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-2022-00807

February 1, 2023

Todd Tillinger
Chief, Regulatory Division
U.S. Army Corps of Engineers, Seattle District
4735 E. Marginal Way South, Bldg. 1202
Seattle, Washington 98134-2388

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response the J.E. McAmis, Inc. Open-Cell Bulkhead Construction, Old Mouth of the Cowlitz River, Longview, Washington (HUC 17080030700) (NWS-2017-431)

Dear Mr. Tillinger:

Thank you for your April 7, 2022, request for formal 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 J.E. McAmis, Inc. bulkhead construction (NWS-2017-431). This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016).

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson–Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)) for this action.

In the attached biological opinion, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*), Snake River basin (SR) fall-run Chinook salmon, SR spring/summer run Chinook salmon, Upper Columbia River (UCR) spring-run Chinook salmon, Upper Willamette River (UWR) Chinook salmon, Columbia River (CR) chum salmon (*O. keta*), LCR coho salmon (*O. kisutch*), SR sockeye salmon (*O. nerka*), LCR steelhead (*O. mykiss*), Middle Columbia River (MCR) steelhead, UCR steelhead, SR steelhead, UWR steelhead, Pacific eulachon (*Thaleichthys pacificus*), green sturgeon (*Acipenser medirostris*) or result in the destruction or adverse modification of designated critical habitats. Southern Resident Killer Whale (*Orcinus orca*)) and humpback whales (Central America DPS, Mexico DPS; *Megaptera novaeangliae*) and their designated critical habitats are not likely to be adversely affected.

This document also includes the results of our analysis of the action's likely effects on essential fish habitat (EFH) pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes two conservation recommendations to avoid, minimize, or otherwise offset potential adverse effects on EFH. These conservation recommendations are a subset of the ESA take statement's terms and conditions. Section 305(b) (4) (B) of the MSA requires Federal agencies to provide a detailed written response to NMFS within 30 days after receiving these recommendations.

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

If the response is inconsistent with the EFH conservation recommendations, the Corps must explain why the recommendations will not be followed, including the scientific justification for any disagreements over the effects of the action and the recommendations.

Please contact Bonnie Shorin at Bonnie.Shorin@noaa.gov or at 360 995-2750, 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: Danette Guy, USACE

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

J.E. McAmis, Inc. Open-Cell Bulkhead Construction
Old Mouth of the Cowlitz River, Longview, Washington
(HUC 17080030700) (NWS-2017-431)

NMFS Consultation Number: WCRO-2022-00807

Action Agency: U.S. Army Corps of Engineers – Seattle District

Affected Species and NMFS' Determinations:

ESA-Listed Species	ESA Status	Is the action likely to adversely affect the species?	Is the action likely to adversely affect the critical habitat?	Is the action likely to jeopardize the species?	Is the action likely to destroy or adversely modify critical habitat?
Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tschawtscha*)	T	Yes	Yes	No	No
Upper Columbia River (UCR) spring-run Chinook salmon	E	Yes	Yes	No	No
Upper Willamette River (UWR) spring-run Chinook salmon	T	Yes	Yes	No	No
Snake River (SR) spring/summer run Chinook salmon	T	Yes	Yes	No	No
SR fall-run Chinook salmon	T	Yes	Yes	No	No
Columbia River (CR) chum salmon (*O. keta*)	T	Yes	Yes	No	No
LCR coho salmon (*O. kisutch*)	T	Yes	Yes	No	No
SR sockeye salmon (*O. nerka*)	E	Yes	Yes	No	No
LCR steelhead (*O. mykiss*)	T	Yes	Yes	No	No
Middle Columbia River (MCR) steelhead	T	Yes	Yes	No	No
UCR steelhead	T	Yes	Yes	No	No
UWR steelhead	T	Yes	Yes	No	No
SR steelhead	T	Yes	Yes	No	No
Southern DPS of Columbia smelt eulachon (Thaleichthys pacificus)	T	Yes	Yes	No	No
Southern DPS of Green sturgeon (Acipenser medirostris)	T	Yes	Yes	No	No
Southern Resident Killer Whale (Orcinus orca))	E	No	No	No	No
Central American DPS Humpback Whale (Megaptera novaeangliae)	E	No	No	No	No
Mexican DPS Humpback Whale (Megaptera novaeangliae)	T	No	No	No	No

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
Pacific Coast Groundfish	No	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 1, 2023

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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.

1.1Background

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

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

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the Lacey, Washington, office.

1.2 Consultation History

On September 17, 2021, the USACE requested formal consultation with the National Marine Fisheries Service (NMFS, NOAA Fisheries) in accordance with the ESA. On January 6, 2022, NMFS informed the USACE via a letter of insufficiency that the biological evaluation was insufficient to proceed with the consultation.

On April 7, 2022, the USACE again requested formal consultation, including a response to the letter of insufficiency, with the National Marine Fisheries Service (NMFS, NOAA Fisheries) in accordance with the ESA and a new NMFS number was assigned (WCRO-2022-00807) and formal consultation was initiated.

On May 16th NMFS emailed the USACE asking for more information about the piles being installed and how much underwater noise the piling driving would create. On June 13th, 2022, the USACE provided a response from the consultant and the consultation process proceeded.

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 CFR part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. On November 14, 2022, the Northern District of California issued an order granting the government's request for voluntary remand without vacating the

2019 regulations. The District Court issued a slightly amended order two days later on November 16, 2022. As a result, the 2019 regulations remain in effect, and we are applying the 2019 regulations here. For purposes of this consultation and in an abundance of caution, we considered whether the substantive analysis and conclusions articulated in the biological opinion and incidental take statement would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different.

Table 1. Listed species and critical habitat affected by the proposed action, species status, and FR notice dates

ESU or DPS Species	Listing Notice	Listing Status	Critical Habitat Listing
Lower Columbia Chinook	6/28/2005; 70 FR 37160	Threatened	9/2/2005; 70 FR 52630
Lower Columbia Steelhead	1/5/2006; 71 FR 834	Threatened	9/2/2005; 70 FR 52630
Lower Columbia Coho	6/28/2005; 70 FR 37160	Threatened	2/24/2016; 81 FR 9252
Columbia River Chum	6/28/2005; 70 FR 37160	Threatened	9/2/2005; 70 FR 52630
Upper Columbia Chinook	6/28/2005; 70 FR 37160	Endangered	9/2/2005; 70 FR 52630
Upper Columbia Steelhead	1/5/2006; 71 FR 834	Threatened	9/2/2005; 70 FR 52630
Middle Columbia Steelhead	1/5/2006; 71 FR 834	Threatened	9/2/2005; 70 FR 52630
Snake River Sockeye	4/14/2014; 79 FR 20802	Endangered	12/28/1993; 58 FR 68543
Snake River Spring/Summer Chinook	6/28/2005; 70 FR 37160	Threatened	10/25/1999; 64 FR 57399
Snake River Fall Chinook	6/28/2005; 70 FR 37160	Threatened	10/25/1999; 64 FR 57399
Snake River Steelhead	1/5/2006; 71 FR 834	Threatened	9/2/2005; 70 FR 52630
Upper Willamette River Chinook Salmon	6/28/2005; 70 FR 37160	Threatened	9/2/2005; 70 FR 52630
Upper Willamette River Steelhead	1/5/2006; 71 FR 834	Threatened	9/2/2005; 70 FR 52630
Southern DPS Pacific Eulachon	3/18/10; 75 FR 13012	Threatened	10/20/2011; 76FR 65324
Southern DPS Green Sturgeon	4/7/2006; 71 FR 17757	Threatened	10/9/2009; 74 FR 52300
Southern Resident DPS Killer Whale	01/24/2008; 73 FR 4176	Endangered	08/02/2021;71 FR 69054
Central America DPS Humpback Whale	09/08/2016; 81 FR 62259	Endangered	04/21/2021;86 FR 21082
Mexican DPS Humpback Whale	09/08/2016; 81 FR 62259	Threatened	04/21/2021;86 FR 21082

1.3 Proposed Federal Action

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

The USACE proposes to issue a permit to J.E. McAmis. Inc (JEM) for the construction of an open cell bulkhead, outfall, splash pad, and installation of eight mooring dolphins consisting of two, 24-inch diameter steel piles each. The proposed action would also replace existing riprap. The proposed action is located in Longview WA, Cowlitz County with frontage on the Old Mouth of the Cowlitz River (OMCR). J.E. McAmis also proposes mitigation and conservation on an island in the OMCR located directly across the water from the proposed action on land owned by J.E McAmis.

The proposed action includes installation of a sheet pile bulkhead waterward of an existing dilapidated sheet pile wall to create a stable upland platform behind the new bulkhead. The new, expanded bulkhead would fill approximately 0.53 acres of shallow water habitat. The old bulkhead, riprap, and debris will be removed using a land-based excavator after the installation of the new sheet pile bulkhead. Tail anchors will be installed in the bank and structural fill will be placed behind the sheet pile wall. Eight mooring dolphins will be constructed using a crane derrick with vibratory hammer. Each dolphin will be constructed in a monopile configuration consisting of two piles (24-inch diameter each) that are vertically oriented, for a total of 16, 24-inch piles. The piles are expected to be driven to a depth of approximately 40 feet below mudline. The project will also consist of earthwork, paving, and road improvements that will occur above the ordinary high-water mark (OHWM) as well as the construction of new stormwater facilities. The proposed action would also expand an existing unconnected wetland by connecting it to the OMCR as mitigation for the bulkhead construction. Native species will be planted in the wetland to enhance the habitat and trees will be retained on-site to the greatest extent practicable.
Under the MSA, "Federal action" means any action authorized, funded, undertaken, or proposed to be authorized, funded, or undertaken by a federal agency (see 50 CFR 600.910).

1.4 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 proposed action area consists of the OMCR and the Columbia River to the mouth for the stormwater impacts, the mitigation site, and the upland sites that will be affected by the proposed construction activities. The turbidity from in-water work is expected to extend 200 feet from the project area. The noise from the proposed action's construction activities is expected to not extend more than 25 feet from the action area. Terrestrial noise from vibratory pile driving is expected to extend 792 feet to 8,238 feet in the water, however, the noise levels are expected to attenuate before extending out 8,238 feet in the water due to landmasses that will stop sound waves from traveling beyond the Columbia River directly adjacent to the OMCR.

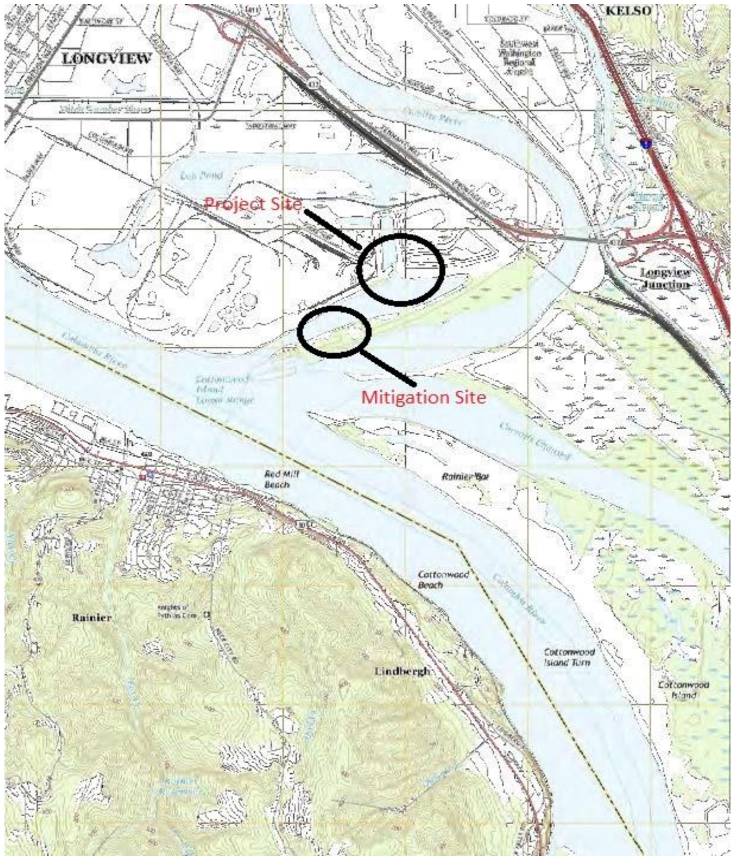

Figure 1. Site Vicinity for proposed McAmis Site Improvement Project and Mitigation (Maul Foster Alongi, April 23, 2021).

2. ENDANGERED SPECIES ACT BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with 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 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 also relies on the regulatory definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02).

The designation(s) of critical habitat for [*list species*] use(s) the term primary constituent element (PCE) or essential features. The 2016 final rule (81 FR 7414; February 11, 2016) that revised the critical habitat regulations (50 CFR 424.12) replaced 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.
- Evaluate the effects of the proposed action on species and their critical habitat using an exposure-response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species; or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest reasonable and prudent alternatives to the proposed action.

2.2 Rangewide Status of the Species and Critical Habitat

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

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. Major ecological realignments are already occurring in response to climate change (IPCC WGII, 2022). Long-term trends in warming have continued at global, national, and regional scales. Global surface temperatures in the last decade (the 2010s) were estimated to be 1.09 °C higher than the 1850-1900 baseline period, with larger increases over land ~1.6 °C compared to oceans ~0.88 (IPCC WGI, 2021). The vast majority of this warming has been attributed to anthropogenic releases of greenhouse gases (IPCC WGI, 2021). Globally, 2014-2018 were the 5 warmest years on record both on land and in the ocean (2018 was the 4th warmest) (NOAA NCEI 2022). Events such as the 2013-2016 marine heatwave (Jacox et al. 2018) have been attributed directly to anthropogenic warming in the annual special issue of Bulletin of the American Meteorological Society on extreme events (Herring et al. 2018). Global warming and anthropogenic loss of biodiversity represent profound threats to ecosystem functionality (IPCC WGII 2022). These two factors are often examined in isolation, but likely have interacting effects on ecosystem function.

Updated projections of climate change are similar to or greater than previous projections (IPCC WGI, 2021). NMFS is increasingly confident in our projections of changes to freshwater and marine systems because every year brings stronger validation of previous predictions in both physical and biological realms. Retaining and restoring habitat complexity, access to climate refuges (both flow and temperature) and improving growth opportunities in both freshwater and marine environments are strongly advocated in the recent literature (Siegel and Crozier 2020).

Climate change is systemic, influencing freshwater, estuarine, and marine conditions. Other systems are also being influenced by changing climatic conditions. Literature reviews on the impacts of climate change on Pacific salmon (Crozier 2015, 2016, 2017, Crozier and Siegel 2018, Siegel and Crozier 2019, 2020) have collected hundreds of papers documenting the major themes relevant for salmon. Here we describe habitat changes relevant to Pacific salmon and steelhead, prior to describing how these changes result in the varied specific mechanisms impacting these species in subsequent sections.

Forests

Climate change will impact the forests of the western U.S., which dominate the landscape of many watersheds in the region. Forests are already showing evidence of increased drought severity, forest fire, and insect outbreaks (Halofsky et al. 2020). Additionally, climate change will affect tree reproduction, growth, and phenology, which will lead to spatial shifts in vegetation. Halofsky et al. (2018) projected that the largest changes will occur in low- and high-elevation forests, with the expansion of low-elevation dry forests and diminishing high-elevation cold forests and subalpine habitats.

Forest fires affect salmon streams by altering sediment load, channel structure, and stream temperature through the removal of the canopy. Holden et al. (2018) examined environmental factors contributing to observed increases in the extent of forest fires throughout the western U.S. They found strong correlations between the number of dry-season rainy days and the annual extent of forest fires, as well as a significant decline in the number of dry-season rainy days over the study period (1984-2015). Consequently, predicted decreases in dry-season precipitation, combined with increases in air temperature, will likely contribute to the existing trend toward more extensive and severe forest fires and the continued expansion of fires into higher elevation and wetter forests (Alizedeh 2021).

Agne et al. (2018) reviewed the literature on insect outbreaks and other pathogens affecting coastal Douglas-fir forests in the Pacific Northwest and examined how future climate change may influence disturbance ecology. They suggest that Douglas-fir beetle and black stain root disease could become more prevalent with climate change, while other pathogens will be more affected by management practices. Agne et al. (2018) also suggested that due to complex interacting effects of disturbance and disease, climate impacts will differ by region and forest type.

Freshwater Environments

The following is excerpted from Siegel and Crozier (2019), who present a review of recent scientific literature evaluating effects of climate change, describing the projected impacts of climate change on instream flows:

Cooper et al. (2018) examined whether the magnitude of low river flows in the western U.S., which generally occur in September or October, are driven more by summer conditions or the prior winter’s precipitation. They found that while low flows were more sensitive to summer evaporative demand than to winter precipitation, interannual variability in winter precipitation was greater. Malek et al. (2018), predicted that summer evapotranspiration is likely to increase in conjunction with declines in snowpack and increased variability in winter precipitation. Their results suggest that low summer flows are likely to become lower, more variable, and less predictable.

The effect of climate change on groundwater availability is likely to be uneven. Sridhar et al. (2018) coupled a surface-flow model with a ground-flow model to improve predictions of surface water availability with climate change in the Snake River Basin. Projections using RCP

4.5 and 8.5 emission scenarios suggested an increase in water table heights in downstream areas of the basin and a decrease in upstream areas.

As cited in Siegel and Crozier (2019), Isaak et al. (2018), examined recent trends in stream temperature across the Western U.S. using a large regional dataset. Stream warming trends paralleled changes in air temperature and were pervasive during the low-water warm seasons of 1996-2015 (0.18-0.35°C/decade) and 1976-2015 (0.14-0.27°C/decade). Their results show how continued warming will likely affect the cumulative temperature exposure of migrating sockeye salmon *O. nerka* and the availability of suitable habitat for brown trout *Salmo trutta* and rainbow trout *O. mykiss*. Isaak et al. (2018) concluded that most stream habitats will likely remain suitable for salmonids in the near future, with some becoming too warm. However, in cases where habitat access is currently restricted by dams and other barriers salmon and steelhead will be confined to downstream reaches typically most at risk of rising temperatures unless passage is restored (FitzGerald et al. 2020, Myers et al. 2018).

Streams with intact riparian corridors that lie in mountainous terrain are likely to be more resilient to changes in air temperature. These areas may provide refuge from climate change for a number of species, including Pacific salmon. Krosby et al. (2018), identified potential stream refugia throughout the Pacific Northwest-based on a suite of features thought to reflect the ability of streams to serve as such refuges. Analyzed features include large temperature gradients, high canopy cover, large relative stream width, low exposure to solar radiation, and low levels of human modification. They created an index of refuge potential for all streams in the region, with mountain area streams scoring the highest. Flat lowland areas, which commonly contain migration corridors, were generally scored lowest, and thus were prioritized for conservation and restoration. However, forest fires can increase stream temperatures dramatically in a short time span by removing riparian cover (Koontz et al. 2018), and streams influenced by low snowpack melt due to climate change may see the largest increases in stream temperature due to the removal of temperature buffering (Yan et al. 2021). These processes may threaten some habitats that are currently considered refugia.

Marine and Estuarine Environments

Along with warming stream temperatures and concerns about sufficient groundwater to recharge streams, a recent 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 percent), while 68 percent 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.

Rising ocean temperatures, stratification, ocean acidity, hypoxia, algal toxins, and other oceanographic processes will alter the composition and abundance of a vast array of oceanic species. In particular, there will be dramatic changes in both predators and prey of Pacific salmon, salmon life-history traits, and relative abundance. Siegel and Crozier (2019) observe that changes in marine temperature are likely to have a number of physiological consequences on fishes themselves. For example, in a study of small planktivorous fish, Gliwicz et al. (2018) found that higher ambient temperatures increased the distance at which fish reacted to prey.

Numerous fish species (including many tuna and sharks) demonstrate regional endothermy, which in many cases augments eyesight by warming the retinas. However, Gliwicz et al. (2018) suggest that ambient temperatures can have a similar effect on fish that do not demonstrate this trait. Climate change is likely to reduce the availability of biologically essential omega-3 fatty acids produced by phytoplankton in marine ecosystems. Loss of these lipids may induce cascading trophic effects, with distinct impacts on different species depending on compensatory mechanisms (Gourtay et al. 2018). Reproduction rates of many marine fish species are also likely to be altered with temperature (Veilleux et al. 2018). The ecological consequences of these effects and their interactions add complexity to predictions of climate change impacts in marine ecosystems.

Perhaps the most dramatic change in physical ocean conditions will occur through ocean acidification and deoxygenation. It is unclear how sensitive salmon and steelhead might be to the direct effects of ocean acidification because of their tolerance to a wide pH range in freshwater (see Ou et al. 2015 and Williams et al. 2019), however, the impacts of ocean acidification and hypoxia on sensitive species (e.g., plankton, crabs, rockfish, groundfish) will likely affect salmon indirectly through their interactions as predators and prey. Similarly, increasing frequency and duration of harmful algal blooms may affect salmon directly, depending on the toxin (e.g., saxitoxin vs domoic acid), but will also affect their predators (seabirds and mammals). The full effects of these ecosystem dynamics are not known but will be complex. Within the historical range of climate variability, less suitable conditions for salmonids (e.g., warmer temperatures, lower stream flows) have been associated with detectable declines in many of these listed units, highlighting how sensitive they are to climate drivers (Ford 2022, Lindley et al. 2009, Williams et al. 2016, Ward et al. 2015). In some cases, the combined and potentially additive effects of poorer climate conditions for fish and intense anthropogenic impacts caused the population declines that led to these population groups being listed under the ESA (Crozier et al. 2019).

Climate change effects on salmon and steelhead

In freshwater, year-round increases in stream temperature and changes in flow will affect physiological, behavioral, and demographic processes in salmon, and change the species with which they interact. For example, as stream temperatures increase, many native salmonids face increased competition with more warm-water tolerant invasive species. Changing freshwater temperatures are likely to affect incubation and emergence timing for eggs, and in locations where the greatest warming occurs may affect egg survival, although several factors impact inter-gravel temperature and oxygen (e.g., groundwater influence) as well as sensitivity of eggs to thermal stress (Crozier et al. 2020). Changes in temperature and flow regimes may alter the amount of habitat and food available for juvenile rearing, and this in turn could lead to a restriction in the distribution of juveniles, further decreasing productivity through density dependence. For migrating adults, predicted changes in freshwater flows and temperatures will likely increase exposure to stressful temperatures for many salmon and steelhead populations, and alter migration travel times and increase thermal stress accumulation for ESUs or DPSs with early-returning (i.e., spring- and summer-run) phenotypes associated with longer freshwater holding times (Crozier et al. 2020, FitzGerald et al. 2020). Rising river temperatures increase the energetic cost of migration and the risk of *en route* or pre-spawning mortality of adults with long freshwater migrations, although populations of some ESA-listed salmon and steelhead may be able to make use of cool-water refuges and run-timing plasticity to reduce thermal exposure (Keefer et al. 2018, Barnett et al. 2020).

Marine survival of salmonids is affected by a complex array of factors including prey abundance, predator interactions, the physical condition of salmon within the marine environment, and carryover effects from the freshwater experience (Holsman et al. 2012, Burke et al. 2013). It is generally accepted that salmon marine survival is size-dependent, and thus larger and faster-growing fish are more likely to survive (Gosselin et al. 2021). Furthermore, early arrival timing in the marine environment is generally considered advantageous for populations migrating through the Columbia River. However, the optimal day of arrival varies across years, depending on the seasonal development of productivity in the California Current, which affects prey available to salmon and the risk of predation (Chasco et al. 2021). Siegel and Crozier (2019) point out the concern that for some salmon populations, climate change may drive mismatches between juvenile arrival timing and prey availability in the marine environment. However, phenological diversity can contribute to metapopulation-level resilience by reducing the risk of a complete mismatch. Carr-Harris et al. (2018), explored the phenological diversity of marine migration timing in relation to zooplankton prey for sockeye salmon *O. nerka* from the Skeena River of Canada. They found that sockeye migrated over a period of more than 50 days, and populations from a higher elevation and further inland streams arrived in the estuary later, with different populations encountering distinct prey fields. Carr-Harris et al. (2018) recommended that managers maintain and augment such life-history diversity.

Synchrony between terrestrial and marine environmental conditions (e.g., coastal upwelling, precipitation, and river discharge) has increased in spatial scale causing the highest levels of synchrony in the last 250 years (Black et al. 2018). A more synchronized climate combined with simplified habitats and reduced genetic diversity may be leading to more synchrony in the productivity of populations across the range of salmon (Braun et al. 2016). For example, salmon productivity (recruits/spawner) has also become more synchronized across Chinook populations from Oregon to the Yukon (Dorner et al. 2018, Kilduff et al. 2014). In addition, Chinook salmon have become smaller and younger at maturation across their range (Ohlberger 2018). Other Pacific salmon species (Stachura el. al. 2014) and Atlantic salmon (Olmos et al. 2020) also have demonstrated synchrony in productivity across a broad latitudinal range.

At the individual scale, climate impacts on salmon in one life stage generally affect body size or timing in the next life stage and negative impacts can accumulate across multiple life stages (Healey 2011; Wainwright and Weitkamp 2013, Gosselin et al. 2021). Changes in winter precipitation will likely affect incubation and/or rearing stages of most populations. Changes in the intensity of cool season precipitation, snow accumulation, and runoff could influence migration cues for fall, winter, and spring adult migrants, such as coho and steelhead. Egg survival rates may suffer from more intense flooding that scours or buries redds. Changes in hydrological regime, such as a shift from mostly snow to more rain, could drive changes in life history, potentially threatening diversity within an ESU (Beechie et al. 2006). Changes in summer temperature and flow will affect both juvenile and adult stages in some populations, especially those with yearling life histories and summer migration patterns (Crozier and Zabel 2006; Crozier et al. 2010, Crozier et al. 2019).

At the population level, the ability of organisms to genetically adapt to climate change depends on how much genetic variation currently exists within salmon populations, as well as how selection on multiple traits interact, and whether those traits are linked genetically. While genetic diversity may help populations respond to climate change, the remaining genetic diversity of many populations is highly reduced compared to historic levels. For example, Johnson et al. (2018), compared genetic variation in Chinook salmon from the Columbia River Basin between contemporary and ancient samples. A total of 84 samples determined to be Chinook salmon were collected from vertebrae found in ancient middens and compared to 379 contemporary samples. Results suggest a decline in genetic diversity, as demonstrated by a loss of mitochondrial haplotypes as well as reductions in haplotype and nucleotide diversity. Genetic losses in this comparison appeared larger for Chinook from the mid-Columbia than those from the Snake River Basin.

In addition to other stressors, modified habitats and flow regimes may create unnatural selection pressures that reduce the diversity of functional behaviors (Sturrock et al. 2020). Managing to conserve and augment existing genetic diversity may be increasingly important with more extreme environmental change (Anderson et al. 2015), though the low levels of remaining diversity present challenges to this effort (Freshwater 2019). Salmon historically maintained relatively consistent returns across variation in annual weather through the portfolio effect (Schindler et al. 2015), in which different populations are sensitive to different climate drivers. Applying this concept to climate change, Anderson et al (2015) emphasized the additional need for populations with different physiological tolerances. Loss of the portfolio increases volatility in fisheries, as well as ecological systems, as demonstrated for Fraser River and Sacramento River stock complexes (Freshwater et al. 2019, Munsch et al. 2022).

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

2.2.1 Status of 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 to the population it served or is serving another important role.

For the southern DPS green sturgeon, a team similar to the CHARTs — a critical habitat review team (CHRT) — identified and analyzed the conservation value of particular areas occupied by southern green sturgeon, and unoccupied areas necessary to ensure the conservation of the species (USDC 2009). The CHRT did not identify those particular areas using HUC nomenclature, but did provide geographic place names for those areas, including the names of freshwater rivers, the bypasses, the Sacramento-San Joaquin Delta, coastal bays and estuaries, and coastal marine areas (within 110 m depth) extending from the California/Mexico border north to Monterey Bay, California, and from the Alaska/Canada border northwest to the Bering Strait; and certain coastal bays and estuaries in California, Oregon, and Washington.

For southern DPS eulachon, critical habitat includes portions of 16 rivers and streams in California, Oregon, and Washington (USDC 2011). We designated all of these areas as migration and spawning habitat for this species.

A summary of the status of critical habitats considered in this opinion is provided in Table 1, below.

Physical and Biological Features of Salmon and Steelhead Critical Habitat

The NMFS designated critical habitat for three different groups of salmonids that occupy the LCR, on three different dates. For each designation, NMFS used slightly different descriptions of the physical and biological features (PBFs) of critical habitat. In addition, NMFS identified the essential elements of the PBFs using slightly different terminology. This section presents each of the approaches to the terminology used for each of the subsequent designations and attributes those to the specific salmonids covered by each designation, for convenience, in the remainder of the document, we will refer to them as PBFs, even though the original designations used different terminologies. Many of the PBFs and their essential elements actually overlap across designations.

The NMFS designated critical habitat for several Snake River salmonids on October 25, 1999 (64 FR 57399), including Snake River Sockeye and separate Spring/Summer, and Fall-run Snake River Chinook salmon ESUs. Snake River steelhead critical habitat was designated in 2005 and is detailed below. The PBFs (originally termed “essential features”) of critical habitat for Snake River salmonids are (1) Spawning and juvenile rearing areas; (2) juvenile migration corridors; (3) areas for growth and development to adulthood; and (4) adult migration corridors. The essential elements of the spawning and rearing PBFs are: 1) Spawning gravel; (2) water quality; (3) water quantity; (4) water temperature; (5) food; (6) riparian vegetation; and (7) access. The designation also breaks down the migration corridor for juvenile and adult salmonids as follows: Essential features of the juvenile migration corridors include adequate: (1) Substrate (2) water quality; (3) water quantity; (4) water temperature; (5) water velocity; (6) cover/shelter; (7) food; (8) riparian vegetation; (9) space; and (10) safe passage conditions. The adult migration corridors are the same areas included in juvenile migration corridors. Essential features would include those in the juvenile migration corridors, excluding adequate food.

Subsequently, NMFS designated critical habitat for 10 ESUs and DPSs of Columbia River salmon and steelhead and Snake River steelhead on September 2, 2005 (70 FR 52630), and lower Columbia River coho salmon on February 24, 2016 (81 FR 9252) as shown in Table 2. The PBFs are referred to as Primary Constituent Elements (PCE) in 70 FR 52630 and in 81 FR 9252, and those terms may be used interchangeably in this document. Specific PCEs, and essential features for salmonids designated in 2005, and 2016 include:

1. Freshwater spawning sites with water quantity and quality conditions and substrate that support spawning, incubation, and larval development;

2. Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility, water quality and forage that support juvenile development, and natural cover such as shade, submerged and overhanging large wood, logjams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks;

3. Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks that support juvenile and adult mobility and survival;

4. Estuarine areas free of obstruction and excessive predation with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation;

5. Nearshore marine areas free of obstruction and excessive predation with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and

6. Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

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.

Physical and Biological Features of <u>Southern DPS Green Sturgeon Critical Habitat</u>

A team similar to the CHARTs, referred to as a Critical Habitat Review Team (CHRT), identified and analyzed the conservation value of particular areas occupied by southern green sturgeon, and unoccupied areas they felt are necessary to ensure the conservation of the species (USDC 2009b). The CHRT did not identify those particular areas using HUC nomenclature, but did provide geographic place names for those areas, including the names of freshwater rivers, the bypasses, the Sacramento-San Joaquin Delta, coastal bays and estuaries, and coastal marine areas (within 110 m depth) extending from the California/Mexico border north to Monterey Bay, California, and from the Alaska/Canada border northwest to the Bering Strait; and certain coastal bays and estuaries in California, Oregon, and Washington.

For freshwater rivers north of and including the Eel River, the areas upstream of the head of the tide were not considered part of the geographical area occupied by the southern DPS. However, the critical habitat designation recognizes not only the importance of natal habitats, but of habitats throughout their range. Critical habitat has been designated in coastal U.S. marine waters within 60 fathoms depth from Monterey Bay, California (including Monterey Bay), north to Cape Flattery, Washington, including the Strait of Juan de Fuca, Washington, to its United States boundary; the Sacramento River, lower Feather River, and lower Yuba River in California; the Sacramento-San Joaquin Delta and Suisun, San Pablo, and San Francisco bays in California; the lower Columbia River estuary; and certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor) and freshwater (USDC 2009b). Table 2 delineates physical and biological features for southern green sturgeon.

Table 2. Physical or biological features of critical habitat designated for southern green sturgeon and corresponding species life history events.

Physical or Biological Features Site Type	Physical or Biological Features Site Attribute	Species Life History Event
Freshwater riverine system	Food resources Migratory corridor Sediment quality Substrate type or size Water depth Water flow Water quality	Adult spawning Embryo incubation, growth and development Larval emergence, growth and development Juvenile metamorphosis, growth and development
Estuarine areas	Food resources Migratory corridor Sediment quality Water flow Water depth Water quality	Juvenile growth, development, seaward migration Subadult growth, development, seasonal holding, and movement between estuarine and marine areas Adult growth, development, seasonal holding, movements between estuarine and marine areas, upstream spawning movement, and seaward post-spawning movement
Coastal marine areas	Food resources Migratory corridor Water quality	Subadult growth and development, movement between estuarine and marine areas, and migration between marine areas Adult sexual maturation, growth and development, movements between estuarine and marine areas, migration between marine areas, and spawning migration

The CHRT identified several activities that threaten the PCEs in coastal bays and estuaries and necessitate the need for special management considerations or protection. The application of pesticides is likely to adversely affect prey resources and water quality within the bays and estuaries, as well as the growth and reproductive health of Southern DPS green sturgeon through bioaccumulation. Other activities of concern include those that disturb bottom substrates, adversely affect prey resources, or degrade water quality through re-suspension of contaminated sediments. Of particular concern are activities that affect prey resources. Prey resources are affected by: commercial shipping and activities generating point source pollution and non-point source pollution that discharge contaminants and result in bioaccumulation of contaminants in green sturgeon; disposal of dredged materials that bury prey resources; and bottom trawl fisheries that disturb the bottom (but result in beneficial or adverse effects on prey resources for green sturgeon). In addition, petroleum spills from commercial shipping and proposed hydrokinetic energy projects are likely to affect water quality or hinder the migration of green sturgeon along the coast (USDC 2009b).

Physical and Biological Features of Pacific Eulachon Critical Habitat

The NMFS designated critical habitat for the southern DPS of Pacific eulachon on October 11, 2011 (76 FR 65324). Critical habitat includes portions of 16 rivers and streams in California, Oregon, and Washington (USDC 2011). We designated all of these areas as migration and spawning habitat for this species. Specific PBFs, and the essential features associated with the PBFs for Pacific eulachon designated in 2011 include:

1. Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, and with migratory access for adults and juveniles. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring.

2. Freshwater and estuarine migration corridors associated with spawning and incubation sites that are free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted. These features are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow larval fish to proceed downstream and reach the ocean.

3. Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival. Eulachon prey on a wide variety of species including crustaceans such as copepods and euphausiids (Hay and McCarter 2000, WDFW and ODFW 2001), unidentified malacostracans (Smith and Saalfeld 1955), mysids, barnacle larvae, and worm larvae (WDFW and ODFW 2001). These features are essential to conservation because they allow juvenile fish to survive, grow, and reach maturity, and they allow adult fish to survive and return to freshwater systems to spawn.

Table 3. Critical habitat, designation date, federal register citation, and status summary for critical habitat considered in this opinion

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 PCEs 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 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 PCEs 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 this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
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 PCEs 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.
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 in this area 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 PCEs 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.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
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 PCEs 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 this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
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 PCEs 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.
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 PCEs 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 PCEs 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 PCEs 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.
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 this area 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
Southern DPS of eulachon	10/20/11 76 FR 65324	Critical habitat for eulachon includes portions of 16 rivers and streams in California, Oregon, and Washington. All of these areas are designated as migration and spawning habitat for this species. In Oregon, we designated 24.2 miles of the lower Umpqua River, 12.4 miles of the lower Sandy River, and 0.2 miles of Tenmile Creek. We also designated the mainstem Columbia River from the mouth to the base of Bonneville Dam, a distance of 143.2 miles. Dams and water diversions are moderate threats to eulachon in the Columbia and Klamath rivers where hydropower generation and flood control are major activities. Degraded water quality is common in some areas occupied by southern DPS eulachon. In the Columbia and Klamath river basins, large-scale impoundment of water has increased winter water temperatures, potentially altering the water temperature during eulachon spawning periods. Numerous chemical contaminants are also present in spawning rivers, but the exact effect these compounds have on spawning and egg development is unknown. Dredging is a low to moderate threat to eulachon in the Columbia River. Dredging during eulachon spawning would be particularly detrimental.

2.2.2 Status of the Species

Table 4, below, provides a summary of listing and recovery plan information, status summaries and limiting factors for the species addressed in this opinion. More information can be found in recovery plans and status reviews for these species. Acronyms appearing in the table include DPS (Distinct Population Segment), ESU (Evolutionarily Significant Unit), ICTRT (Interior Columbia Technical Recovery Team), MPG (Multiple Population Grouping), NWFSC (Northwest Fisheries Science Center), and VSP (Viable Salmonid Population).

Table 4. Summary of listing and recovery plan information, status summaries and limiting factors for the species addressed in this opinion

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	NMFS 2016; Ford 2022	This ESU comprises 32 independent populations. Relative to baseline VSP levels identified in the recovery plan (Dornbusch 2013), there has been an overall improvement in the status of a number of fall-run populations although most are still far from the recovery plan goals; Spring-run Chinook salmon populations in this ESU are generally unchanged; most of the populations are	• 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

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
				at a "high" or "very high" risk due to low abundances and the high proportion of hatchery-origin fish spawning naturally. Many of the populations in this ESU remain at "high risk," with low natural-origin abundance levels. Overall, we conclude that the viability of the Lower Columbia River Chinook salmon ESU has increased somewhat since 2016, although the ESU remains at "moderate" risk of extinction	• Reduced access to off-channel rearing habitat • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Contaminant
Upper Columbia River spring-run Chinook salmon	Endangered 6/28/05	Upper Columbia Salmon Recovery Board 2007	NMFS 2016; Ford 2022	This ESU comprises four independent populations. Current estimates of natural-origin spawner abundance decreased substantially relative to the levels observed in the prior review for all three extant populations. Productivities also continued to be very low, and both abundance and productivity remained well below the viable thresholds called for in the Upper Columbia Salmon Recovery Plan for all three populations. Based on the information available for this review, the Upper Columbia River spring-run Chinook salmon ESU remains at high risk, with viability largely unchanged since 2016.	• 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
Snake River spring/summer-run Chinook salmon	Threatened 6/28/05	NMFS 2017a	NMFS 2016; Ford 2022	This ESU comprises 28 extant and four extirpated populations. There have been improvements in abundance/productivity in several populations relative to the time of listing, but the majority of populations experienced sharp declines in abundance in the recent five-year period Overall, at this the Snake River spring/ summer-run Chinook salmon ESU continues to be at moderate-to-high risk.	• Degraded freshwater habitat • Effects related to the hydropower system in the mainstem Columbia River, • Altered flows and degraded water quality • Harvest-related effects • Predation
Upper Willamette River Chinook salmon	Threatened 6/28/05	NMFS 2011	NMFS 2016; Ford 2022	This ESU comprises seven populations. Abundance levels for all but Clackamas River DIP remain well below their recovery goals. Overall, there has likely been a declining trend in the viability of the Upper Willamette River	• Degraded freshwater habitat • Degraded water quality • Increased disease incidence • Altered stream flows

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
				Chinook salmon ESU since the last review. The magnitude of this change is not sufficient to suggest a change in risk category, however, so the Upper Willamette River Chinook salmon ESU remains at "moderate" risk of extinction.	• 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
Snake River fall-run Chinook salmon	Threatened 6/28/05	NMFS 2017b	NMFS 2016; Ford 2022	This ESU has one extant population The single extant population in the ESU is currently meeting the criteria for a rating of "viable" developed by the ICTRT, but the ESU as a whole is not meeting the recovery goals described in the recovery plan for the species, which require the single population to be "highly viable with high certainty" and/or will require reintroduction of a viable population above the Hells Canyon Complex (NMFS 2017b). The Snake River fall-run Chinook salmon ESU therefore is considered to be at a moderate-to-low risk of extinction.	• 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.
Columbia River chum salmon	Threatened 6/28/05	NMFS 2013	NMFS 2016; Ford 2022	This species has 17 populations divided into 3 MPGs. 3 populations exceed the recovery goals established in the recovery plan (Dornbusch 2013). The remaining populations have unknown abundances. Abundances for these populations are assumed to be at or near zero. The viability of this ESU is relatively unchanged since the last review (moderate to high risk), and the improvements in some populations do not warrant a change in risk category, especially given the uncertainty regarding climatic effects in the near future.	• 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

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
					• Contaminants
Lower Columbia River coho salmon	Threatened 6/28/05	NMFS 2013	NMFS 2016; Ford 2022	Of the 24 populations that make up this ESU, only 6 of the 23 populations for which we have data appear to be above their recovery goals. Overall abundance trends for the Lower Columbia River coho salmon ESU are generally negative. Natural spawner and total abundances have decreased in almost all DIPs, and Coastal and Gorge MPG populations are all at low levels, with significant numbers of hatchery-origin coho salmon on the spawning grounds. Improvements in spatial structure and diversity have been slight and overshadowed by declines in abundance and productivity. For individual populations, the risk of extinction spans the full range, from "low" to "very high." Overall, the Lower Columbia River coho salmon ESU remains at "moderate" risk, and viability is largely unchanged since 2016.	• 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
Oregon Coast coho salmon	Threatened 6/20/11; reaffirmed 4/14/14	NMFS 2016b	NMFS 2016; Ford 2022	This ESU comprises 56 populations including 21 independent and 35 dependent populations. The biological status of the ESU has decreased slightly since the 2015 review (high certainty of persistence, moderate certainty of sustainability), however, current ESU scores improved relative to the 2012 assessment (moderate certainty of persistence, low-to-moderate certainty of sustainability). The climate change assessment by Wainwright and Weitkamp (2013) indicated that Oregon Coast coho salmon will likely be negatively affected by climate change at all stages of the life cycle. Overall, the Oregon Coast coho salmon ESU is therefore at "moderate-to-low" risk of extinction.	• Reduced amount and complexity of habitat including connected floodplain habitat • Degraded water quality • Blocked/impaired fish passage • Inadequate long-term habitat protection • Changes in ocean conditions
Snake River sockeye salmon	Endangered 6/28/05	NMFS 2015	NMFS 2016; Ford 2022	This single population ESU is at remains at "extremely high risk," although there has been substantial progress on the first phase of the	• Effects related to the hydropower system in the mainstem Columbia River

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
				proposed recovery approach—developing a hatchery-based program to amplify and conserve the stock to facilitate reintroductions. Current climate change modeling supports the "extremely high risk" rating with the potential for extirpation in the near future (Crozier et al. 2020). The viability of the Snake River sockeye salmon ESU therefore has likely declined since the time of the prior review, and the extinction risk category remains "high."	• Reduced water quality and elevated temperatures in the Salmon River • Water quantity • Predation
Upper Columbia River steelhead	Threatened 1/5/06	Upper Columbia Salmon Recovery Board 2007	NMFS 2016; Ford 2022	This DPS comprises four independent populations. The most recent estimates (5- year geometric mean) of total and natural-origin spawner abundance have declined since the last report, largely erasing gains observed over the past two decades for all four populations (Figure 12, Table 6). Recent declines are persistent and large enough to result in small, but negative 15-year trends in abundance for all four populations. The overall Upper Columbia River steelhead DPS viability remains largely unchanged from the prior review, and the DPS is at high risk driven by low abundance and productivity relative to viability objectives and diversity concerns.	• 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
Lower Columbia River steelhead	Threatened 1/5/06	NMFS 2013	NMFS 2016; Ford 2022	This DPS comprises 23 historical populations, 17 winter-run populations and 6 summer-run populations. 10 are nominally at or above the goals set in the recovery plan (Dornbusch 2013); however, it should be noted that many of these abundance estimates do not distinguish between natural- and hatchery- origin spawners. The majority of winter-run steelhead DIPs in this DPS continue to persist at low abundance levels (hundreds of fish), with the exception of the	• 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

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
				Clackamas and Sandy River DIPs, which have abundances in the low 1,000s. Although the five-year geometric abundance means are near recovery plan goals for many populations, the recent trends are negative. Overall, the Lower Columbia River steelhead DPS is therefore considered to be at "moderate" risk.,	• 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
Upper Willamette River steelhead	Threatened 1/5/06	NMFS 2011	NMFS 2016; Ford 2022	This DPS has four demographically independent populations. Populations in this DPS have experienced long-term declines in spawner abundance. Although the recent magnitude of these declines is relatively moderate, continued declines would be a cause for concern. In the absence of substantial changes in accessibility to high-quality habitat, the DPS will remain at "moderate-to-high" risk. Overall, the Upper Willamette River steelhead DPS is therefore at "moderate-to-high" risk, with a declining viability trend.	• 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
Middle Columbia River steelhead	Threatened 1/5/06	NMFS 2009b	NMFS 2016; Ford 2022	This DPS comprises 17 extant populations. Recent (five-year) returns are declining across all populations, the declines are from relatively high returns in the previous five-to-ten-year interval, so the longer-term risk metrics that are meant to buffer against short-period changes in abundance and productivity remain unchanged. The Middle Columbia River steelhead DPS does not currently meet the viability criteria described in the Middle Columbia River steelhead recovery plan.	• 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
Snake River basin steelhead	Threatened 1/5/06	NMFS 2017a	NMFS 2016; Ford 2022	This DPS comprises 24 populations. Based on the updated viability information available for this review, all five MPGs are not meeting the specific objectives in the draft recovery plan, and the viability of many individual populations	• Adverse effects related to the mainstem Columbia River hydropower system • Impaired tributary fish passage • Degraded freshwater habitat • Increased water temperature

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
				remains uncertain. Of particular note, the updated, population-level abundance estimates have made very clear the recent (last five years) sharp declines that are extremely worrisome, were they to continue.	• Harvest-related effects, particularly for B-run steelhead • Predation • Genetic diversity effects from out-of-population hatchery releases
Southern DPS of green sturgeon	Threatened 4/7/06	NMFS 2018	NMFS 2015c	The Sacramento River contains the only known green sturgeon spawning population in this DPS. The current estimate of spawning adult abundance is between 824-1,872 individuals. Telemetry data and genetic analyses suggest that Southern DPS green sturgeon generally occur from Graves Harbor, Alaska to Monterey Bay, California and, within this range, most frequently occur in coastal waters of Washington, Oregon, and Vancouver Island and near San Francisco and Monterey bays. Within the nearshore marine environment, tagging and fisheries data indicate that Northern and Southern DPS green sturgeon prefer marine waters of less than a depth of 110 meters.	• Reduction of its spawning area to a single known population • Lack of water quantity • Poor water quality • Poaching
Southern DPS of eulachon	Threatened 3/18/10	NMFS 2017c	Gustafson et al. 2016	The Southern DPS of eulachon includes all naturally spawned populations that occur in rivers south of the Nass River in British Columbia to the Mad River in California. Sub populations for this species include the Fraser River, Columbia River, British Columbia, and the Klamath River. In the early 1990s, there was an abrupt decline in the abundance of eulachon returning to the Columbia River. Despite a brief period of improved returns in 2001-2003, the returns and associated commercial landings eventually declined to the low levels observed in the mid-1990s. Although eulachon abundance in monitored rivers has generally improved, especially in the 2013-2015 return years, recent poor ocean conditions and the likelihood that these conditions will persist into the near future	• Changes in ocean conditions due to climate change, particularly in the southern portion of the species' range where ocean warming trends may be the most pronounced and may alter prey, spawning, and rearing success. • Climate-induced change to freshwater habitats • Bycatch of eulachon in commercial fisheries • Adverse effects related to dams and water diversions • Water quality, • Shoreline construction • Over harvest • Predation

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
				suggest that population declines may be widespread in the upcoming return years	

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 for this project is described in Section 1.4.

2.3.1 Environmental Baseline

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

2.3.2 Habitat Conditions in the Action Area

The project is located in a highly industrial area of the Columbia River and the Old Mouth of the Cowlitz River. Based on a fate and transport approach to stormwater discharges, The action area extends from the project site to the mouth of the Columbia River, with stormwater effects most strongly influencing the project area, but with contaminants being carried downstream. The action area is influenced by the water quality, sediment quality, river flow, noise, prey communities, and riparian conditions in the action area. Fish habitat in the action area has been adversely affected by a variety of in-water and upland human activities, including habitat losses from all causes (urbanization, roads, diking, etc.), flood control, irrigation, and hydroelectric dams, pollution, municipal and industrial water use, introduced species, hatchery production (NMFS 2013), and climate change as described in section 2.2 above. Analysis of historical habitat distributions in a Geographical Information System indicated that scrub/shrub and forested wetland types have declined in the estuary since the late 19th and early 20th centuries by 55 and 58 percent, respectively. Diking, filling, and other changes have reduced the total area of all wetland types combined from approximately 155 to 75 km2 (Bottom et al. 2008).

A portion of the action area around the Port includes a highly industrialized corridor of the Columbia River and has characteristics typical of industrial shorelines. The upland and riverbank setting has a long history of industrial use associated with marine operations, log booming, and the upland storage of logs, lumber, and potentially other materials. The site is located nearby to a closed landfill, Pacific Fibre Products waterway, and the KapStone Paper Mill facility. Other land uses adjacent to the JEM property are structures associated with the dike, closed landfills, and transportation infrastructures such as railroads and state highways. The upland portion of the property includes a mix of paved areas, gravel/dirt roads, and some areas of vegetation. The upland vegetation is mostly located in the active industrial areas and consists of grasses and weeds that function as open lawn space. Several existing over-water and in-water structures within the OMCR are relicts of past marine operations. These include sheet pile walls, a timber bulkhead, and numerous timber piles. There are two boat ramps located on the property of the proposed action. The shoreline in the action area was developed by placing fill material along the banks and steep slopes. Shoreline armoring in the action area includes artificial debris, concrete, asphalt rubble, rebar, and other metal debris. Native plants present along the upper banks of the action area include cottonwoods and willows, along with non-native Himalayan blackberry. The shoreline currently has minimal overhanging vegetation or large wood debris present.

The mitigation site is located on the peninsula that separates the OMCR from the Cowlitz River. The peninsula is a flat and forested floodplain consisting of a riverine, tidal, and unconsolidated shorelines. The wetlands in the mitigation site are classified as freshwater tidal fringe wetlands with both native and non-native plant species present.

The action area is used for vessel transportation and moorage. Sunken vessels and other dilapidated structures occur in the aquatic portion of the action area. The nearshore area includes walkways, numerous deteriorated timber piles, and dolphin structures. Habitat conditions present in the action area provide limited habitat for ESA-listed aquatic species.

The substrate in the vicinity of the project area contains a high percentage of sandy fines. The tidal influence in the action area can change the water levels between 2-4 feet daily. The OMCR is not listed in the Washington State Department of Ecology's Clean Water Act Section 303(d) which was completed in 2014. However, the Columbia River at the mouth of the OMCR and the Cowlitz river upstream of the mouth is listed for temperature and bacteria (Columbia River only).

The OMCR in the action area is slow-moving, with limited to no emergent aquatic vegetation. The aquatic substrate in the vicinity of the project area contains a high percentage of fines, with the coarsest material occurring toward the Columbia River. According to the Washington Department of Fish and Wildlife (WDFW) *Salmonscape* mapper, no spawning sites have been identified in or adjacent to the action area.

The sediment in the nearshore action area consists of sand and silt underlain with cemented rock. Specific analysis of the sediment in the immediate action area is limited however nearby to the action area is the Federal Navigation Channel (FNC) which has well-researched sediments. The material removed from the FNC is generally clean sand with very little organic matter and free of toxins. Chemical analysis of sediment samples collected in the navigation channel by the Corps in 2008 indicates that there were no exceedances of the benthic toxicity screening levels for chemicals of concern (Corps 2011, Confluence 2016).

Pacific salmon typically prefer cooler and flowing waters for spawning. Chum salmon spawn in the lowest reaches of rivers and streams, typically within 60 miles of the ocean, and typically prefer gravel or larger rocks for spawning; areas where rocks protruding above the substrate create an upwelling, accelerating current; and/or boundaries between pools and riffles. Coho spawning habitat typically consists of small streams with stable gravel substrates. Chinook spawning sites typically have larger gravel and more water flow up through the gravel than the sites used by other Pacific salmon. These favored spawning conditions are currently uncommon or absent in the action area.

Noise levels in the action area are high due to construction activities and other activities occurring at the Port that increase noise levels. Noise and activity during construction could disturb some species in the adjacent shoreline areas and the work area.

Benthic and epibenthic diversity is low within this section of the Columbia River (Corps 1999). Midge (*Chironomidae*) and amphipods (*Corophium*), both food sources for juvenile salmon and other fishes, may be present in the action area in low densities due to their preference for shallow, low-current areas. Based on the characteristics of the Columbia River, zooplankton, such as Daphnia, and crustaceans are expected to occur in the action area. Other aquatic insects (e.g., *Odonata, Trichoptera, Ephemeroptera*) are unlikely to occur in the action area because of the lack of aquatic vegetation.

Due to historic use and the industrial nature of the action area, little riparian or aquatic vegetation is present along the shoreline or exposed beach areas. The area of the proposed bulkhead contains riprap with sparse overhanging vegetation along the bank.

Degraded water quality in the action area results from loads of increased fine sediments, elevated water temperatures, especially during the summer (Weitkamp 1994), and a host of municipal and industrial discharges, permitted or otherwise (LCREP 2007). These conditions are a result of upstream land uses, all of which influence the LCR and its recovery potential (Fresh et al. 2005).

The baseline also includes the effects of projects that have proceeded subsequent to section 7 consultation. During the last five years, NMFS has engaged in several Section 7 consultations on Federal projects adversely affecting ESA-listed fish and their habitats in and near the action area. These include vicinity (Multnomah County, Oregon; Clark County, Washington) adjacent to or within the action area (WCR-2019-11648, WCR-2018-10138, WCR-2017-7450, WCR-2017-6622, WCR-2016-5516), including the effects of actions addressed in programmatic consultations (the SLOPES IV programmatic consultation; NMFS number WCR-2011-05585). In general, those actions caused temporary, construction-related effects (increased noise and turbidity), and longer-term effects like increasing overwater coverage. Current conditions of the baseline hinder the quality of downstream migration and reduce benthic production of forage items.

We note that all actions processed under the SLOPES IV programmatic consultation also include minimization measures to reduce or avoid both short- and long-term effects on the environment. These include requiring grated and translucent materials to allow light penetration, pile caps to prevent piscivorous bird perching, and limits on the square footage of new overwater coverage. Actions implemented under SLOPES IV continue to have some effects that can reduce fitness and survival in a small number of individuals and have contemporaneous minimization measures to reduce the level of habitat degradation at large. Overall effects of these SLOPES IV actions do incrementally contribute to the environmental baseline and the effects of existing structures (e.g., increased shading, reduction in prey, increased predation, and possible minor migration delays).

While no critical habitat is designate in the project site, the Columbia River, when the mouth of the river is included, is designated as critical habitat for 18 species.

2.3.4 Species in the Action Area

All ESA-listed Columbia basin salmon and steelhead may rear and/or migrate through areas close to the action area, such as the Columbia River and nearby Cowlitz River, resulting in effects on individuals of species and rearing and migration critical habitat PBFs. Rearing of juvenile salmonids is likely to occur in shallower waters composed primarily of sand/silt bathos near shorelines. Upstream migration of adult salmonids and downstream migrations of salmonid smolts are likely to occur in the mainstem LCR. The survival of migrating fish has been reduced, to the degree that multiple life-history strategies have been lost as the habitat has been altered. Similarly, eulachon migrate near the action area both as adults and as larval passive out-migrants. Green sturgeon adults and sub-adults have annual resting and feeding in the Columbia River.

Because all of the ESA-listed species considered in this opinion must migrate near the action area, 100 percent could be exposed to the degraded baseline conditions both as juveniles and as adults, especially from stormwater runoff. Exposure to degraded habitat conditions may negatively affect the condition of individual fishes that will also be exposed to the effects of the proposed action and may in turn influence the nature and degree of their response. For this reason, we evaluate here the effects of the baseline on listed fish.

Salmonids in the action area will generally exhibit either a stream-maturing or ocean-maturing life history type. A stream-type life history is exemplified by juvenile salmon and steelhead that typically rear in upstream tributary habitats for over a year such as those fish that migrate and spawn in the nearby Cowlitz River. Salmonids exhibiting this life history include LCR Chinook salmon (spring runs), LCR steelhead, LCR coho salmon, MCR steelhead, UWR steelhead, UWR Chinook salmon, SR spring/summer Chinook salmon, UCR Chinook salmon, SR steelhead, SR sockeye, and UCR steelhead. These juvenile fish migrate through the action area as smolts, approximately 100 to 200 mm in size, move quickly downstream and pass by the action area within one to two days (Dawley et al. 1986).

An ocean-type life history is exemplified by juvenile salmon that move out of spawning streams and migrate towards the LCR estuary as sub-yearlings and are actively rearing within the LCR estuary. Fish that exhibit these life histories include LCR Chinook salmon (fall runs), CR chum salmon, and SR fall-run Chinook salmon. These fish are generally smaller in size (less than 100 mm) and more likely to spend days to weeks residing in tidal freshwater habitats characterized by the action area, with peak abundances occurring from March through May (Hering et al. 2010; McNatt et al. 2016).

In addition to variations in outmigration timing, juvenile ESA-listed species also have a wide horizontal and vertical distribution in the CR related to size and life history stage. Generally speaking, juvenile salmonids will occupy the action area across the river's width and to average depths of up to 35 feet (Carter et al. 2009). Smaller-sized fish use the shallow inshore habitats, and larger fish use the channel margins and main channel. The pattern of use generally shifts between day and night. Juvenile salmon occupy different locations within the CR and are typically in shallower water during the day, avoiding predation by larger fish that are more likely to be in deeper water. These juveniles will venture into the deeper areas of the river away from the shoreline, towards the navigation channel, and along with the bathymetric break – or channel margin – and will be closer to the bottom of the channel at night (Carter et al. 2009). The smaller sub-yearling salmonids will likely congregate along with the nearshore areas in shallow water and extend into the channel margins (Bottom et al., 2011). Yet, as Carlson et al. (2001) indicated, there is a higher use of the channel margins than previously thought, and considering the parameters above, relative juvenile position in the water column suggests higher potential sub-yearling use in areas of 20 to 30 feet deep.

The consequence of systematic habitat loss is reduced habitat variety and corollary loss of species variety that relied on a complex of diverse conditions. According to Rich's (1920) survey results, salmon present in the estuary during September-December 1916 consisted of a diversity of life history types, including recent migrants from upriver, as well as individuals that had spent a significant period rearing in the estuary (Burke 2005; Bottom et al. 2005). However, beach-seining surveys since 2002 indicated that proportionally fewer juvenile salmon now utilize the estuary throughout the late summer and fall, and the population curve is now skewed toward the period March through July and peaks sharply in spring or early summer (Bottom et. al.; et. al. 2008). Analysis of historical data showed that there were at least six Chinook life history types in the Columbia River, including five variants of sub-yearling life history, before extensive development in the basin (Rich 1920). These strategies were distinguished by the length of time spent in each freshwater environment, time spent in the estuary, and time and size at the ocean entrance. Chinook salmon with estuarine rearing life histories are now substantially reduced in importance, leaving three principal life history types in the basin: fry migrants, sub-yearling migrants that rear in natal streams (including hatchery-reared juveniles), and/or main rivers and yearling migrants (Burke 2005). LCR steelhead has lost four historical populations, and LCR Chinook diversity has declined by 8-10 historical populations. Further construction and habitat modification will result in the loss of more populations of ESA-listed fish, and these trends will continue.

2.4 Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action (see 50 CFR 402.02). A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered the factors set forth in 50 CFR 402.17(a) and (b).

As described above in section 1.3, JE McAmis proposes building an OpenCell bulkhead to replace their current structure in poor condition. The construction of the new bulkhead will require dewatering in the immediate area of new bulkhead construction, along with fish exclusion measures. The bulkhead will be backfilled with structural fill, creating new pollution generation impervious surfaces (PGIS). A nearby wetland on an island across the OMCR from the bulkhead will undergo restoration intended to provide better connectivity to the LCR, OMCR, and Cowlitz River to provide improved habitat for juvenile salmonids rearing in the OMCR. The mitigation site will also be isolated and prevent fish use until the mitigation is completed.

The short effects of the proposed action are reasonably certain to include: 1) loss of rearing/foraging habitat due to the dewatering of the site and from disturbed benthic conditions; 2) increased underwater noise from pile driving, construction equipment and from construction vessel operations. 4) decreased water quality due to sediments entering the water column and causing turbidity.

Long-term effects would include 1) stormwater impacts from the construction of new impervious surfaces and discharge from the outflow; 2) habitat modifications from restoration work on the island across the OMCR from the bulkhead construction site, and; 3) modifications to the shoreline, including the installation of new riprap, and the permanent loss of 0.53 acres of aquatic habitat. These changes in the environment will affect PBFs of critical habitat and the species that are present when these effects occur.

Noise

Underwater noise will be generated from pile driving for the installation of the 8 mooring dolphins, king piles and sheet pile wall over the course of 6-8 weeks. All sheet pile and pipe piles will be installed using a vibratory pile driver. Increased noise can startle fish and cause them to move away from the noise source, stop foraging and can cause increased predation if the fish exposed are startled. Adult fish that are migrating close enough the action area are expected to move away from the noise source and continue their migration to their natal spawning grounds. Juvenile fish are the most impacted by underwater noise, however the noise levels are not expected to be impactful due to the lack of use of the OMCR by ESA-listed species and the distance from the noise source to where ESA-listed juvenile fish could be present during their migration or when rearing and foraging. The noise levels from the pile driving for the mooring dolphins is expected to be 105 dBh and the noise levels from the pile driving for the sheet pile wall is expected to not exceed 88 dBh which is lower than the 150 dBh that is known to produce a startle effect in fish.

2.4.1 Effects on Critical Habitat

There is no designated critical habitat in the construction area for this project. The nearest designated critical habitat (Columbia River) is 6,300 feet from the construction area. The mitigation site is 2,300 feet from the Columbia River. The mitigation site is intended to improve long-term habitat conditions for juvenile rearing and foraging for ESA-listed species.

Effects to critical habitat include stormwater leaving the project site, which are expected to reach critical habitat in the Columbia River during rain events that cause stormwater to leave the newly-created impervious surface behind the bulkhead site.

Habitat modifications

Bulkhead Construction-
While the bulkhead is not within designated critical habitat, it will simplify the shoreline which could provide improved habitat for salmonid predators such as small and largemouth bass. Salmonids, particularly juveniles, prefer complex habitats, such as shorelines with large woody

debris, overhanging vegetation, and off-channel connected wetlands. The use of these complex structures decreases juvenile predation (Kahler et al., 2000). Bulkheads provide little to no complexity and will result in decreased use by migrating and foraging juvenile salmonids. In summary, bulkheads eliminate shallow-water habitats and complex habitat features that may function as critical prey refuge for juvenile salmonids. Bulkheads reduce the diversity and abundance of ESA-listed species (Kahler et al., 2000).

Rearing/foraging habitat-The construction of the bulkhead and the replacement of riprap along the shoreline will decrease shoreline habitat and will preclude habitat improvements in the bulkhead area, perpetuating poor habitat conditions.

The mitigation site- In the short term, the mitigation site will be de-watered and not available for use by listed species which will result in a net short-term decrease in available foraging and rearing habitat. The site currently has poor connectivity to the OMCR due to unconnected wetlands and a lack of habitat complexity. In the long-term, the site will provide a connection between wetlands located on the island, the OMCR, and the Cowlitz River. Replanting of vegetation near the shore would provide cover and organic inputs into the water column. In the long term, the mitigation site improvements are intended to provide beneficial habitat improvements and offset permanent effects of the bulkhead and the associated loss of the habitat.

Water Quality

Stormwater - Many stormwater pollutants travel long distances in rivers either in solution, adsorbed to suspended particles, or else they are retained in sediments, mainly clay and silt, which can only be deposited in areas of reduced water velocity, such as behind dams or backwater and off-channel areas, until they are mobilized and transported by future sediment moving flows (Alpers et al. 2000a; Alpers et al. 2000b; Anderson et al. 1996). Wagner et al. (2018) reported that the fate and downstream transport of tire wear particles depends on the mixture's density and composition. Since tire wear particles (produced on roads and parking lots) are composed of lower density materials (rubber and carbon black) than those in asphalt or other particulate matter suspended in runoff (gravel, plastics, etc.), it is likely that tire wear particles remain in suspension and travel further downstream (Wagner et al. 2018). Further, the main components of tire wear particles are anticipated to resist biodegradation and persist in the environment, potentially contributing toxins over extended periods (Wagner et al. 2018). Recent studies indicated that compost-amended bioswales effectively removed a variety of contaminants from runoff, including PAHs and heavy metals (Fardel et al., 2020; McIntyre et al., 2015).

Unlike traditional stormwater collection and conveyance practices, such as storm drain systems with direct outfalls to waterways, vegetated filter strips at the edges of paved surfaces or vegetated swales (i.e., bioswales) can collect and convey stormwater in ways that infiltrate into soils with large amounts of organic matter that bind or otherwise remove contaminants from the stormwater before it reaches a stream (McIntyre et al. 2015). This project includes the discharge of minimally treated runoff that will occur throughout the design life of the proposed project. The project will increase the amount of pollution generating impervious surfaces by 29 percent (39,964 square feet). Since the project has only vault treatment, which captures sediment and metals bound to sediment, uncaptured stormwater pollutants will likely enter OMCR and flow downstream. However, dilution will occur as the stormwater moves further from the discharge points but is likely to still contain chronic low levels of contamination from the discharge point until ultimately reaching the Pacific Ocean via the Columbia River.

The duration and severity will vary over the operation life of the project, based on event-specific characteristics, such as the antecedent dry period, the precipitation volume, and the amount of vehicular use of the surface of the bulkhead. Traffic-related contaminants include PAHs, heavy metals, and a growing list of contaminants that are just beginning to be identified, including tire wear particles (Peter et al. 2018; Tian et al. 2020). These pollutants will become more concentrated on impervious surfaces until they either degrade in place or are transported by wind, precipitation, or active site management. Stormwater contaminants that accumulate on roadway surfaces are prevalent in higher concentrations in urban creeks during the initial phase ("first flush") of rain events, but contaminants continue to be present throughout the duration of and immediately following such storms (Peter et al. 2020). Likely contaminants include:

- Zinc: A common component of road surface runoff (vehicle emissions, motor oils, lubricants, tires, and fuel oils), several ions of zinc are highly mobile in aquatic environments, are often transported many miles downstream, and eventually bind to sediments. Zinc interacts with many chemicals and aquatic conditions to reduce pH, dissolved oxygen, and dissolved organic carbon. Elevated temperatures increase zinc toxicity, causing altered patterns of accumulation, metabolism, and toxicity (Eisler 1993; Farag et al. 1998). The toxicity of zinc mixtures with other metals is mostly additive; however, the toxicity of zinc-copper mixtures is more than additive (or synergistic) for freshwater fish and amphipods (Skidmore 1964; de March 1988).

- Copper: Copper from automobiles is one of the most common heavy metals present in stormwater, especially stormwater originating from parking lots. Copper is highly toxic to aquatic biota.

- Polycyclic Aromatic Hydrocarbons (PAHs): Petroleum-based contaminants are usually in the form of two or more condensed aromatic carbon rings, include more than 100 different chemicals, and usually occur as complex mixtures in the environment. Major human-related sources released to the environment are from wood stoves, creosote-treated wood, vehicle emissions, plastics including tire wear particles, improper motor oil disposal, leaks, and asphalt sealants (WDOE 2021). PAHs are lipophilic, persistent, interact synergistically with bio-accumulative and redox-active metals and other contaminants, and may disperse long distances in water (Arkoosh et al. 2011; Gauthier et al. 2014, 2015; WDOE 2021). Metabolites are commonly more toxic than the parent, some are carcinogenic, neurotoxic, and cause genetic damage. Although biotransformation of PAHs causes oxidative stress with subsequent cellular damage and increased energy is required at the cost of growth, many organisms (including salmon) can eliminate at least the lower density PAHs from their bodies as part of metabolism and excretion (Arkoosh et al. 2011). However, plants and some aquatic organisms, such as mussels and lamprey, have limited ability to metabolize or degrade PAHs, which may bioaccumulate over several years (Tian et al. 2019; Nilsen et al. 2015). The environmental fate of each type of PAH depends on its molecular weight. In surface water, PAHs can volatilize, photolyze, oxidize, biodegrade, bind to suspended particles or sediments, or accumulate in aquatic organisms, with bioconcentration factors often in the 10-10,000 range. In sediments, PAHs can biodegrade or accumulate in aquatic organisms or non-living organic matter. Some evaporate into the air from the surface, but most do not easily dissolve in water. Some evaporate into the air from surface waters, but most stick to solid particles and settle into sediments. Changes in pH and hardness may increase or decrease the toxicity of PAHs, and the variables of organic decay further complicate their environmental pathway (Santore et al. 2001).

- 6PPD-quinone: Chemicals in stormwater have been directly linked to pre-spawn mortality syndrome in adult coho salmon, mortality in rearing juvenile coho salmon, as well as mortality in aquatic invertebrates that are important forage resources for juvenile salmonids (Chow et al. 2019; McIntyre et al. 2015; McIntyre et al. 2018; Spromberg et al. 2016). Tian et al. (2020) recently identified a degradation product in automobile tire rubber called 6PPD which transforms into 6PPD-quinone when exposed to tropospheric ozone is present in stormwater runoff and has directly contributed to coho salmon pre-spawn mortality, especially during large rain events.

These ubiquitous pollutants are a source of potential adverse effects on salmon and steelhead, even at ambient levels (Johnson et al. 2007; Loge et al. 2006; Sandahl et al. 2007; Spromberg and Meador 2006), and are detrimental to several features of designated critical habitat.

The effects of stormwater pollution described above will occur during and after each discharge of runoff that will occur throughout the design life of the project (estimated to be 50 years for the purpose of this analysis), although the duration and severity of each effect will vary with the precipitation volume and discharge of stream flow in the receiving stream and can affect all ESA-listed fish present in the LCR.

Except for SR sockeye salmon and SR fall-run Chinook salmon, poor substrate or water quality is a factor limiting the recovery of all Pacific salmon considered in this opinion. The incremental benefit of reduced sediment load is contemporaneous with the incremental detriment of long-lasting deleterious contaminants in the discharges from the proposed outfall for the foreseeable future. The discharge of the stormwater contaminants slightly and incrementally, but systemically and for the foreseeable future, degrade features necessary to support:

- migration value for all salmonids critical habitat, along with lower Columbia and Willamette salmonids rearing value, and spawning value for chum salmon,
- spawning and migration value for eulachon,
- over-summering value for green sturgeon
- estuarine values for growth, maturation, and development of fish to ocean life stage of all salmonids, and eulachon.

While the increment of detriment will be diffusely distributed throughout the habitat, it will constitute a slight additional constraint on features of critical habitat that already limit productivity, inhibiting the capacity to achieve conservation goals for abundance and productivity, particularly for salmonids.

2.4.2 Effects on Species

Effects of the action on species are based on individual fish exposure to the habitat changes described above, or effects occurring to the fish themselves. In this case, fifteen ESA-listed fish species of the upper and lower Columbia basins occur near the action area, and they may be exposed to the habitat effects of the action, as well as possible direct exposure to stormwater, turbidity, noise from pile driving and decreased area for rearing and foraging. The amount of time spent by fish in the action area during construction is dependent on the life stage of the fish. Adult salmonids are likely to move upstream and through the action area within minutes. Juvenile salmonids, depending on the species and age of the fish, may spend hours to months close to the action area. Juvenile salmonid foraging primarily occurs in waters less than 20 feet deep. Deeper waters and greater flows found in the Columbia River flow lane will provide a migration corridor for adults and larger juveniles. Presence overlap with the proposed action by life history stage is provided below in the appendix, which also presents the abundance of each life stage presence (relative number of individuals likely to be exposed).

The exposure of ESA-listed fish species to habitat changes in the action area (i.e., short-term alterations in water quality from the action, short-term changes in benthic forage), and their exposure to elevated noise will vary by timing and location of activity and when different densities and life history stages of the ESA-listed fish will be present (see appendix). The magnitude of exposure experienced by ESA-listed fish species is directly related to the amount of time construction occurs. Construction will take place during the in-water work window of October 1st-December 15th for 4-6 weeks for the construction/installation of the sheet piles for the new bulkhead, and the installation of the mooring dolphins. The in-water work at the mitigation site will take place in the summer when water levels are low. Phase one of the mitigation work will take two months to complete which includes dewatering the mitigation site and minor excavation.

The number of fish exposed and the duration of exposure of adult and juvenile fishes will increase with the number of fish present during the in-water work window.

Adult salmonid presence. Though peak migratory periods vary by species, some adult Columbia River salmonids are reasonably certain to be present in the action area during the IWWW, and therefore will be exposed to the effects of the action:

- Adult Chinook salmon presence in the action area is most likely from late spring through the fall.
- Adult coho salmon presence is most likely in late summer through early winter with peak presence occurring during the in-water work window.
- Adult chum salmon primarily occur during the fall and winter with peak presence occurring during the in-water work window.
- Adult sockeye salmon presence will most likely range from late spring to late summer and are not expected to be present during the in-water work window.
- Adult steelhead presence will most likely range from early summer to early fall with upper Columbia River Steelhead being present in abundant numbers during the in-water work window.

Based on the broad run timing of these species, and the proposed work period of October 1st to December 31st for construction exposure is unlikely for adult salmonids except Columbia River chum and Lower Columbia River coho, Chinook, and upper Columbia River Steelhead, for which peak adult migration and holding overlaps with the work window of with the proposed action (Table 3). Green sturgeon are expected to be exposed to the water quality impacts of the proposed project. Eulachon are likely to be exposed to the water quality impacts from increased turbidity, stormwater, and noise from pile driving.

Since the in-water work for the mitigation work will take place in dry conditions and no fish will be present in the action area due to fish salvage and de-watering of the site, no exposure for adult salmonids, eulachon, or green sturgeon is expected for the mitigation portion of the proposed action.

Exposure and Response to Turbid Conditions and Stormwater

The proposed action will temporarily degrade water quality due to turbidity and stormwater runoff within the OMCR during construction and for the lifetime of the structure for stormwater impacts. Add turbidity impacts

As discussed above, stormwater runoff delivers a wide variety of pollutants to aquatic ecosystems, and many of the pollutants are unregulated and unevaluated. Fish exposure to these ubiquitous pollutants in the freshwater and estuarine habitats is likely to cause multiple adverse effects on salmon and steelhead, sturgeon, and eulachon, even at pre-project, ambient levels (Hecht et al. 2007; Laetz et al. 2009; Macneale et al. 2010; Sandahl et al. 2007; Spromberg and Meador 2006) and are among the identified threats to sturgeon. Contaminants also accumulate in both the prey and tissues of juvenile salmon. Depending on the level of concentration, those contaminants can cause a variety of lethal and sublethal effects on salmon and steelhead, including disrupted behavior, reduced olfactory function, immune suppression, reduced growth, disrupted smoltification, hormone disruption, disrupted reproduction, cellular damage, and physical and developmental abnormalities (Fresh et al. 2005; Hecht et al. 2007; Lower Columbia River Estuary Partnership 2007). Even at very low levels, chronic exposures to those contaminants have a wide range of adverse effects on the ESA-listed species considered in this opinion (Carls et al. 2008; Comeleo et al. 1996; Feist et al. 2011; Hecht et al. 2007; Sandahl et al. 2007; Spromberg and Meador 2006), including:

- Early development – gastrulation, organogenesis, hatching success
- Juvenile growth – foraging behavior, growth rate, condition index
- Smoltification (only in salmonids) – anion exchange, thyroxin blood hormone, salinity tolerance
- Disease-induced mortality – immunocompetence, pathogens, histopathology
- Predation-induced mortality – predator detection, shelter use, schooling behavior
- Migration/distribution – use of rearing habitats, adult homing, spawning site selection
- Reproduction – courtship behavior, number of eggs produced, fertilization success

Although stormwater runoff from the action cannot be demonstrated specifically to adverse effects on specific fish, the types of contaminants in that runoff have been shown to injure or kill individual fish. This occurs through a variety of behavioral, endocrine-disrupting, and immunotoxin disease effects, either by themselves or through additive, interactive, and synergistic interactions with other contaminants (Baldwin *et al.* 2009; Feist *et al.* 2011; Hicken *et al.* 2011; Spromberg and Meador 2006; Spromberg and Scholz 2011) at ambient levels already present in Rock Creek and the LCR (Fuhrer *et al.* 1996; Johnson *et al.* 2013; Morace 2006; Morace 2012; ODEQ 2012).

These effects of contaminants on individuals are influenced by multiple factors, such as life-history stage at the time of exposure, the particular species exposed, geographic distribution of the species, the duration of exposure, and land-use patterns where the projects occur, which influences the composition of chemicals to which the individual fish are exposed (Feist *et al.* 2011; Johnson *et al.* 2013; Scholz *et al.* 2011; Spromberg and Scholz 2011; Stehr *et al.* 2009).

<u>Exposure and Response to increased noise from pile driving-</u> Adult ESA-listed fish are not expected to be injured or delayed in their migration due to exposure to noise generated by pile driving. Sound pressure generated by vibratory piling for the sheet piles is expected to be 88 dBh per sheet installed (WSDOT 2020a). The noise generated by the installation of the 8 mooring dolphins is expected to be 105 dBh per dolphin. The noise threshold at which fish start to experience behavior changes associated with vibratory pile driving is 150 dBh. Noise above 150 dB can produce a startle effect in salmonids. Stress associated with behavioral changes can increase predation and induce changes in migration for juvenile salmonids. Adult salmonids are likely to respond by avoiding the area (Mueller et al 1998, Knudsen et al 1992, 1994).

Eulachon

Eulachon have a very different life history than Pacific salmon and begin their passive migration to the sea as soon as they emerge for the egg. Wind, river currents, and the tidal ebb and flow necessary to flush water out of the Columbia River estuary may redistribute eulachon larvae between the mainstem and channel margins and delay their ocean entry for several weeks. eulachon life history is somewhat similar to the juvenile salmon sub-yearling strategy in that eulachon larvae have a very small body size, and based on migration patterns, have little or no exposure to tributary conditions. However, eulachon may occupy shallow backwater or channel margin habitats in the lower mainstem or estuary for days or weeks before ocean entry, where the potential for exposure would be highest. Prior to ocean entry, eulachon larvae obtain nutrition primarily by absorbing their yolk sac and not through active feeding, thus reducing a primary source of contaminant exposure. As a result, eulachon are less likely to absorb or bioaccumulate contaminants than juvenile salmon. Elevated sound pressure from pile driving is not expected to effect eulachon.

Green Sturgeon

Southern green sturgeon present their own life history pattern concerning residence time and habitat use in the LCR, where they are present in the mainstem and its estuary during most parts of the year, although the total residence time there for individual sturgeon is unknown. However, due to their long lifespans, they are likely to be exposed multiple times to the effects of stormwater pollution both as individuals and through the prey they consume which is also likely to be contaminated by stormwater pollution. Southern green sturgeon are unique among species considered in this opinion in that all individuals in the action area are likely to be mature or subadult, rest and feed in benthic regions of the mainstem lower river and estuary for months at a time, and may repeat that behavior for an indeterminate number of years throughout their long lives. Thus, the life history of sturgeon makes them particularly susceptible to the adverse effects of persistent bioaccumulating contaminants in sediments and prey.

Juvenile salmonid presence.

- LCR Chinook salmon (rearing occurs for the full duration of the work window, out-migration during the month of November, both in "relatively abundant" numbers.
- Upper Columbia Chinook are not expected to be present during the in-water work window.
- Upper Willamette Chinook (rearing throughout the entire work window is relatively abundant numbers, outmigrants present in the months of November and February).
- Snake River Fall Chinook are not expected to be present during the in-water work window.
- CR chum are not expected to be present during the in-water work window.
- LCR coho are not expected to be present during the in-water work window.
- LCR Steelhead are expected to be present during the in-water work window in low abundance.
- UCR, MCR, SR, and UWR Steelhead are not expected to be present during the in-water work window.

The level of exposure juvenile salmonids will have to the effects of the action will vary and depend on species and life history stage, along with the location, timing, and depth of the activities. The potential for exposure to construction effects is greatest among LCR and UWR Chinook, and LCR steelhead that rear in the Lower Columbia throughout the entire work window.

Juvenile ESA-listed species migrate through the action area at different rates and times depending on species and life history. The migration rate and time will influence the duration of exposure for those fish that have a migration path near the areas under construction. Stream-rearing fish will migrate through the action area as smolts, and these juveniles tend to be 100 to 200 mm in size. At this size and age, individual fish move quickly downstream, and will be through the action area within 1 - 2 days and including LCR Chinook and steelhead, and UWR chinook. This limits the duration of exposure to the proposed action.

Ocean-type juvenile salmon, however, tend to move out of spawning streams and migrate towards the lower Columbia River estuary as sub-yearlings and are actively rearing within the Lower Columbia River. These include LCR Chinook salmon (fall runs) which are the likely migrating ESU during the window and are the juvenile species likely to have the greatest exposure to the effects of the proposed action. These fish are smaller in size (less than 100 mm) and more likely to spend days to weeks in the action area foraging (Carter et al. 2009). The potential for their exposure is therefore significantly greater.

Juvenile ESA-listed species have a wide horizontal and vertical distribution related to size and life history stage. Generally speaking, while juvenile salmonids favor areas where water is 20 feet or shallower in-depth, they could be present near the action area, as well as across the width of the river, and to average depths of up to 35 feet (Carter et al. 2009). However, since juvenile presence near the construction site and the migration site are not known and the shallow water habitat along the shoreline is of poor quality due to human modifications and lack of riparian vegetation exposure to the effects of the action is expected to be minimal. The effects from an increase in impervious surfaces from the construction of the bulkhead and the associated stormwater impacts are expected to be present as the greatest adverse exposure mechanism for juvenile salmon and the effects of stormwater discharges will be felt during all times of the year and throughout the lifetime of the project.

<u>Exposure and Response to Stormwater:</u> Juvenile Pacific salmon can generally be classified into one of two major life-history types, sub-yearling, and yearling, based on age at emigration from freshwater (Carter *et al.* 2009; Groot and Margolis 1991; Johnson *et al.* 2013). The difference is significant because it suggests that the distribution and duration of exposure varies based on life history type. To some degree, species with similar life history requirements in the action area are likely to have a similar response to the effects of the action. For example, yearlings spend their first year or longer in tributaries before using deeper mainstem channels to migrate to the sea, and they arrive at the estuary as larger fish than sub-yearlings. Sub-yearlings migrate to the ocean in their first year as fry or smolts and may spend several months or years rearing in backwater or channel margins of the mainstem and estuary before entering the ocean. These locations tend to have higher levels of contaminants therefore, sub-yearlings are likely to be more susceptible to bio-accumulative pollutants in shallow-water and estuarine habitats because of their longer residence times than yearlings, although both are equally vulnerable to acute exposures (NMFS 2011c). Effects from elevated contaminants in stormwater are expected to be sub lethal; however, this minor addition to existing poor water quality conditions is likely be additive to decreased overall fitness and subsequent decreased survival of salmon, eulachon, and green sturgeon.

<u>Exposure and Response to Turbid Conditions</u>: Exposure is likely among all juveniles' salmonids considered in this opinion, whether migrating or rearing. The intensity of the exposure is related to how close to the source of turbidity the fish are, because suspended sediment is highest nearest the operation, with finer sediments in suspension longer and further from the equipment. The duration of exposure is a maximum of a day or two for migrating juveniles if they engage in no avoidance behavior at all. The duration for rearing juveniles could be much longer because their avoidance abilities are weaker, so could last several days or more at the outer edges of the plume. Any elevations in turbidity and TSS generated by pile driving will be localized, short-term, and similar to the variations that occur naturally.

The effects of suspended sediment and turbidity on fish range from beneficial to detrimental. Elevated total suspended solids (TSS) have been reported to enhance cover conditions, reduce piscivorous fish/bird predation rates, and improve survival, although elevated TSS have also been reported to cause physiological stress, reduce growth, and adversely affect survival (Newcombe, and Jensen 1996). Fish may experience a reduction in predation from piscivorous fish and birds by occupying turbid waters (Gregory and Levings 1998), but longer-term exposure to these conditions can cause physiological stress responses that can increase maintenance energy needs and reduce feeding and growth (Lloyd et al. 1987; Redding et al. 1987; Servizi and Martens 1991).

Newcombe and Jensen (1996) analyzed numerous reports on documented fish responses to suspended sediment in streams and estuaries and identified a scale of ill effects based on sediment concentration and duration of exposure. The effects of suspended sediment on fish increase in severity with sediment concentration and exposure time and can progressively include behavioral avoidance and/or disorientation, physiological stress (e.g., coughing), gill abrasion, and death—at extremely high concentrations. A severity level of six on the Newcombe and Jensen (1996) scale correlates to moderate physiological stress and is associated with a large increase in the coughing rate and an increase in blood glucose levels (Servizi and Martens 1992) and is considered the breakpoint whereby an adverse effect by NMFS is concluded from exposure. Specifically, level six for juvenile salmonids equates to an increase in suspended sediment concentration of about 1,097 milligrams per liter for 1 to 3 hours of exposure time (Newcombe and Jensen 1996). Studies also show that salmonids can detect and distinguish turbidity and other water quality gradients (Quinn 1988, Simenstad 1988, Bisson and Bilby 1982), and that larger juvenile salmonids are more tolerant to suspended sediment than smaller juveniles (Servizi and Martens 1991).

Suspended sediment from excavation, pile driving, and construction is expected to occur, but suspended sediments and associated turbidity are expected to be of short duration. To the extent that salmonids are present in the areas affected with elevated suspended sediment, they are expected to be of sufficient size to enable their avoidance of waters affected by excessive suspended sediments without adverse effects. Thus, exposure of salmon or steelhead to suspended sediment from this project will be for minutes rather than hours and is extremely unlikely to approach the suspended sediment concentrations associated with moderate physiological stress identified in Newcombe and Jensen’s 1996 manuscript (i.e., Level 6).

Given the small area of river affected by turbid conditions, even during relatively high densities of ESA-listed juvenile salmonids being present we expect only a few ESA-listed fish in the action area are likely to experience the direct effects caused by suspended sediment (gill abrasion, cough, raised cortisol), however many juveniles are likely to experience avoidance, displacement to adjacent rearing habitat, and increased competition for food and refuge in unaffected habitat areas. A small subset of these fish may experience reduced growth as a result and therefore have reduced fitness.

<u>Exposure and Response to Short-Term Loss of Benthic Prey and Rearing Habitat</u>: To the degree that some foraging of sub-yearling salmonids in the action area occurs deeper than 25 feet, they are also likely to be exposed to reductions in forage. Sub-yearlings are actively feeding as they move downstream. However, juvenile salmonids in the Columbia River use their vision to detect, acquire, and subsequently, feed on small invertebrates (i.e., *Dipterans*, *Psychosidadae,* and *Corophium*; Roegner et al. 2004), so their ability to effectively feed will decline with elevated turbidity. This will likely, and temporarily, reduce growth, lipid stores, and ultimately fitness and survival in the small number of sub-yearling juvenile fish, which may be in rearing habitat near the project site. Additionally, despite their occasional presence in waters up to 30 feet deep,

juvenile salmonids are likely not rearing in the action area due to a lack of habitat complexity (no large wood or current breaks), overhanging vegetation, and the industrial anthropogenic use of the OMCR which includes noise, boat movement, and shoreline in poor condition. For these reasons, we expect only a small number of juveniles from each of the species with Columbia River rearing will be impaired in their forage success and growth, and therefore fitness of some individuals may be reduced as a result of the proposed action.

We do not expect significantly reduced food availability to juvenile salmonids to occur as a result of dredging and shoreline modification during work at the mitigation site, as the mitigation site will provide long-term benefits to salmonids and any shoreline modifications at the mitigation site will be short-term. New vegetation will provide organic inputs that will stimulate the production of prey communities and provide a more suitable habitat for rearing, foraging, and migrating juvenile salmonids.

Exposure and Response to Increased Sound Pressure Levels: Juvenile LCR chinook, UWR Chinook, SR fall chinook, and LCR steelhead are expected to be present near the action area during vibratory pile driving and potentially exposed to increased sound pressure levels. The fitness of some individuals may be reduced as a result of their exposure to increased sound pressure levels. Pile driving will occur for 4-6 weeks during the work window of October 1-December 15th. Exposure to individual fish will be low due to the lack of presence of juvenile salmonids in the area around where the piles are being installed. Juvenile fish that are farther away could be startled by the pile-driving noise which could cause an increase in predation or responses such as ceasing to forage or moving farther away from the pile-driving noise. The noise that will be generated by vibratory piling driving over the course of 4-6 weeks by vibratory pile driving is expected to occur is between 88-105 dBh. At 150 dBh or higher, we would expect behavioral changes such as avoidance and reductions in foraging behavior to occur. Juvenile salmonids may also experience increased predation due to changes in behavior associated with vibratory pile driving that may make juvenile salmon more vulnerable to predation from predatory fish and birds.

Eulachon. Eulachon are present at all times of the work window except the month of October. Presence occurs both as migrating adults and as larval fish passively out-migrating through the action area. Both life stages are present with relatively high abundance, and peak adult abundance in the month of February. Both adults and juveniles will be exposed to noise and decreased water quality from turbidity and stormwater impacts. Prey is not a significant feature as larval fish consume their yolk sack while they passively migrate downstream, and do not begin consuming prey until they are lower in the estuary.

The vast majority of eulachon spawning takes place in Washington State tributaries, including the Cowlitz, Elochoman, Kalama, and others. Spawning takes place atop sand and fine gravel substrates to which the eggs adhere and mature, often being transported downstream through this maturation process through sediment transport processes that occur along the riverine corridor. Once eggs are hatched, typically after about 30 days, the larvae disperse throughout the water column and are widely distributed as they drift downstream passively. The proposed work window for this project ends in late December, prior to the peak of eulachon larval outmigration (which occurs from April through June). Eulachon are not expected to be present in the immediate action area and are only expected to be exposed to the effects of decreased water quality from stormwater impacts and noise exposure. The response is expected to be the same as salmonid exposure

Adults and juveniles from the 15 ESUs analyzed in this Opinion, use the action area for migration and rearing. We assess the importance of habitat effects in the action area to the ESUs by examining the relevance of those effects to the characteristics of VSPs. The characteristics of VSPs are sufficient abundance, population growth rate (productivity), spatial structure, and diversity. Considering the short residence time of adult and juvenile ESA-listed salmonids in the action area, the number of listed species encountering the effects of the action is likely to be low. The effects on the growth and survival of individual salmon are unlikely to affect the abundance, productivity, or distribution of the component populations of the ESA-listed salmonids in the action area. Even considering cumulative effects anticipated in the action area, when they are combined with the effects of the action and added to the environmental baseline, the aggregate of impacts on the species will affect too few fish to influence the population viability characteristics of the affected species.

2.5 Cumulative Effects

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

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 2.4). We could expect over the lifetime of the proposed action that some climate effects, described in the baseline, such as warming water temperatures, or increasing variability of volume (low flows, high flows) become more pronounced. These effects could increase food web disruptions, migration success, or other stresses on any or all of the listed species that rely on the action area.

Also in this action area, state, or private activities in the vicinity of the project location, including other stormwater projects are expected to increase and be a source of cumulative effects in the action area. Additionally, future state and private activities in upstream areas (particularly intensifying land use, and changes in tree cover) are expected to cause habitat and water quality changes that are expressed as cumulative effects in the action area. Our analysis considers: (1) how future activities in OMCR and the Columbia River basin are likely to influence habitat conditions in the action area; and (2) cumulative effects caused by specific future activities in the vicinity of the project location.

Approximately six million people live in the Columbia River basin, concentrated largely in urban centers. The effect of that population is expressed as changes to physical habitat and loadings of pollutants contributed to the Columbia River. These changes were caused by residential, commercial, industrial, agricultural, and other land uses for economic development, and are described in the Environmental Baseline (Section 2.3). The collective effects of these activities tend to be expressed most strongly in lower river systems where the impacts of numerous upstream land management actions aggregate to influence natural habitat processes and water quality. As such, these effects accrue within this action area, though most are generated from actions upstream of the action area. As the human population grows, the range of effects described here are likely to intensify.

Resource-based industries (*e.g.*, agriculture, hydropower facilities, timber harvest, fishing, and metals and gravel mining) caused many long-lasting environmental changes that harmed ESA-listed species and their critical habitats, such as basin-wide loss or degradation of stream channel morphology, spawning substrates, instream roughness, and cover, estuarine rearing habitats, wetlands, floodplains, riparian areas, water quality (*e.g.*, temperature, sediment, dissolved oxygen, contaminants), fish passage, and habitat refugia. Those changes reduced the ability of populations of ESA-listed species to sustain themselves in the natural environment by altering or interfering with their behavior in ways that reduce their survival throughout their life cycle. The environmental changes also reduced the quality and function of critical habitat PBFs that are necessary for successful spawning, production of offspring, and migratory access necessary for adult fish to swim upstream to reach spawning areas and for juvenile fish to proceed downstream and reach the ocean. Without those features, the species cannot successfully spawn and produce offspring.

While widespread degradation of aquatic habitat associated with intense natural resource extraction is no longer common, ongoing, and future land management actions are likely to continue to have a depressive effect on aquatic habitat quality in the Columbia River basin and within the action area. Additionally, as the human population grows, other non-federal uses of the river are likely to increase and intensify, such as recreational boating and fishing, and point and nonpoint stormwater inputs from upland areas. As a result, recovery of aquatic habitat is likely to be slow in most areas, and contemporaneous cumulative effects from basin-wide activities are likely to have a slightly negative impact on population abundance trends and the quality of critical habitat PBFs into the future.

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.

Each species considered in this opinion is threatened by extinction risk, with the exception of two (UCR spring Chinook salmon, and Snake River sockeye), which are considered endangered.

Each of these species is listed due to a combination of low abundance and productivity, reduced spatial structure, and decreased genetic diversity of their constituent independent populations. Most of the component populations of LCR Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer-run, summer-run Chinook salmon, UWR spring-run Chinook salmon, SR fall-run Chinook salmon, CR chum salmon, LCR coho salmon, SR sockeye salmon, LCR steelhead, MCR steelhead, UCR steelhead, SR steelhead, and UWR steelhead, are at a low level of abundance or productivity. Several species have lost multiple historical populations as a result of anthropogenic changes throughout their habitat. Individuals from all of the ESA-listed component populations must move through and/or rear in the Columbia River portion the action area at some point during their life history.

Factoring the current environmental baseline, the fish from the component populations that move through and/or use the action area will encounter habitat conditions degraded by the modified flow regime, reduced water quality from chemical pollution, loss of functioning floodplains and secondary channels, and loss of vegetated riparian areas and associated shoreline cover, and loss of historical estuarine conditions. The significance of the degradation is reflected in the limiting factors including insufficient access to floodplain and secondary channels, degraded habitat, loss of spawning and rearing space, pollution, juvenile fish stranding, and increased predation, highlighting the importance of protecting the current functioning habitat and limiting water quality degradation, minimizing entrainment, and reducing potential predation of ESA-listed fish. The fitness of individual fish that rear or migrate in degraded conditions may already be reduced when they reach the action area, making them more susceptible to detrimental effects when they encounter effects of the proposed action.

Within this context, the proposed action will create short-term and long-term negative effects, and long-term beneficial effects from proposed mitigation. Long-term effects include runoff leaving the new bulkhead area entering the mouth of the OMCR, and loss of 0.53 acres of shallow water habitat. Short-term effects include noise and suspended sediment from noise from pile driving, turbidity, and short-term impacts to access to the OMCR. Access to beneficial habitat created in the mitigation area will provide long-term beneficial effect by creating new areas for rearing and foraging for juvenile salmonids. These habitat alterations will cause displacement of a small number of adult and juvenile fish, as they avoid the short-term effects. These alterations will be short-term and will occur during the work window the minimize exposure to many of the ESA-listed juvenile species that are most vulnerable to the potential impacts of the action. When we consider the current status of the threatened and endangered fish populations and degraded environmental baseline within the action area, the proposed action’s annual decrease in species abundance is likely to be very small, to be across more than one population, and more than one listed species. This reduction in abundance itself, even annually for short-term and long-term effects is not expected to be sufficient to affect the distribution, diversity, or productivity of any of the component populations of the ESA-listed species because the reductions are expected to be among a few fish, and, as such, their loss will likely be indistinguishable among that cohort as returning adults.

In the context of the status of designated critical habitat and the specific baseline conditions of PBFs in the action area, the proposed action will not obstruct passage of migrating salmonids, alter flows, destabilize the channel, change its characteristics, alter water temperature, or substantially reduce available forage for migrating or rearing salmonids in the short term. Mitigation will provide long-term beneficial effects and create twice the amount of habitat that is lost from the bulkhead construction.

The last element in the integration of effects includes a consideration of the cumulative effects anticipated in the action area. When considering the cumulative effects of non-federal actions, recovery of aquatic habitat from the degraded baseline conditions is likely to be slow in most of the action area, and cumulative effects (from continued or increasing uses of the action area) are likely to have a long-term negative impact on habitat conditions.

In summary, fitness level consequences to exposed individuals are anticipated at low levels. Very few individuals are expected to experience high-level fitness consequences. None of the populations are expected to experience reductions in VSP parameters. Therefore, NMFS concludes that the proposed action is not anticipated to reduce appreciably the likelihood of both the survival and recovery of these listed salmonids in the wild.

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 the cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of LCR Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer-run Chinook salmon, UWR spring-run Chinook salmon, SR fall-run Chinook salmon, CR chum salmon, LCR coho salmon, SR sockeye salmon, LCR steelhead, MCR steelhead, UCR steelhead, SR steelhead, UWR steelhead, Southern DPS green sturgeon, or eulachon, 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.

2.8.1 Amount or Extent of Take

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

- Incidental take in the form of harm due to exposure to stormwater
- Incidental take in the form of harm due to exposure to turbidity
- Incidental take in the form of harm from long-term decreased prey and rearing habitat
- Incidental take in the form of harm, injury, or death from exposure to noise from pile driving

Take by these mechanisms will affect juvenile ESA-listed salmon and steelhead, eulachon, and green sturgeon. All listed fish will be exposed to stormwater effects for the life of the project. Only juvenile salmon and steelhead are expected to incur short-term effects from installation of the bulkhead and mitigation construction, including elevated suspended sediment and noise. Only salmon and steelhead will incur effects from long-term loss of 0.53 acres of shallow water habitat. These effects include loss of rearing habitat and loss of benthic prey.

Due to the highly variable number of individual fish present at any given time, and difficulties in the ability to observe injury or mortality of fish, which may sink out of sight, be consumed by predatory species, or have delayed death outside of the action area, a definitive number of ESA-listed fish that will be killed, injured, or otherwise adversely affected cannot be determined. In such circumstances, NMFS will use a habitat-based surrogate to account for the amount of take, which is called an "extent" of take. The extent of take is causally related to the harm that occurs and is an observable measure for monitoring, compliance, and re-initiation purposes.

Harm from turbid conditions – Because injury to individuals can occur when exposed to high levels of suspended sediment, or as a result of avoiding areas affected with high levels of sediment, the extent of take is measured as the anticipated area where suspended sediment will be present. In this case, the downstream extent of the CWA-authorized mixing zone is 100 feet downstream from the point of disturbance.

Harm from diminished prey availability – Reductions in fitness among juveniles are likely when prey availability is decreased, and competition increases for prey resources. The extent of take is therefore measured as the size of the permanent fill for the bulkhead, approximately 0.53 acres.

Injury, death, or harm from sound - Installation of piles is reasonably certain to harm juvenile salmonids sensitive to sound pressure levels created from vibratory hammering, including LCR Chinook salmon, LCR coho salmon, SR fall-run Chinook salmon, and UWR Chinook salmon, which are expected to be present in the action area during pile installation. Death may occur should juvenile salmonids temporarily display behavior putting them at higher risk of predation such as swimming into deeper water where predators occur. We cannot estimate the number of fish likely to be predated because the number of fish present at the time the pile driving occurs is variable. The potential harm to salmonids is related to the duration of vibratory hammer use per day and in total. We measured the extent of take instead by a maximum of <1 hour of pile driving with a vibratory hammer per day for a maximum of 1 day, per year.

Injury, death, or harm from stormwater exposure- The proposed action will create approximately 37,964 square feet of new impervious surface. The project will incorporate a stormwater conveyance system with a subsurface vault to treat stormwater runoff. Stormwater runoff from the new and contributing impervious surface will result in conveying a wide variety of pollutants to aquatic ecosystems, such as nutrients, metals, petroleum-related compounds, sediment washed off the road surface, and agricultural chemicals. Stormwater inputs will result in a long-term reduction of water quality and an increase in water quantity due to concentrated flows derived from impervious surfaces which are reasonably certain to cause injury to fish depending on the level of exposure. As discussed above, stormwater contaminants can cause a variety of lethal and sublethal effects on fish, including disrupted behavior, reduced olfactory function, immune suppression, reduced growth, disrupted smoltification, hormone disruption, disrupted reproduction, cellular damage, and physical and developmental abnormalities (Fresh et al. 2005; Hecht et al. 2007; Lower Columbia River Estuary Partnership 2007). The distribution of those pollutants also varies widely within the action area as a function of surrounding land use, pre-rainfall conditions, rainfall intensity and duration, and mixing from other drainage areas. Stormwater runoff events are often relatively brief, especially in urban streams, so that large inputs of runoff and pollutants can occur and dissipate within a few hours. Moreover, the distribution and abundance of fish that occur within the action area are inconsistent over time, affected by habitat quality, interactions with other species, harvest programs, and other influences that cannot be precisely determined by observation or modeling. The extent of take being used as a surrogate for stormwater effects is as follows:

The extent of take for stormwater effects is the size of the new impervious surface and the stormwater treatment vault. As such, if the project creates more than 37,964 square feet of impervious surface, take is exceeded. Further, if the project does not maintain the functionality of the vault treatment on an annual basis, take is exceeded.

2.8.2 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.

2.8.3 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). The USACE shall require any permittee or contractor performing the work described in this document to:

1. Minimize incidental take by minimizing stormwater impacts;
2. Minimize incidental take from underwater noise during vibratory pile driving for both the sheet piles and mooring dolphins;
3. Minimize incidental take by minimizing turbidity; and
4. Minimize incidental take by minimizing the effects of shoreline modifications.

2.8.4 Terms and Conditions

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

1. The following term and condition implements RPM 1, minimize stormwater runoff from PGIS by:

    a. Incorporation of media cartridges in the water quality vault, and subsequent maintenance and replacement as need of the media cartridges annually. Ensure the new impervious surface is no larger than 37,964 square feet.

2. The following term and condition implements RPM 2, minimize underwater noise during vibratory pile driving:

    a. Use a vibratory hammer to install all piles associated with sheet piles and mooring dolphins.
    b. Minimize the duration of vibratory hammer operation to the greatest extent possible.

3. The following term and condition implements RPM 3, and minimize turbidity during construction:

    a. The applicant, J.E. McAmis, shall ensure turbidity returns to background levels downstream (200 ft) during construction by adhering to BMPs including monitoring and compliance for the reporting of turbidity levels observed during construction operations.
    b. If turbidity levels are exceeded, install a floating silt curtain around the in-water construction area or other areas that are experiencing increased turbidity due to the proposed action to minimize the dispersion of suspended sediment thereby reducing turbidity.
    c. USACE and the applicant shall ensure that in-water work will be performed in accordance with permit conditions, which set timing restrictions for in-water work of October 1 to December 15th.

4. The following term and condition implements RPM 4, shoreline modification:

    a. The applicant, J.E. McAmis, shall ensure fill in the bulkhead area is no larger than 0.53 acres.
    b. Ensure the mitigation site provides functional habitat by maintaining wetland connections, replacing failed plants, and other maintenance projects as needed to keep the site functional.

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 following two conservation recommendations are discretionary measures that NMFS believes are consistent with this obligation and therefore should be carried out by the USACE:

1. Removed sunken vessels from the OMCR.
2. Increase habitat complexity near the bulkhead by planting native vegetation such as willows and cottonwoods and adding habitat features such as LWD.
3. Install onsite stormwater detention facilities that promote the infiltration and evaporation of stormwater through the use of bioswales, rain gardens, and vegetated drainage ditches to minimize the amount of stormwater that reaches the OMCR

Please notify NMFS if the USACE or the applicant carries out these recommendations so that we will be kept informed of actions that are intended to improve the conservation of listed species or their designated critical habitats.

2.10 Species and Critical Habitats Not Likely to be Adversely Affected

The USACE determined the proposed action is not likely to adversely affect the following ESA-listed resources: southern resident killer whale, central American DPS humpback whale, and Mexican DPS humpback whale, and designated critical habitats for southern resident killer whale, central American DPS humpback whale, and Mexican DPS humpback whale. NMFS concurs with these determinations, as described below.

Southern Resident Killer Whale and their Designated Critical Habitat
Southern resident killer whales (SRKW) could be present and be exposed to degraded water quality, however, the water quality reduction is brief and due to mixing between ocean and river water at the mouth of the Columbia River, their exposure is likely to be diffuse to such a degree that no significant response is expected. Prey abundance is not expected to be significantly diminished due to exposure to stormwater exposure, pile driving, or turbidity. Effects on SRKW are insignificant.

Primary biological features of SRKW critical habitat include: 1) Water quality to support growth and development; 2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction and development, as well as overall population growth; and 3) passage conditions to allow for migration, resting, and foraging. As discussed above, the proposed action is not expected to degrade water quality to a degree that inhibits growth and development. The project will not diminish the quantity, quality, or availability of prey such that it would affect growth, reproduction, development, or population growth. The project will not affect passage conditions. Effects on SRKW designated critical habitat are insignificant.

Central American DPS Humpback Whale and Mexican DPS Humpback Whale and their Designated Critical Habitat

Prey is the only feature of critical habitat that could be diminished for listed humpback whales that forage at the mouth of the Columbia River. However, prey abundance is not expected to be diminished due to exposure to stormwater. Effects on humpback whales from either DPS is expected to be discountable.

2.11 Reinitiation of Consultation

This concludes the ESA section 7 consultation for J.E. McAmis OpenCell Bulkhead Replacement.

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

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 the 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 Fishery Management Council (PFMC 2005) Pacific Coast salmon (PFMC 2014); and 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

As part of the information provided in the request for ESA concurrence, the USACE determined that the proposed action may have an adverse effect on EFH designated for Pacific Coast Salmon.

3.2 Adverse Effects on Essential Fish Habitat

The proposed action will temporarily diminish water quality, disturb benthic habitat, create turbidity, increase stormwater inputs, harden the shoreline, and increase underwater noise that will affect forage production and local hydraulic conditions. Overall, the area of disturbance is relatively small in relation to the Columbia River Estuary, partially disconnected/isolated from the main-stem Columbia River, the disturbances will be short-lived for all effects except stormwater impacts and the impacts from the creation of new connected viable fish habitat new the action area, will maintain current conditions, and will not change the functional characteristics of the habitat. These localized and temporary diminishments in EFH will occur in each year of the lifetime of the action.

3.3 Essential Fish Habitat Conservation Recommendations

The effects of the proposed action will be minimized by the use of clamshell dredge and monitoring and use of a vibratory hammer. To minimize the effects on Pacific Coast salmon EFH, including complex channels and floodplain habitats HPAC the USACE should:

1. Maintain trees onsite in the mitigation site to the greatest degree possible to provide more shade and cooler water temperatures for fish
2. Add LWD and beaver dam analogs to the new wetland connection site to provide greater habitat complexity.
3. Add stormwater treatments that reduce the effects of stormwater on water quality, such as a treatment train that includes conveyance from the surface of the bulkhead to a holding pond or bioswales. Minimize discharge to the OMCR to the greatest degree possible by infiltrating through natural soils 100 percent of stormwater to prevent discharge into the OMCR.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, 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 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)).

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 user of this opinion is the USACE and other interested users which could include J.E. McAmis and their consultants. Individual copies of this opinion were provided to the USACE. The document will be available at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adhere 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 part 600.

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

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

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

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6. Appendix

Chart of ESA-listed species by presence in the LCR by month. Dark pink indicates peak presence, light pink low, but present in the LCR.

Species	Lifestage	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Chinook (Lower Columbia)													
ESU	Adult(migrating and holding)												
	Adult(spawning)												
	Eggs and Pre-emergence												
	Juvenile(rearing)												
	Juvenile(emigration)												
Chinook(upper Columbia)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Spring ESU	Adult(migrating and holding)												
	Adult(spawning)												
	Eggs and Pre-emergence												
	Juvenile(rearing)												
	Juvenile(emigration)												
Chinook (Snake River)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Spring/Summer ESU	Adult(migrating and holding)												
	Adult(spawning)												
	Eggs and Pre-emergence												
	Juvenile(rearing)												
	Juvenile(emigration)												
Fall ESU	Adult(migrating and holding)												
	Adult(spawning)												
	Eggs and Pre-emergence												
	Juvenile(rearing)												
	Juvenile(emigration)												
Chinook(Upper Willamette)													
Spring ESU	Adult(migrating and holding)												
	Adult(spawning)												
	Eggs and Pre-emergence												
	Juvenile(rearing)												
	Juvenile(emigration)												
Eulachon (southern DPS)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Southern DPS	Adult(migrating and holding)												
	Adult(spawning)												
	Eggs incubation												
	larvae emigration												
Green Sturgeon		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Southern DPS	Sub-adult and adult foraging												
Chum		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Lower Columbia ESU	Adult(migrating and holding)												
	Adult(spawning)												
	Eggs and Pre-emergence												
	Juvenile(rearing)												
	Juvenile(emigration)												
Coho		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Lower Columbia ESU	Adult(migrating and holding)												
	Adult(spawning)												
	Eggs and Pre-emergence												
	Juvenile(rearing)												
	Juvenile(emigration)												
Sockeye		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Snake River ESU	Adult(migrating and holding)												
	Adult(spawning)												
	Eggs and Pre-emergence												
	Juvenile(rearing)												
	Juvenile(emigration)												
Steelhead(Lower Columbia)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
DPS	Adult(migrating and holding)												
	Adult(spawning)												
	Eggs and Pre-emergence												
	Juvenile(rearing)												
	Juvenile(emigration)												
Steelhead(Mid Columbia)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
DPS	Adult(migrating and holding)												
	Adult(spawning)												
	Eggs and Pre-emergence												
	Juvenile(rearing)												
	Juvenile(emigration)												
Steelhead(Upper Columbia)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Summer DPS	Adult(migrating and holding)												
	Adult(spawning)												
	Eggs and Pre-emergence												
	Juvenile(rearing)												
	Juvenile(emigration)												
Steelhead (Upper Willamette)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Summer	Adult(migrating and holding)												
	Adult(spawning)												
	Eggs and Pre-emergence												
	Juvenile(rearing)												
	Juvenile(emigration)												
Winter	Adult(migrating and holding)												
	Adult(spawning)												
	Eggs and Pre-emergence												
	Juvenile(rearing)												
	Juvenile(emigration)												
Steelhead(Snake River ESU)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
DPS	Adult(migrating and holding)												
	Adult(spawning)												
	Eggs and Pre-emergence												
	Juvenile(rearing)												
	Juvenile(emigration)												