6 micrograms copper per liter in cell E40 and 2.4 micrograms zinc per liter in cell E43 respectively. We used the 2 year, 24 hour storm event for Astoria from NMFS (2015) to estimate rainfall volume. Parameter values are summarized below.

Parameter	Value	Reference
Treated wood area above OHW	11,430,790 cm^2	Biological Assessment
Treated wood area below OHW	1,742,675 cm^2	Biological Assessment
Maximum tidal current speed	77 cm/sec	https://tidesandcurrents.noaa.gov/noaatidepredictions.html?id=9440083&legacy=1
Steady state current speed	0 cm/sec	https://tidesandcurrents.noaa.gov/noaatidepredictions.html?id=9440083&legacy=1
Background dissolved copper concentration	0.6 ug/L	(Chadwick et al., 2004; Morace, 2006)
Background dissolved zinc concentration	2.4 ug/L	(Chadwick et al., 2004; Morace, 2006)
Average annual rainfall	124.5 cm/year	2014_03-14_SLOPES V Transportation_NWR-2013-10411
Copper Arch H2O block efficiency	68%	Biological Assessment
Zinc Arch H2O block efficiency	85%	Biological Assessment
Width of Structure	6,400 cm	Biological Assessment
Length of structure	853 cm	Biological Assessment
Water depth	304 cm	Biological Assessment