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 Consultation No.:
WCRO-2019-01083

March 2, 2020

William D. Abadie
Chief, Regulatory Branch
Portland District, Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208-2946

10.25923/akka-z708

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Clatsop County Dock Boat Ramp and Dock Replacement, Westport Slough, Oregon (HUC 170800030801, COE Number NWP-2019-93.)

Dear Mr. Abadie:

Thank you for your letter of June 13, 2019, requesting initiation of 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 Clatsop County Boat Ramp and Dock Replacement. This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016).

The enclosed document contains a biological opinion (opinion) that analyzes the effects of your proposal to permit Clatsop County to replace a boat ramp and dock in the Westport Slough, of the Lower Columbia River (LCR). In this opinion, we conclude that the proposed action, is not likely to jeopardize the continued existence of LCR Chinook salmon (*Oncorhynchus tshawytscha*), LCR coho salmon (*O. kisutch*), CR chum salmon (*O. keta*), LCR steelhead (*O. mykiss*), Upper Willamette (UW) River steelhead, Middle Columbia River (MCR) steelhead, Upper Columbia River (UCR) spring-run Chinook salmon, UCR steelhead, Snake River (SR) spring/summer run Chinook salmon, SR fall-run Chinook salmon, UW Chinook salmon, SR sockeye salmon (*O. nerka*), Snake River Basin (SRB) steelhead, and Green sturgeon (*Acipenser medirostris*). Further, we conclude that the proposed action will not result in the destruction or adverse modification of their designated critical habitats.

As required by section 7 of the ESA, we are providing an incidental take statement with the opinion. The incidental take statement describes reasonable and prudent measures we consider necessary or appropriate to minimize incidental take associated with this action.

The take statement sets forth nondiscretionary terms and conditions, including reporting requirements that the U.S. Army Corps of Engineers (COE) and any person who performs the action must comply with to carry out the reasonable and prudent measures. Incidental take from actions that meet these terms and conditions will be exempt from the ESA take prohibition.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1855(b)) for this action. This 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. 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 Federal action agency 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 Chad Baumler of the Oregon Washington Area Coastal Office in Lacey, Washington at 360-753-4126 or by e-mail at chad.baumler@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

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

cc: Brad Johnson, COE

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

Clatsop County Dock Boat Ramp and Dock Replacement
Westport Slough, Oregon HUC 170800030801 (COE Number NWP-2019-93)

NMFS Consultation Number: WCRO-2019-01083

Action Agency: U.S. Army Corps of Engineers

Affected Species and NMFS' Determinations:

ESA-Listed Species	ESA Status	Is the action likely to adversely affect this species or its critical habitat?	Is the action likely to jeopardize this species?	Is the action likely to adversely affect critical habitat?	Is the action likely to destroy or adversely modify critical habitat for this species?
Lower Columbia River Chinook salmon (*Oncorhynchus tschawtscha*)	T	Yes	No	Yes	No
Upper Columbia River spring-run Chinook salmon	E	Yes	No	No	No
Snake River spring/summer run Chinook salmon	T	Yes	No	No	No
Snake River fall-run Chinook salmon	T	Yes	No	No	No
Columbia River chum salmon (*O. keta*)	T	Yes	No	No	No
Lower Columbia River coho salmon (*O. kisutch*)	T	Yes	No	Yes	No
Snake River sockeye salmon (*O. nerka*)	E	Yes	No	No	No
Lower Columbia River steelhead (*O. mykiss*)	T	Yes	No	No	No
Middle Columbia River steelhead	T	Yes	No	No	No
Upper Columbia River steelhead	T	Yes	No	No	No
Snake River Basin steelhead	T	Yes	No	No	No
Pacific Eulachon (*Thaleichthys pacificus*)	T	No	No	No	No
North American green sturgeon (*Acipenser medirostris*)	T	Yes	No	Yes	No
Upper Willamette River steelhead	T	Yes	No	No	No
Upper Willamette River Chinook salmon	T	Yes	No	No	No

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

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

Issued By:

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

Date: March 2, 2020

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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.

1.1 Background

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

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

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available through NMFS' Environmental Consultation Organizer (https://eco.fisheries.noaa.gov). A complete record of this consultation is on file at NMFS Oregon Washington Coastal Area Office, Lacey, Washington.

1.2 Consultation History

On June 13, 2019, the U.S. Army Corps of Engineers, Portland District (COE), sent a request for formal consultation for a dock and boat ramp replacement. The request included a memorandum for services, and a biological assessment that included project drawings and photos. The COE concluded that the project would likely adversely affect LCR Chinook, LCR coho, LCR steelhead and southern green sturgeon. The COE found that the project would not likely adversely affect CR chum salmon, UW River steelhead, MCR steelhead, UCR spring-run Chinook salmon, UCR steelhead, SR spring/summer run Chinook salmon, SR fall-run Chinook salmon, UW Chinook salmon, SR sockeye salmon, SRB steelhead, and eulachon.

On July 15, 2019 NMFS concluded the project was likely to adversely affect all of the salmonids and green sturgeon, and initiated consultation. NMFS concurred that the project was not likely to adversely affect eulachon.

Updates to the regulations governing interagency consultation (50 CFR part 402) were effective on October 28, 2019. This consultation was pending at that time, and we are applying the updated regulations to the consultation. As the preamble to the final rule adopting the regulations noted, "[t]his final rule does not lower or raise the bar on section 7 consultations, and it does not alter what is required or analyzed during a consultation. Instead, it improves clarity and, consistency, streamlines consultations, and codifies existing practice." We have reviewed the information and analyses relied upon to complete this biological opinion in light of the updated regulations and conclude the opinion is fully consistent with the updated regulations.

1.3 Proposed Federal Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). 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).

For EFH, "Federal action" means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).

The COE, proposes to issue a permit under section 10 of the Rivers and Harbors Act and section 404 of the Clean Water Act. Under the proposed permit, the applicant will construct a concrete boat ramp, boarding docks, improve the existing parking lot, and remove an existing boat ramp and dock. This new structure will be used for safe recreational access to the Westport Slough, and is needed due to increased use and poor ramp access during low water. The project is expected to take 6-8 weeks to complete.

The proponent will:

- Replace an existing 19-foot by 73-foot concrete boat ramp with a larger 47-foot by 115 foot concrete boat ramp;
- Raise the ramp and parking area to a level above seasonal flood levels;
- Pave the parking lots;
- Place 2,163 cubic yards of dredged and fill material below the high tide line (HTL) and within two adjacent wetlands;
- Remove the twin 6-foot by 100-foot wood boarding docks and a 10-foot by 15-foot wood platform;
- Remove 32 existing creosote timber pilings from the project area and an additional 93 remnant creosote pilings from a site west of the boat ramp in Westport slough;
- Install a 6-foot by 140-foot aluminum boarding dock and four 12-inch steel piles;
- Construct a 10-foot by 332-foot aluminum dock with attached 6-foot by 30-foot paddle craft dock supported by a 6-foot by 80-foot aluminum gangway and 15 18-inch steel piles;
- Remove 13 trees and 1.25 acres of onsite vegetation;
- Provide stormwater treatment including rain gardens, stormwater planters and riprap for diffusing stormwater discharges;
- Perform stream habitat restoration and riparian plantings.

The project also incorporates measures to avoid or reduce effects to listed species and habitat:

- All in-water work and work below ordinary high water (OHW) will occur from July 15 to September 15 to coincide with the lowest numbers of salmonids in the action area;
- A floating silt curtain and other measures to limit spread of turbidity including monitoring and work stoppage if isolation is not successful;
- The excavated native bed material will be temporarily stockpiled in the isolation area before being legally and properly disposed of in an off-site upland disposal site;
- Exclusion activities to remove any present fish prior to in-water work; to include herding, netting, and if necessary, electroshocking, in that order;

- Sediment control measures and fencing to minimize introducing sediment to the slough;
- Conical tops to prevent perching by piscivorous birds;
- All areas of temporary shoreline disturbance will be restored and re-vegetated with native plantings;
- Grate as much of the docks as possible while remaining safe and ADA compliant; and
- All new pilings will be installed with a vibratory hammer. In the event that the vibratory hammer cannot fully embed the piles to the necessary depth, the contractor will use an impact hammer with bubble curtain and soft start to seat the piles.

We considered whether or not the proposed action would cause any other activities and determined that it would cause increased recreational boating use.

1.4 Action Area

"Action area" means, under the ESA, 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).

For this consultation, the action area consists of the footprint of the proposed boat ramp, boat dock, and one half mile upstream and 0.8 miles downstream to the confluence with the Columbia River from the installation, where the additional increased effect of recreational boating and stormwater are reasonably certain to occur. We expect that the widest ranging effect will occur from boating to and from this structure and the physical effects of boating on habitat and species will bound the action area upstream and downstream.

A total of 14 ESA-listed species use the action area for adult migration, and/or juvenile rearing and migration. Critical habitat has been designated within the Action Area for only LCR coho, LCR Chinook, and green sturgeon.

The action area is designated EFH for Chinook salmon and coho salmon (Pacific Fishery Management Council 2014), and is an area where environmental effects of the proposed action may adversely affect EFH of those species. The effects to EFH are analyzed in the MSA portion of the document.

Figure 1. Confluence of Westport Slough and Columbia River; Action Area associated with project indicated by the red polygon

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

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

The action agency determined, and NMFS concurs, that the proposed action is not likely to affect eulachon. These analyses are found in the "Not Likely to Adversely Affect" Determinations section 2.10.

2.1 Analytical Approach

This biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably would be expected, directly

or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

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

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

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

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

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

2.2 Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and

recovery. The species status section also helps to inform the description of the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the essential PBFs that help to form that conservation value.

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

During the last century, average regional air temperatures in the Pacific Northwest increased by 1-1.4°F as an annual average, and up to 2°F in some seasons (based on average linear increase per decade; Abatzoglou *et al.* 2014; Kunkel *et al.* 2013). Warming is likely to continue during the next century as average temperatures are projected to increase another 3 to 10°F, with the largest increases predicted to occur in the summer (Mote *et al.* 2014). Decreases in summer precipitation of as much as 30 percent by the end of the century are consistently predicted across climate models (Mote *et al.* 2014). Precipitation is more likely to occur during October through March, less during summer months, and more winter precipitation will be rain than snow (ISAB 2007; Mote *et al.* 2014). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB 2007; Mote *et al.* 2014). Models consistently predict increases in the frequency of severe winter precipitation events (i.e., 20-year and 50-year events), in the western United States (Dominguez *et al.* 2012). The largest increases in winter flood frequency and magnitude are predicted in mixed rain-snow watersheds (Mote *et al.* 2014).

Overall, about one-third of the current cold-water salmonid habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua *et al.* 2009). Higher temperatures will reduce the quality of available salmonid habitat for most freshwater life stages (ISAB 2007). Reduced flows will make it more difficult for migrating fish to pass physical and thermal obstructions, limiting their access to available habitat (Mantua *et al.* 2010; Isaak *et al.* 2012). Temperature increases shift timing of key life cycle events for salmonids and species forming the base of their aquatic foodwebs (Crozier *et al.* 2011; Tillmann and Siemann 2011; Winder and Schindler 2004). Higher stream temperatures will also cause decreases in dissolved oxygen and may also cause earlier onset of stratification and reduced mixing between layers in lakes and reservoirs, which can also result in reduced oxygen (Meyer *et al.* 1999; Winder and Schindler 2004, Raymondi *et al.* 2013). Higher temperatures are likely to cause several species to become more susceptible to parasites, disease, and higher predation rates (Crozier *et al.* 2008; Wainwright and Weitkamp 2013; Raymondi *et al.* 2013).

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

In addition to changes in freshwater conditions, predicted changes for coastal waters in the Pacific Northwest as a result of climate change include increasing surface water temperature, increasing but highly variable acidity, and increasing storm frequency and magnitude (Mote *et al.* 2014). Elevated ocean temperatures already documented for the Pacific Northwest are highly likely to continue during the next century, with sea surface temperature projected to increase by 1.0-3.7ºC by the end of the century (IPCC 2014). Habitat loss, shifts in species' ranges and abundances, and altered marine food webs could have substantial consequences to anadromous, coastal, and marine species in the Pacific Northwest (Tillmann and Siemann 2011, Reeder *et al.* 2013). Moreover, as atmospheric carbon emissions increase, increasing levels of carbon are absorbed by the oceans, changing the pH of the water. Acidification also impacts sensitive estuary habitats, where organic matter and nutrient inputs further reduce pH and produce conditions more corrosive than those in offshore waters (Feely *et al.* 2012, Sunda and Cai 2012).

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

Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of salmon and steelhead, while cooler ocean periods have coincided with relatively high abundances, and therefore these species are predicted to fare poorly in warming ocean conditions (Scheuerell and Williams 2005; Zabel *et al.* 2006). This is supported by the recent observation that anomalously warm sea surface temperatures off the coast of Washington from 2013 to 2016 resulted in poor coho and Chinook salmon body condition for juveniles caught in those waters (NWFSC 2015). Changes to estuarine and coastal conditions, as well as the timing of seasonal shifts in these habitats, have the potential to impact a wide range of listed aquatic species (Tillmann and Siemann 2011, Reeder *et al.* 2013).

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

2.2.1 Status of the Species

Table 1, 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. These documents are available on the NMFS West Coast Region website (http://www.westcoast.fisheries.noaa.gov/).

Table 1. Listing classification and date, recovery plan reference, most recent status review, status summary, and limiting factors for each species considered in this opinion.

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Upper Willamette River Chinook salmon	Threatened 6/28/05	NMFS 2011	NWFSC 2015	This ESU comprises seven populations. Five populations are at very high risk, one population is at moderate risk (Clackamas River) and one population is at low risk (McKenzie River). Consideration of data collected since the last status review in 2010 indicates the fraction of hatchery origin fish in all populations remains high (even in Clackamas and McKenzie populations). The proportion of natural origin spawners improved in the North and South Santiam basins, but is still well below identified recovery goals. Abundance levels for five of the seven populations remain well below their recovery goals. Of these, the Calapooia River may be functionally extinct and the Molalla River remains critically low. Abundances in the North and South Santiam rivers have risen since the 2010 review, but still range only in the high hundreds of fish. The Clackamas and McKenzie populations have previously been viewed as natural population strongholds, but have both experienced declines in abundance despite having access to much of their historical spawning habitat. Overall, populations appear to be at either moderate or high risk, there has been likely little net change in the VSP score for the ESU since the last review, so the ESU remains at moderate risk.	• Degraded freshwater habitat • Degraded water quality • Increased disease incidence • Altered stream flows • Reduced access to spawning and rearing habitats • Altered food web due to reduced inputs of microdetritus • Predation by native and non-native species, including hatchery fish • Competition related to introduced salmon and steelhead • Altered population traits due to fisheries and bycatch

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Upper Columbia River spring-run Chinook salmon	Endangered 6/28/05	Upper Columbia Salmon Recovery Board 2007	NWFSC 2015	This ESU comprises four independent populations. Three are at high risk and one is functionally extirpated. Current estimates of natural origin spawner abundance increased relative to the levels observed in the prior review for all three extant populations, and productivities were higher for the Wenatchee and Entiat populations and unchanged for the Methow population. However, abundance and productivity remained well below the viable thresholds called for in the Upper Columbia Recovery Plan for all three populations.	• 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 2016a	NWFSC 2015	This ESU comprises 28 extant and four extirpated populations. All expect one extant population (Chamberlin Creek) are at high risk. Natural origin abundance has increased over the levels reported in the prior review for most populations in this ESU, although the increases were not substantial enough to change viability ratings. Relatively high ocean survivals in recent years were a major factor in recent abundance patterns. While there have been improvements in abundance and productivity in several populations relative to prior reviews, those changes have not been sufficient to warrant a change in ESU status.	• Degraded freshwater habitat • Effects related to the hydropower system in the mainstem Columbia River, • Altered flows and degraded water quality • Harvest-related effects • Predation

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Snake River fall-run Chinook salmon	Threatened 6/28/05	NMFS 2015a	NWFSC 2015	This ESU has one extant population. Historically, large populations of fall Chinook salmon spawned in the Snake River upstream of the Hells Canyon Dam complex. The extant population is at moderate risk for both diversity and spatial structure and abundance and productivity. The overall viability rating for this population is 'viable.' Overall, the status of Snake River fall Chinook salmon has clearly improved compared to the time of listing and compared to prior status reviews. 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 Dam complex.	• 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	NWFSC 2015	Overall, the status of most chum salmon populations is unchanged from the baseline VSP scores estimated in the recovery plan. A total of 3 of 17 populations are at or near their recovery viability goals, although under the recovery plan scenario these populations have very low recovery goals of 0. The remaining populations generally require a higher level of viability and most require substantial improvements to reach their viability goals. Even with the improvements observed during the last five years, the majority of populations in this ESU remain at a high or very high risk category and considerable progress remains to be made to achieve the recovery goals.	• Degraded estuarine and nearshore marine habitat • Degraded freshwater habitat • Degraded stream flow as a result of hydropower and water supply operations • Reduced water quality • Current or potential predation • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Lower Columbia River coho salmon	Threatened 6/28/05	NMFS 2013	NWFSC 2015	Of the 24 populations that make up this ESU, 21 populations are at very high risk, 1 population is at high risk, and 2 populations are at moderate risk. Recent recovery efforts may have contributed to the observed natural production, but in the absence of long term datasets it is not possible to parse out these effects. Populations with long term data sets exhibit stable or slightly positive abundance trends. Some trap and haul programs appear to be operating at or near replacement, although other programs still are far from that threshold and require supplementation with additional hatchery-origin spawners. Initiation of or improvement in the downstream juvenile facilities at Cowlitz Falls, Merwin, and North Fork Dam are likely to further improve the status of the associated upstream populations. While these and other recovery efforts have likely improved the status of a number of coho salmon populations, abundances are still at low levels and the majority of the populations remain at moderate or high risk. For the Lower Columbia River region land development and increasing human population pressures will likely continue to degrade habitat, especially in lowland areas. Although populations in this ESU have generally improved, especially in the 2013/14 and 2014/15 return years, recent poor ocean conditions suggest that population declines might occur in the upcoming return years	• Degraded estuarine and near-shore marine habitat • Fish passage barriers • Degraded freshwater habitat: Hatchery-related effects • Harvest-related effects • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Snake River sockeye salmon	Endangered 6/28/05	NMFS 2015b	NWFSC 2015	This single population ESU is at very high risk dues to small population size. There is high risk across all four basic risk measures. Although the captive brood program has been successful in providing substantial numbers of hatchery produced fish for use in supplementation efforts, substantial increases in survival rates across all life history stages must occur to re-establish sustainable natural production In terms of natural production, the Snake River Sockeye ESU remains at extremely high risk although there has been substantial progress on the first phase of the proposed recovery approach – developing a hatchery based program to amplify and conserve the stock to facilitate reintroductions.	• Effects related to the hydropower system in the mainstem Columbia River • 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	NWFSC 2015	This DPS comprises four independent populations. Three populations are at high risk of extinction while 1 population is at moderate risk. Upper Columbia River steelhead populations have increased relative to the low levels observed in the 1990s, but natural origin abundance and productivity remain well below viability thresholds for three out of the four populations. The status of the Wenatchee River steelhead population continued to improve based on the additional year's information available for the most recent review. The abundance and productivity viability rating for the Wenatchee River exceeds the minimum threshold for 5 percent extinction risk. However, the overall DPS status remains unchanged from the prior review, remaining 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

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

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Middle Columbia River steelhead	Threatened 1/5/06	NMFS 2009b	NWFSC 2015	This DPS comprises 17 extant populations. The DPS does not currently include steelhead that are designated as part of an experimental population above the Pelton Round Butte Hydroelectric Project. Returns to the Yakima River basin and to the Umatilla and Walla Walla Rivers have been higher over the most recent brood cycle, while natural origin returns to the John Day River have decreased. There have been improvements in the viability ratings for some of the component populations, but the DPS is not currently meeting the viability criteria in the MCR steelhead recovery plan. In general, the majority of population level viability ratings remained unchanged from prior reviews for each major population group within the DPS.	• 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 2016a	NWFSC 2015	This DPS comprises 24 populations. Two populations are at high risk, 15 populations are rated as maintained, 3 populations are rated between high risk and maintained, 2 populations are at moderate risk, 1 population is viable, and 1 population is highly viable. Four out of the five MPGs are not meeting the specific objectives in the draft recovery plan based on the updated status information available for this review, and the status of many individual populations remains uncertain A great deal of uncertainty still remains regarding the relative proportion of hatchery fish in natural spawning areas near major hatchery release sites within individual populations.	• Adverse effects related to the mainstem Columbia River hydropower system • Impaired tributary fish passage • Degraded freshwater habitat • Increased water temperature • Harvest-related effects, particularly for B-run steelhead • Predation • Genetic diversity effects from out-of-population hatchery releases

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
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
Upper Willamette River steelhead	Threatened 1/5/06	NMFS 2011	NWFSC 2015	This DPS has four demographically independent populations. Three populations are at low risk and one population is at moderate risk. Declines in abundance noted in the last status review continued through the period from 2010-2015. While rates of decline appear moderate, the DPS continues to demonstrate the overall low abundance pattern that was of concern during the last status review. The causes of these declines are not well understood, although much accessible habitat is degraded and under continued development pressure. The elimination of winter-run hatchery release in the basin reduces hatchery threats, but non-native summer steelhead hatchery releases are still a concern for species diversity and a source of competition for the DPS. While the collective risk to the persistence of the DPS has not changed significantly in recent years, continued declines and potential negative impacts from climate change may cause increased risk in the near future.	• Degraded freshwater habitat • Degraded water quality • Increased disease incidence • Altered stream flows • Reduced access to spawning and rearing habitats due to impaired passage at dams • Altered food web due to changes in inputs of microdetritus • Predation by native and non-native species, including hatchery fish and pinnipeds • Competition related to introduced salmon and steelhead • Altered population traits due to interbreeding with hatchery origin fish

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Lower Columbia River Chinook salmon	Threatened 6/28/05	NMFS 2013	NWFSC 2015	This ESU comprises 32 independent populations. Twenty-seven populations are at very high risk, 2 populations are at high risk, one population is at moderate risk, and 2 populations are at very low risk Overall, there was little change since the last status review in the biological status of this ESU, although there are some positive trends. Increases in abundance were noted in about 70% of the fall-run populations and decreases in hatchery contribution were noted for several populations. Relative to baseline VSP levels identified in the recovery plan, there 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.	• Reduced access to spawning and rearing habitat • Hatchery-related effects • Harvest-related effects on fall Chinook salmon • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Contaminant

2.2.1 Status of the Critical Habitat

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

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

For 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.

Table 2. 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 PBFs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some, or high potential for improvement. We rated conservation value of HUC5 watersheds as high for 30 watersheds, medium for 13 watersheds, and low for four watersheds.
Lower Columbia River coho salmon	2/24/16 81 FR 9252	Critical habitat encompasses 10 subbasins in Oregon and Washington containing 55 occupied watersheds, as well as the lower Columbia River and estuary rearing/migration corridor. Most HUC5 watersheds with PBFs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 34 watersheds, medium for 18 watersheds, and low for three watersheds.
Southern DPS of green sturgeon	10/09/09 74 FR 52300	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; tidally influenced areas of the Columbia River estuary from the mouth upstream to river mile 46; 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), including, but not limited to, areas upstream to the head of tide in various streams that drain into the bays, as listed in Table 1 in USDC (2009). The CHRT identified several activities that threaten the PBFs 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).

2.3 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).

Habitat conditions in the action area

The action area has been adversely affected by a broad number of in-water and upland human activities, including habitat losses from all causes (urbanization, roads, diking, etc.), fishing pressure, flood control, irrigation dams, pollution, municipal and industrial water use, introduced species, and hatchery production (NRC 1996, NMFS 2013). The quality and quantity of habitats in many upriver Columbia River basin watersheds have declined dramatically in the last 150 years, together influencing conditions in the action area. These multiple watersheds, like the action area, are characterized by loss of connectivity with floodplains and feeding and resting habitat for juvenile salmonids in the form of low-velocity marshland and tidal channel habitats (Bottom *et al.* 2005). Water quality throughout the action area is degraded by urban, industrial, and agricultural practices across the basin that contributes multiple pollutants at levels above natural conditions. Habitat degradation has generally reduced the quality of this important rearing and migration habitat for sturgeon, salmon and steelhead.

From Westport Slough's downstream confluence with the Columbia River at river mile 43.5, it extends approximately 9.3 miles upstream where is connects to Beaver Slough at Anunde Island. A road crossing and 5-foot diameter concrete culvert act as a control structure between Beaver Slough and Westport Slough. Since the 5-foot culvert is relatively small, the flows in the Westport Slough at the Westport Boat Ramp are largely a function of tidal exchange. All ESA-listed Columbia basin salmon and steelhead in addition to green sturgeon may rear and/or migrate through the action area. Adult salmonids will move upstream and through the action area within minutes. Juvenile salmonids, depending on the species and age of the fish, may spend hours to days within the action area. Juvenile salmonid foraging primarily occurs in waters less than 25 feet deep, with deeper waters and greater flows providing a migration corridor.

The presence of overwater structures in the Lower Columbia Estuary that obscure light penetration are ideal for native and non-native piscine predators alike. Since 1990 the Bonneville Power Administration has funded a sport-reward program that has removed millions of northern pikeminnow from the LCR (Beamesderfer *et al.* 1996; Friesen and Ward 1999; Knutsen and Ward 2011). Other actions such as the depredation and relocation of large colonial nesting waterbird colonies have reduced the numbers of avian predators that prey upon salmonids in the

Columbia River estuary that may improve progress in reaching recovery goals by up to 6 percent (NMFS 2011b).

During the last five years, NMFS has engaged in various Section 7 consultations on Federal projects impacting ESA-listed populations and their habitats in vicinity to the action area, including the effects of actions addressed in programmatic consultations (SLOPES IV; NMFS 2011-05585) with the COE. In general, those actions, similar to the one under consideration in this consultation, affect the environment in ways that have temporary effects in the environment from construction (increased noise and turbidity), and longer terms effects like increasing overwater coverage that can bear on the quality of downstream migration and expose smolts and juvenile out-migrating fish to predation.

All actions processed under the SLOPES IV programmatic consultation also include minimization measures to reduce or avoid both short and long term effects in the environment, including, grated decking to allow light penetration, pile caps to prevent piscivorous bird perching, and square footage maximums. While some adverse effects of actions implemented under SLOPES IV can cause some reduced fitness and survival in a small number of individuals, for every action, the minimization measures reduce the overall contribution to habitat degradation at large. So the overall effects of these actions do contribute to the present environmental baseline and the effects of existing structures (e.g. increased shading, reduction in prey, increased predation, and possible minor migration delays) are considered in this consultation.

***Species use of the action area*:**

Despite degraded habitat conditions, juvenile ESA-listed species migrate through the action area at different rates, depending on species and life history. Numerous early life history strategies of CR salmonids have been lost as a result of past management actions discussed under the environmental baseline (Bottom *et al.* 2005). Today, salmonids expected 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. Salmonids exhibiting this life history include LCR Chinook salmon (spring runs), LCR steelhead, LCR coho salmon, MCR steelhead, SR spring/summer Chinook salmon, UCR Chinook salmon, SR steelhead, SR sockeye, and UCR steelhead. These juvenile fish will 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 Lower Columbia River. 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 within the action area (Hering *et al.* 2010; McNatt *et al.* 2016).

Green sturgeon use the Columbia River estuary for subadult and adult growth, development, and migration. Green sturgeon congregate in coastal waters and estuaries, including non-natal

estuaries. Beamis and Kynard (1997) suggested that green sturgeon move into estuaries of nonnatal rivers to feed. Data from Washington studies indicate that green sturgeon will only be present in estuaries from June until October (Moser and Lindley 2007). Recent fieldwork indicates that green sturgeon generally inhabit specific areas of coastal estuaries near or within deep channels or holes, moving into the upper reaches of the estuary, but rarely into freshwater (WDFW and ODFW 2012). Green sturgeon in these estuaries may move into tidal flats areas, particularly at night, to feed (Dumbauld *et al*. 2008). Green sturgeon will be feeding and migrating in the action area from June to October and will be exposed to the short and long term effects of the proposed action.

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. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b).

Effects of the proposed action, and actions caused by the proposed action, are reasonably certain to include: 1) Acoustic impacts, 2) reduction of water quality, 3) obstruction of the migratory pathway, 4) enhancement of piscivorous predator habitat, 5) reduction in forage, and 6) reduction riparian habitat. The magnitude of these effects will vary temporally, and are discussed in turn below.

2.4.1 Effects on Critical Habitat

Designated critical habitat within the action area for ESA-listed salmon and steelhead considered in this opinion consists of freshwater rearing sites and freshwater migration corridors and their essential physical and biological features (PBFs); these are also called primary constituent elements (PCEs). The primary constituent elements for freshwater rearing include floodplain connectivity, forage, natural cover, water quality, and water quantity. Primary constituent elements for freshwater migration include unobstructed migratory corridor, natural cover, water quality, and water quantity. These PBFs fulfill many functions for migrating salmonids, including allowing them to successfully avoid predators.

PBFs for Green sturgeon in the action area include estuarine areas which provide food resources, migratory corridors, and appropriate water quality, flow and depth to support growth of juvenile, sub-adult, and sexually mature green sturgeon.

1) Acoustic Impacts:
Pressure waves are created by pile driving and transmitted through the water column. These waves are expected to induce behavioral effects and may reach the 183 decibel threshold known to impair and/or kill salmon, if an impact hammer is needed to imbed the piles. This disturbance of aquatic habitat will persist for a maximum of 200 strikes per day during installation of new

piles. When work ceases, sound pressure levels will return to the ambient, baseline level. However, the action area will experience episodes of noise for the life of the project as a result of future recreational boating activity, which is the intended use for this structure.

2) Reduction of Water Quality
Although the amount of impervious surface and stormwater discharge from the proposed project is relatively small, the proposed project will incrementally increase pollutant levels. Despite the use of best available practices, treatment will not capture all stormwater pollutants, meaning that discharges of road-derived contaminants are reasonably certain to occur with precipitation events in perpetuity. The dilution modeling conducted for regulatory compliance does mean that at a certain distance from the discharge point, it becomes impossible to discern the additional level of pollutant from the background level. However, this does not mean that the receiving water bodies or downstream waters are not impaired by this additional source of contaminants, but rather that the effect of the additional load cannot be meaningfully measured within the habitat.

Some level of water quality reduction is also likely from the unintentional release of fuel, oil, and hydraulic fluids from recreational boat use, episodically, over the lifetime of the structure. Releases, while likely to be infrequent, and are reasonably certain to occur over the estimated lifetime of the proposed structure (up to 40 years). We anticipate that the quantity of released hydrocarbons at any given time will be small and that such releases will be diluted quickly, but we cannot predict with certainty the amount or timing of such releases. Because the nature of releases of contaminants associated with boat use is expected to be small, infrequent, and in a location where there is sufficient flow for quick dilution, overall we do not expect the water quality impairments to significantly degrade the water quality PBF, but we do expect occasional episodes of impairment over the life of the project.

3) Obstruction of Migratory Pathway
The placement of the ramp, gangway and docks are in the migratory pathway for both adult and juvenile salmonids. The presence of this structure is likely to cause the fish to swim around the overwater structures, which will slightly lengthen their migratory pathway. Even a small increase in the migration route has the potential to be adverse, as it can increase opportunities for piscivorous predators to prey on juveniles and has been shown to be correlated with juvenile mortality (Anderson et al., 2005). Additionally, when juvenile fish migrate around structures in their migratory pathway, they experience greater energy expenditure and reduced growth at each structure. As a result, the overwater structures are likely to reduce the quality of the migratory corridor PBF to a small degree. This effect to the migratory pathway will persist over the life of the structure, which is expected to be several decades.

4) Enhancement of Piscivorous Predator Habitat
The gangway, dock and piles will create overwater cover, and locally slow velocity, both of which are favorable habitat conditions for piscivorous predators, such as pike minnow, smallmouth bass, and largemouth bass, which occupy the action area (Faler et al., 1988; Isaak and Bjornn, 1996). Pike minnow and smallmouth bass have consistently been shown to use low-velocity habitats (Faler et al., 1988; Isaak and Bjornn, 1996; Tabor et al. 1993; Martinelli and Shively, 1997). In Columbia River reservoirs, their preference for low-velocity microhabitats that are associated with overwater structures places them in the path of nearshore-associated

outmigrating juveniles (Carrasquero, 2001). In McNary reservoir, smallmouth bass also have been found to prefer slow-velocity habitats (Tabor et al., 1993). In his literature review Rondorf et al. (2010) cites further studies with the finding: pikeminnow and smallmouth bass seek out low velocity habitats, prefer cover, and utilize overwater structures including docks. Interpreting these findings and applying them to the proposed action, we are reasonably certain that the proposed replacement will extend the duration that piscivorous predators will use the action area. This anticipated action-related outcome of improving habitat conditions for piscivorous predators, is expected to reduce the quality of critical habitat for two PBFs - juvenile salmonid rearing and outmigration - for the decades-long duration the proposed project will remain in place.

5) Shade/Reduction of Forage
Placement of the docks will cause partial shading under a 3,470 square foot area. Shading from overwater structures likely reduces the abundance of prey organisms for both sturgeon and salmonids and also affects habitat complexity by reducing aquatic vegetation and phytoplankton abundance (Kahler et al. 2000; Carrasquero 2001). Additionally, the ramp and piles will replace part of the benthos, which will no longer support benthic aquatic vegetation, and macroinvertebrates. These anticipated effects will persist as long as the structure remains in place, thus lowering the quantity and quality of the forage PBF of rearing habitat in the action area over several decades.

6) Vegetation Removal
The project will remove 13 trees of varying size and 1.25 acres of riparian vegetation which will impair critical habitat functions in the action area. The tree and riparian vegetation removal is reasonably certain to indirectly reduce aquatic macroinvertebrate salmonid prey (that otherwise would forage on the riparian-derived detritus) and overwater shade (that otherwise would buffer elevated temperatures during summer) and cover from piscivorous birds. The duration of these adverse effects will persist decades or longer, improving incrementally only as tree canopy slowly re-establishes.

Summary of critical habitat effects

The proposed action adds a relatively permanent increment of reduction of water quality and forage conditions for both salmonids and sturgeon their designated critical habitat, and the migratory pathway is also incrementally reduced for salmonids only. The applicant will also remove 32 creosote piles from the action area and an additional 93 remnant piles from the Westport Slough. The removal of the remnant piles will have a beneficial effect on water quality and will reduce the number of ambush points for predators in the slough.

2.4.2 Effects on Species

All species considered in this opinion will be exposed to, and respond to each of the habitat effects described in Section 2.5.1, though at varying duration and with varying response depending on species type, lifestage and age of the individual fish:

1. reduced water quality from the construction of the project, and its future stormwater;

2. increased noise/ sound pressure levels from pile removal and driving, and from future boating activity;
3. reduced forage;
4. added overwater/in water structure;
5. enhanced predation opportunity;
6. reduced riparian vegetation.

Exposure

As described in the environmental baseline, sub-yearling migrant salmonids and green sturgeon are likely to be present in the action area when the effects of construction occur. Individuals from future generations of each species will experience the effects of the presence of the subject infrastructure after construction is complete.

Juvenile salmonids - Constraining in-water work to the time of year when the density of sub-yearlings salmonids will be low will reduce the number of individual animals exposed to the effects of construction, but not avoid it. Thus, a small number of juvenile salmonids will likely be exposed to construction effects.

Adult Salmonids - Peak migratory periods for adult salmonids in the action area vary by species, but adult CR salmonids are reasonably certain to be present in the action area year-round (from passage data at Bonneville Dam 10-year average, http://www.cbr.washington.edu/dart/adult_hrt.html), thus some salmonids are likely to be exposed to the construction effects:

- Chinook salmon most likely occur in the action area from late spring through the fall.
- Coho salmon presence is most likely in late summer through early winter.
- Chum salmon primarily occur during the fall.
- Adult sockeye salmon presence will most likely occur from late spring to late summer.
- Steelhead are present from February to December, though the majority of upstream passage through the LCR occurs during spring and summer.

Sturgeon – Green Sturgeon are present in the Columbia River as sub-adults and adults, and they remain in the Columbia River from May into November. Green sturgeon peak in the LCR estuary during the work window and thus are expected to be present for the entirety of the construction.

Table 3. Presence of ESA-listed fish species in the Lower Columbia River by life stage, NMFS' Northwest Fisheries Science Center, and NMFS' Protected Resources Division (2017). Fish abundance is denoted using a combination of text and shading [no shading (-) = not presence; light shading (P) = presence; medium shading (R) = relatively abundant; dark shading (A) = peak abundance]. The inwater work window is July 15th to September 15th outlined in red.

Species	Life Stage	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Eulachon																									
	Adult	R	R	A	A	A	A	R	R	R	-	-	-	-	-	-	-	-	-	-	-	-	-		R
	Adult spawning[2]	R	R	A	A	A	A	R	R	R	-	-	-	-	-	-	-	-	-	-	-	-	-		R
	Egg incubation[3]	R	R	R	R	R	R	R	R	R	R	-	-	-	-	-	-	-	-	-	-	-	-		R
	Larvae emigration	R	R	R	R	R	R	R	R	R	R	R	-	-	-	-	-	-	-	-	-	-	-	-	-
Green Sturgeon																									
	Juvenile rearing[2]	-	-	-	-	-	-	-	-	P	P	R	R	R	R	R	R	R	R	R	-	-	-	-	-
Chinook Salmon																									
LCR	Adult	-	-	-	-	R	R	R	R	A	A	A	A	A	R	R	R	R	R	R	R	-	-	-	-
	Adult spawning	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Eggs & pre-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Juvenile rearing	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	Juvenile	-	-	-	-	A	A	R	A	A	A	A	A	A	A	A	A	R	R	R	R	R	R	-	-
UCR	Adult	-	-	-	-	-	-	-	-	R	A	A	-	-	-	-	-	-	-	-	-	-	-	-	-
	Adult spawning	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Eggs & pre-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Juvenile rearing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Juvenile	-	-	-	-	A	A	R	A	A	A	A	A	A	A	A	A	R	R	R	R	R	R	-	-
UWR	Adult	-	-	-	-	R	R	R	R	A	A	A	R	-	-	-	-	-	-	-	-	-	-	-	-
	Adult spawning	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Eggs & pre-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Juvenile rearing	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	Juvenile	-	-	R	R	R	R	R	A	A	A	A	R	R	P	P	P	P	P	P	P	P	P	-	-
SR spr/sum	Adult	-	-	-	-	R	R	A	A	A	R	R	R	R	R	R	R	R	R	-	-	-	-	-	-
	Adult spawning	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Eggs & pre-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Juvenile rearing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Juvenile					R	R	R	A	A	A	A	R	R	R	R	P	P	P	P	P	-	-	-	-

Species	Life Stage	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
SR fall	Adult	-	-	-	-	-	-	R	R	A	A	A	A	A	R	R	R	R	R	-	-	-	-	-	-
	Adult spawning	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Eggs & pre-emergence	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Juvenile rearing	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	Juvenile emigration	-	-	R	R	A	A	R	A	A	A	A	A	A	A	A	A	R	R	R	R	R	R	R	R
Chum Salmon																									
CR	Adult	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	A	A	A	A	A	A	A
	Adult spawning	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Eggs & pre-emergence	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Juvenile rearing	R	R	R	R	R	R	R	R	R	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Juvenile emigration[4]	-	-	R	R	R	R	A	A	R	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coho Salmon																									
LCR	Adult	A	A	A	A	-	-	-	-	-	-	R	R	R	R	R	R	R	R	A	A	A	A	A	A
	Adult spawning	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Eggs & pre-emergence	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Juvenile rearing	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	Juvenile emigration	-	-	-	-	R	R	R	A	A	A	A	A	A	R	R	P	P	P	P	P	-	-	-	-
Sockeye Salmon																									
SR	Adult	-	-	-	-	-	-	-	R	R	A	A	R	R	-	-	-	-	-	-	-	-	-	-	-
	Adult spawning	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Eggs & pre-emergence	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Juvenile rearing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Juvenile emigration	-	-	-	-	R	R	R	R	A	A	A	R	R	P	P	P	P	P	P	-	-	-	-	-
Steelhead																									
LCR	Adult	-	-	-	-	-	-	R	A	A	A	A	R	-	-	-	-	-	-	-	-	-	-	-	-
	Adult spawning	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Eggs & pre-emergence	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Juvenile rearing	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	Juvenile emigration	-	-	-	-	p	p	R	A	A	A	A	R	R	P	P	P	P	P	P	P	-	-	-	-
MCR	Adult	-	-	-	-	-	-	R	A	A	A	A	R	-	-	-	-	-	-	-	-	-	-	-	-
	Adult spawning	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Eggs & pre-emergence	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Juvenile rearing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Juvenile emigration	-	-	-	-	P	P	R	A	A	A	A	R	R	P	P	P	P	P	P	P	-	-	-	-
UCR	Adult	-	-	-	-				R	R	A	A	R	R	-	-	-	-	-	-	-	-	-	-	-
	Adult spawning	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Eggs & pre-emergence	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Juvenile rearing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Juvenile emigration	-	-	-	-	P	P	R	A	A	A	A	R	R	P	P	P	P	P	P	P	-	-	-	-

Response to diminished Water Quality

Turbidity/Suspended Sediment - Adult salmonid migration rates range up to a few miles per hour (Matter and Sandford, 2003), therefore we expect adult ESA-listed salmonids that do encounter turbidity plumes created during pile removal and installation to be moving upstream at such a rate as to limit this exposure to a matter of minutes. Adult salmonids typically migrate within the main river channel at depths of 10 to 20 feet below the water surface and off the bottom (Johnson et al. 2005).

The short term effects of elevated levels of suspended sediment and turbidity range from improved survival via reduced piscivorous predation, to physiological stress and reduced growth for rearing juveniles, resulting in reduced survival (Newcombe and Jensen 1996). In general, little sediment is released during vibratory pile installation. Fish near this activity are likely to experience brief, low-level amounts of sediment and exhibit responses (e.g., coughing, gill flaring, and temporary limitation in foraging) characterized as sub-lethal (Newcombe and Jensen 1996). Chronic exposure to turbid water can cause physiological stress responses that increase maintenance energy needs and reduce feeding and growth (Lloyd et al. 1987; Redding et al. 1987; Servizi and Martens 1991). In contrast, limited duration exposure to low intensity turbidity make these responses extremely unlikely.

Juvenile and adult salmonids exposed to elevated turbidity respond similarly, physiologically. Because the action will occur in relatively shallow water used by sub-yearling migrating juvenile salmonids, juveniles are more likely to be exposed in a way that will elicit adverse behavioral responses than yearling migrants and adults. Given the small area, quick dilution of the turbidity and the small number of ESA-listed salmonids likely to be present and exposed to elevated suspended sediment, only a few ESA-listed fish in the action area are likely to experience any of the beneficial or adverse effects caused by suspended solids as described above.

Larger adult salmon readily respond by avoiding waters affected by suspended sediment to find refuge and/or passage conditions within unaffected adjacent areas. Studies show that salmonids are able to detect and distinguish turbidity and other water quality gradients (Bisson and Bilby 1982), and that larger salmonids are more tolerant to suspended sediment than smaller juveniles (Servizi and Martens 1991 and 1992). As salmonids grow and their swimming ability increases, their dependence on shallow nearshore habitat declines rapidly (Groot and Margolis 1991). Thus, to the extent that any adults are exposed to turbidity generated by project activities, they are expected to respond by avoiding excessively turbid conditions and find passage within unaffected adjacent areas. Specifically, we expect these fish to avoid the small turbidity plume created by pile extraction and placement without experiencing adverse effects.

Stormwater - The long term effect on water quality from increased stormwater runoff is expected for the 0.8 miles of the Westport Slough to the confluence with the CR. The pollutant load will be indiscernible from the baseline condition beyond into the Columbia River. Because the discharge will include a complex load of organic and inorganic contaminants, into water bodies that are already affected by contaminants, the incremental addition of even small amounts of these pollutants are a source of potential adverse effects to salmonids and green sturgeon, even

when the "new" source load cannot be distinguished from ambient levels (Hecht et al. 2007; Laetz et al. 2009; Macneale et al. 2010; Sandahl et al. 2007; Spromberg and Meador 2006).

Some contaminants also accumulate in both the prey of and tissues of juvenile salmon where, depending on the level of exposure, they cause a variety of lethal and sublethal effects on salmonids, 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 can 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).

Thus, the contribution of these contaminants from the project, while small, will be an additive increment of detriment in the already degraded aquatic habitat of these species. Thus, the effects of this action on the ESA-listed species considered in this opinion include the presumption of additional exposure to contaminants present in the discharged of stormwater, and synergistic effects as these contaminants interact with other compounds already present in the receiving water bodies.

Response to sound pressure waves

The project will use a vibratory hammer for piling removal and to drive the 19 steel piles that will support the new docks. An impact hammer may be required should hard substrate be encountered during vibratory driving. If an impact hammer is required, the Port will deploy a bubble curtain for sound attenuation during impact hammer driving.

While vibratory driving is not known to cause injury outright, NMFS assumes for a conservative analysis that impact driving will occur. Physical injury to salmonids present during construction and smaller green sturgeon because of in-water impact driving is likely occur with impact driving, despite the use of a bubble curtain, as sound levels will exceed thresholds for injury. The degree to which an individual fish exposed to underwater sound will be affected is dependent on the number of variables such as species of fish, size of the fish, presence of a swim bladder, sound pressure intensity and frequency, shape of the sound wave (rise time), depth of the water around the pile and the bottom substrate composition and texture. High levels of underwater sound have been shown to have negative physiological and neurological effects on a wide variety of vertebrate species (Yelverton et al. 1973; Yelverton and Richmond 1981; Cudahy and Ellison 2002; Hastings and Popper 2005). Risk of injury from underwater noise appears related to the effect of rapid pressure changes, termed barotraumas, especially on gas-filled spaces in the bodies of exposed organisms (Turnpenny et al. 1994). Broadly, the effects of underwater noise on organisms range from no observable effects to immediate death. Over this range of effect, there is no easily identifiable point at which behavioral responses occur or where the effects transition to physical injury or death. The sounds from impact pile driving can injure and/or kill fishes, as well as temporarily stun them or alter their behavior. (Turnpenny et al. 1994; Turnpenny and Newell 1994; Popper 2003; Hastings and Popper 2005).

The applicant provided distance calculations that were made starting with baseline single strike levels of 200 dB peak, 175 dB accumulated sound exposure level (SEL), and 187 dB root mean square (RMS) for a 16-inch steel piling measured at 10 meters (WSDOT 2016), and then applying a 10 dB attenuation and default transmission loss constant of 30 meters, with an estimated 200 pile strikes. The onset of physical injury is expected within 11 meters for fish larger than 2 grams and 15 meters for fish less than 2 grams; behavioral effects may be felt at a distance of 79 meters.

Fish with swim bladders appear to be more susceptible to barotraumas from impulsive sounds (sounds of very short duration with a rapid rise in pressure) because the sounds cause their swim bladders to resonate. When a sound pressure wave strikes a gas-filled space such as the swim bladder, it causes that space to expand and contract. When the amplitude of this vibration is sufficiently high, the pulsing swim bladder can press against, and strain, adjacent organs, such as the liver and kidney. This pneumatic compression causes injury, in the form of ruptured capillaries, internal bleeding, and maceration of highly vascular organs (CalTrans 2002). Sound waves can cause different types of tissue to vibrate at different frequencies, and this differential vibration can tear mesenteries and other sensitive collective tissues (Hastings and Popper 2005). Exposure to high noise levels can also lead to injury through "rectified diffusion," the formation and growth of bubbles in tissues. These bubbles can cause inflammation and cellular damage and block or rupture capillaries, arteries, and veins (Crum and Mao 1996; Vlahakis and Hubmayr 2000; Stroetz et al. 2001). Death from barotrauma and rectified diffusion injuries can be instantaneous or delayed for minutes, hours, or even days after exposure.

Even if fish are not killed, elevated noise levels can cause sublethal injuries that affect the fishes' survival and fitness (Slabbekoom et al. 2010). Similarly, if injury does not occur, noise may modify fish behavior in ways that may make them more susceptible to predation or reduce their ability to detect prey (Slabbekoom et al. 2010). Fish suffering damage to hearing organs may suffer equilibrium problems, and have a reduced ability to detect predators and prey (Turnpenny et al. 1994; Hastings 1996). Exposure to elevated noise levels can cause a temporary shift in hearing sensitivity (referred to as a temporary threshold shift, or TTS), decreasing sensory capability for periods lasting from hours to days (Turnpenny et al. 1994; Hastings 1996).

Thus, salmonids and sturgeon exposed to impact hammer derived sound pressure levels could experience direct injury and death if they occur in close proximity to the pile driving activities; the impact hammer use will be limited to a few strikes, if any, per pile and includes use of a bubble curtain and soft start techniques. The majority of pile driving will be done by vibratory hammer, which can cause sub-lethal effects; however, we anticipate that these fish will not be severely affected. The pile driving will take place 2-4 hours a day over a period of 8-10 days during a window when the lowest numbers of juvenile salmonids, the most susceptible life stage, are present. Due to the majority of work being conducted with a vibratory hammer, the low level of species presence and the use of BMPs, NMFS expects that pile driving will not have a measurable effect at the population level of listed species.

Response to In- and Overwater Structures

Installation of the new gangway, landing and dock will add 3,470 square feet of overwater structure to the action area in the river nearshore. All of the overwater structures will be grated as much as possible while satisfying safety and ADA needs, to enable some light transmission into the water column and to the river bottom. Decreased light transmission reduces benthic productivity, which in turn reduces the availability of certain forage items consumed by rearing and migrating salmonids in the action area, and the benthos occupied by new piles and the ramp will produce no forage at all for the life of the structure.

Loss of benthic production by the addition of shade and fill for the ramp is biologically insignificant in the action area as forage items are otherwise already plentiful there. The effects on benthic forage will persist as long as the structure remains in place. However, due to the relatively small footprint and light penetration the amount of benthic forage reduction caused by the proposed action's reduction in forage is not expected to be biologically meaningful to rearing juvenile salmonids or green sturgeon. Rearing juveniles, therefore, are not expected to experience reduced growth or fitness as a consequence of shade-diminished forage reduction. Adult salmon and steelhead rarely forage while moving upstream (Groot and Margolis 1991). The reduction in invertebrate forage related to shade and loss of habitat will have no appreciable effect on adult salmon and steelhead.

The presence of the structure and its shade can interrupt migration behavior in juvenile salmonids. Because juvenile salmonids have slow visual adjustment in stark light/dark interface, juveniles tend to delay when encountering structures like docks, and then circumnavigate the shaded area rather than migrate through the shadow. This extends their migration and increases energy expenditure, which may slightly reduce the growth or fitness of a few individuals of each cohort for the life of the structure. While the new structure will increase the square footage, NMFS does not expect an increase in juveniles affected on an annual basis due to the use of grating in the new structure and removal of remnant pilings.

Response to Enhanced Piscivorous Predation Habitat

The project will add a net total of 3,470 square feet of new overwater structure in the near shore portion of the action area that modifies nearshore habitat for the life of the structure. Because of the relative permanence of the structure in the action area, migrating juvenile salmonids will encounter the structure for the foreseeable future. As described above, juvenile salmonids that encounter overwater structure typically respond by swimming around it (Kemp et al. 2005). Swimming around will lengthen their migratory pathway. Even minor adjustments to the migration route can be adverse, as it increases energetic expenditure, and their encounter time with predators (Petersen and DeAngelis, 2000). Additionally, as described in more detail below, increased expression of energy can increase vulnerability to piscivorous predators and has been shown to be correlated with juvenile mortality (Anderson et al. 2005). Rearing juveniles also experience diminished habitat condition as the structure and shade reduced forage opportunity and displace the smaller juveniles from shallow rearing areas. Thus, to the extent in-water and overwater structures will modify migratory and rearing habitat for a period of decades, these

structures will reduce the quality of the migratory corridor and the rearing habitat to some degree.

As mentioned above, in addition to the increased expression of energy that can accompany juvenile migration around structures that cross the shoreline into the water, the in-water and overwater structures will create areas of cover that slow water velocity and shade the water column. Both enhance habitat for the piscivorous northern pikeminnow, a known predator of out-migrating ESA listed salmon smolts.

We assume that results from other areas of the Columbia River and laboratory studies provide a reasonable surrogate for the interpretation of predation related effects. In the Columbia River, outmigrating juvenile salmon are a seasonally important part of the diet of piscivorous predators including northern pikeminnow. Historically, pikeminnow accounted for 78 percent of total salmonid losses to piscivorous predation (Rieman et al., 1991). In nearshore areas of the Columbia River, including four sampling sites below Bonneville dam, more than 84 percent of fish consumed by northern pikeminnow were juvenile salmonids, regardless of river reach and season (Zimmerman and Ward, 1999).

To determine the extent to which the proposed action will increase predation opportunity, and predict the extent to which predation will increased under the proposed action, NMFS used published, peer-reviewed and technical reports of field and laboratory studies to create a deterministic model (based on arithmetic relationships) that calculates the number of smolts expected to be consumed in the area the gangway, floating landing and floating dock will occupy in pre and post construction conditions. Pikeminnow predation predictions (expressed as a total number of smolts consumed) were generated using long-term (17 year) average abundance estimates, published, average consumption rates in proximity to the action area, and an exponential decay function which estimates the predation success of pikeminnow under varying light intensities. The conceptual model including equations, supporting material, calculations, and key assumptions are detailed in Appendix A. This analysis only predicts predation by pikeminnow associated with the overwater structure, although we assume similar predatory responses are occurring with other piscivorous predators utilizing the overwater structure including smallmouth and largemouth bass. Thus the model estimates are likely an underestimate of enhanced predation due to the proposed action.

We quantified the additional predation likely to occur from enhanced predator habitat under the structures caused by shading effects. Because the consumption rate of pikeminnow increases with decreasing light intensity (Petersen and Gadomski 1994), we varied the amount of light under the dock utilizing the percentage of light penetrating surface area of the over water structure. The reduction in light reaching the water's surface will affect the amount of light penetration at depth where piscivorous predators and juvenile salmon interact. Lower light intensity conditions increase the consumption rate of pikeminnow (Petersen and Gadomski, 1994), thus we can expect more juveniles to be eaten by pikeminnow using the new overwater structure. This difference in consumption rate (number of juveniles/pikeminnow/day) multiplied out over the juvenile outmigration period is the number of extra juvenile salmon predated due to the enhancement of predatory habitat due to shading. Results of the model are presented in Table 3. Light penetration is the most sensitive variable with respect to estimated predation (See

Appendix A, Table A2), because of this sensitivity, we've presented alternative estimates of predation for the overwater structure in comparison to the proposed action's amount of light penetration in Table 3.

The increased consumption per year of juvenile salmonids due to light penetration scenarios ranges from 2-53 individual fish for the new structure, across all salmonid species.

Additional scenarios which vary density and consumption rates of pikeminnow, in addition to light intensity can be found in Appendix A.

Table 4. Results predicting northern pikeminnow predation associated with the gangway and docks for the proposed action, and alternative scenarios which vary the amount of light penetration. This table includes rounding errors as consumption estimates were rounded to the nearest whole fish. Estimated Juvenile Salmonid Consumption at Pike Minnow Density of 0.38, rounded to nearest whole fish.

Time	**Without proposed structure**	**With Structure at 3470 sq ft; 60% light penetration**	**Structure with Less Light Penetration (10%)**	**Structure with More light Penetration (90%)**	**Consumption difference as proposed**
In One Year	46	57	99	48	+11
Over 40 Year Life of Structure	1846	2276	3970	1933	+430

Adult salmonids, even those returning to spawn after only 1 year in the ocean, are too large to be consumed by piscine predators that may utilize in-water and overwater structures associated with the proposed action. Therefore, we do not expect injury or death among adult fish from this habitat alteration. Adult salmonids tend to be more mid-channel oriented and migrate in deeper waters. Thus, the frequency that adults will encounter the structure and likelihood for adverse effects is low, though not rare. We expect adult salmonids that do encounter the main float and finger pier structure will swim around and/or underneath the structure with little or no variation in migratory pathway. To the extent in-water and overwater structures will modify critical habitat for a period of decades, the presence of in-water and overwater structure will only slightly reduce the quality of the migratory corridor for adult salmonids. Placement of the landing and dock in deeper water, farther from the shoreline, will maintain a migration corridor on either side of the structure.

Response to Episodic Effects from Boating Activity

During consultation, NMFS identified boat use near new proposed structure as an effect of the action. NMFS has found that although boat use is already common in the general vicinity of the new dock, we expect an increased level of boat use is associated with the underlying action of building such docks. This is a specifically reasonable assumption as the purpose of the proposed action is to safely accommodate increasing use of the facility for boating.

As described in the pile driving sections, underwater sound is known to cause physiological stress to fish. Boating activity also causes underwater sound. However, boating sound effects (starting, leaving and returning to the dock) are only expected intermittently for short periods (minutes), primarily during spring and summer when boating typically occurs. Fish that encounter boating noise will likely startle and briefly move away from the area. A study of motorboat noise on damselfish noted an increase in mortality by predation (Simpson et al. 2016). While some fish species have been noted to not respond to outboard engines, others respond with increased stress levels, and sufficient avoidance as to decrease density (Whitfield and Becker, 2014), while others experience reduced forage success (Voellmy et al 2014) either by reducing foraging behavior, or because of less effective foraging behavior. Taken together, it can be assumed that juvenile salmonids are likely to respond to episodes of motor boat noise with a stress and startle reaction that can episodically diminish both predator and prey detection for short periods of time.

In summary, because of the intermittent nature of the disturbance and the ability for fish to recuperate when boating noise occurs, we do not expect this effect to be meaningful to survival in adult or juvenile fish that encounter noise from recreational boating, though growth and fitness among juvenile salmonids could be slightly diminished if they encounter frequent episodes of boat noise during rearing.

Response to Reduced Riparian Shoreline

The removal of riparian vegetation will decrease shade and therefore may slightly elevate nearshore water temperatures, and in some cases to such an extent that the warmer water is not optimal for rearing juveniles. Other effects related to reduced riparian vegetation include: Removal of riparian tree cover reduces sources and abundances of prey including detrital insects (Kondolf *et al.* 1996, Naiman *et al.* 1993); the armor associated with the ramp impairs prey types found in soils and sediments (Schmetterling *et al* 2001); these conditions decrease the amount of food, and consequently competition may increase among the rearing fish. Because the project includes riparian plantings at the location, the amount of impact caused by the removal will reduce over a period of years as the plantings become mature.

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.

The action area for this project is the Westport Slough where noise spreading from recreational boating is expected to occur. In contrast, NMFS is unaware of specific, future non-Federal actions reasonably certain to occur in the action area. However, the action area is reasonably certain to continue to experience the influence of the on-going and future activities that will be caused by anthropogenic growth and development. NMFS considers human population growth and associated development to be one of the main drivers for future negative effects on ESA

listed species and their habitat. While non-federal parties are also developing and implementing restoration projects and best management practices for development and resource extraction, these are ameliorating rather than offsetting impacts of development, and even when contemporaneous, are mitigation and restoration benefits are outpaced by the development impacts.

The collective effects of these future non-federal activities will 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. 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, particularly when effects of climate change are also considered. Because the life of the structure is anticipated to be approximately 40 years, we expect that the effects of climate change will become more pronounced over this period. Likely effects will be greater variability in the volume of water in the action area due to the increasing intensity of storm events and the increasing frequency of drought as precipitation patterns shift, and an increasingly warm temperature regime. Snowmelt dominated systems of the Columbia River Basin are expected to change extensively in the timing and extent of flow. Because the lower Columbia River is influenced by ocean tides, salinity and acidity could also shift. Each of these effects is likely to alter food webs and ecosystems that salmonids are adapted to.

As a result, recovery of aquatic habitat is likely to be slow in most areas, and 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.

Considering the status of the ESA-listed species, all but two of the species considered in this opinion are listed as threatened, and two, UCR spring Chinook salmon and SR sockeye salmon, are listed as endangered. Most of the component populations of LCR Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer run Chinook salmon, SR fall-run Chinook salmon, chum salmon, LCR coho salmon, SR sockeye salmon, LCR steelhead, MCR steelhead, UCR steelhead, SRB steelhead, and green sturgeon are at a low level of persistence. All

individuals from populations of the listed species are likely to move through the action area at some point during their life history.

Factoring the current environmental baseline, fish from the affected populations that move through the action area encounter habitat conditions that have been degraded by restricted natural flows, reduced water quality, loss of functioning floodplains and secondary channels, and loss of vegetated riparian areas and associated shoreline cover. The significance of the degradation is reflected in the limiting factors identified above including habitat 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 current functioning habitat and limiting water quality degradation, minimizing entrainment, and reducing potential predation of ESA-listed fish.

Within this context, the construction of the proposed action will create a brief physical disturbance in the water column will create noise and turbidity, as well as the relatively permanent placement of in-water and overwater structure that will modify fish migration and provide habitat for piscine predators, and reduce the production of benthic food items. The modified in-water structure and its disruption of rearing and migration values, including enhanced predator habitat, will persist for many decades. These habitat alterations will displace a small number of adult and juvenile fish as they migrate around the structures. A relatively large number of juvenile fish migrating near the structure may be consumed by piscine predators using the piles, gangway and docks as refugia and foraging habitat. Rearing conditions are slightly impaired by the structure, but fish may contemporaneously benefit slightly from improvements in habitat associated with the pile removal.

The last element in the integration of effects includes a consideration of the cumulative effects anticipated in the action area. Primarily, the 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 negative impact on habitat conditions, which in turn may cause negative pressure on population abundance trends in the future. Moreover, when we consider the design life of the structure (roughly 40 years), we anticipate that the effects of climate change will continue to impair habitat conditions in the action area, most notably, water temperature, and dissolved oxygen.

However, even when we consider the current status of the threatened and endangered fish populations and degraded environmental baseline within the action area, even when considered over the life of the project, together with the effects of the indirect activity, the effects of the proposed action on the abundance of fish[1] is insufficient by itself to affect the distribution, diversity, or productivity of any of the component populations of the ESA-listed species at a measurable level, nor further degrade baseline conditions or limiting factors to a degree that discernibly affects the conservation value of the action area. The effects of the action will be too minor to have a measurable impact on the affected populations because no particular population is expected to experience a greater proportion of the negative effects on abundance. Because the

[1] Based on the analysis in section 2.4.2 of the opinion, NMFS conservatively estimated the maximum number of juvenile salmonids of all listed ESUs that would likely experience predation by pikeminnows for the decades that over water structure will remain in place. Increased action-related piscivorous predation would occur as a result of predatory fish using the structure as ambush cover, and shading effects that increase the predatory efficiency of pikeminnows.

proposed action will not reduce the abundance, productivity, spatial structure, or diversity of the affected populations, the action, when combined with a degraded environmental baseline and additional pressure from cumulative effects, will not appreciably affect any of the listed species considered in this opinion.

In the context of the status of critical habitat and the specific baseline conditions of PBFs in the action area, the proposed action will add a slight obstruction to the migratory corridor, temporarily reduce water quality, and reduce some benthic forage, it will slightly reduce cover, and alter water temperature due to reduced riparian vegetation. When considering the cumulative effects of non-federal actions, recovery of aquatic habitat is likely to be slow in most of the action area and cumulative effects from basin-wide activities are likely to have a neutral to negative impact on the quality of critical habitat PBFs and the watershed scale.

As a whole, the critical habitat for migration and rearing is functioning moderately under the current environmental baseline in the action area. Given that the proposed action will have a highly-localized, low-level effect on the PBFs for migration, rearing, even when considered as an addition to the environmental baseline conditions, the proposed action is not likely to reduce the quality or conservation value of critical habitat for the any species considered in this consultation.

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, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of or destroy or adversely modify designated critical habitat of any of the ESA-listed species considered in this opinion.

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). "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 in the form of harm is reasonably certain from impact hammer use, water quality reductions, and the addition of overwater structure enhancing habitat and opportunity for piscivorous fish that feed on juvenile salmonids. Based on our current understanding of effects of these structures, and site specific conditions, despite the determined estimate of annual take for the purposes of the jeopardy analysis it is not feasible to monitor and document the actual number of juvenile salmonids (and from which populations they represent) that will be predated by piscivorous fishes occupying the area annually, nor over the decades the structure is anticipated to remain in place. In such circumstance, we provide an "extent of take" which documents in an observable manner an area in which take is expected to occur consequential to the habitat effects of the proposed action. In this case, the extent of take is harm associated with the installation, presence, and use of in-water and overwater structure.

Take in the form of harm associated with the installation and use of the parking lot and in-and overwater structure will occur from:

- Sound, within one half mile upstream and 0.8 miles downstream of the Westport Slough, during installation of the piles, and for the life of the structure through normal boating activity.
- Water quality reductions from stormwater associated with the footprint of the new, impervious surface and boat ramp, 1.81 acres.
- Reduced salmonid prey and elevated temperatures from removal of riparian vegetation.

Take in the form of harm associated with the presence of the overwater structure, piles and boat ramp, for a duration of 40 years of will occur from:

- Installation of 19 steel piles
- Increase of 3,470 square feet of overwater cover

The take represented by this estimate is equivalent to the maximum amount of take considered in our jeopardy analysis. Therefore, if exceeded, reinitiation of consultation will be required. This surrogate will function as an effective reinitiation trigger because, unlike the actual number of salmon lost to predation and sound, the structure can be measured.

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 COE and/or its applicant shall:

1. Minimize take from pile installation;
2. Minimize take from piscine predation;
3. Minimize take from impacts to features of migratory and rearing habitat; and
4. Ensure completion of a reporting form to confirm that the take exemption for the proposed action is not exceeded, and that the terms and conditions in this incidental take statement are effective in minimizing incidental take.

2.8.4 Terms and Conditions

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

1. To minimize take from pile installation:
    a. If an impact hammer is needed to embed piles:
        i. Conduct pile driving during daylight hours to avoid peak movement of salmonids;
        ii. Allow a minimum rest period of 12 hours between daily pile driving activities during which no impact pile driving occurs.

2. To minimize take from piscine predation, and impacts to migratory and rearing habitat, the COE shall:
    a. Confirm that the finished design does not exceed the following dimensions:
        i. The project installs only 19 piles associated with the structures;
        ii. The increase in overwater cover does not exceed 3470 square feet;
        iii. Uses the maximum amount of grating while remaining ADA compliant.

3. To minimize take from impacts to features of rearing and migration habitat, ensure that the disturbed riparian area is replanted with native tree species and that these are watered and checked for survival for a period of 5 years. Replacement of failed plantings is required.

4. To provide a completion report within 60 days of the close of any work window, that includes:
    a. A discussion of implementation of the terms and conditions in #1, and #2 above.
    b. Any exceedance of take covered by this opinion.
    Submit monitoring reports to:

National Marine Fisheries Service
Attn:WCRO-2019-01083
510 Desmond Drive SE, Suite 103
Lacey, WA 98503
or electronically to: chad.baumler@noaa.gov

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).

NMFS would like to include the following discretionary recommendations within this biological opinion which support Section 7(a)(1) of the ESA, which identify and implement habitat enhancement or restoration activities within the Westport Slough:

1. Increase the amount of productive shallow-water habitat to benefit ESA-listed species;
2. Restore, or create off-channel habitat or access to off-channel habitat, side channels; alcoves, wetlands, and floodplains;
3. Protect and restore riparian areas to improve water quality;
4. Improve or regrade and revegetate degraded streambanks;
5. Restore instream habitat complexity;
6. Remove invasive plant species from riparian, and upland vegetation communities, and replant with native species.

Please notify NMFS if the COE carries out any of the previously described recommendations so that we will be kept informed of the actions that are intended to improve the conservation and recovery of ESA-listed species and/or their designated critical habitats.

2.10 Not Likely to Adversely Affect Determinations

Eulachon (*Thaleichthys pacificus*)
Adult eulachon may migrate in the action area from mid-January through May which is outside of the proposed work window. Eggs hatch in 20 to 40 days and larval eulachon are carried downstream within a few days from February through June. The action area is not designated critical habitat for eulachon. The timing of the work (July 15 to September 15) avoids both adult and larval migration windows. As the likelihood of exposure to the adverse effects is extremely low, the project's effects on eulachon are discountable.

2.11 Reinitiation of Consultation

This concludes the ESA consultation for Westport Dock (NWP-2019-93).

As 50 CFR 402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat that was not considered in this 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. The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

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

3.1 Essential Fish Habitat Affected by the Project

The proposed action and action area for this consultation are described in the Introduction to this document. The action area includes areas designated as EFH for various life-history stages of Chinook and coho salmon as identified in the Fishery Management Plan for Pacific coast salmon (PFMC 2014).

3.2 Adverse Effects on Essential Fish Habitat

Based on information provided by the COE and the analysis of effects presented in the ESA portion of this document, NMFS concludes that proposed action will have adverse effects on EFH designated for Chinook and coho salmon. These effects include a reduction in water quality from stormwater contaminants, as well as acoustic impacts from pile installation and removal, shading impacts from the new overwater structure, and a short-term loss of benthic invertebrates due to sediment disturbance, and reduced riparian vegetation for a period of years. These effects are described in more detail in Section 2 of this document, above.

3.3 Essential Fish Habitat Conservation Recommendations

1. To minimize acoustic effects of pile installation on habitat:
    a. If an impact hammer is needed to embed piles:
        i. Allow a minimum rest period of 12 hours between daily pile driving activities during which no impact pile driving occurs.

2. To minimize impacts to migratory and rearing habitat:
    a. Ensure that the finished design does not exceed the following dimensions:
        i. The project installs only 19 piles associated with the structures
        ii. The increase in overwater cover does not exceed 3470 square feet
        iii. The amount of fill does not exceed 2163 cubic yards.
        iv. Uses the maximum amount of grating while remaining ADA compliant.
    b. Ensure that riparian plantings are of native tree species, and that 5 years of watering and monitoring occur to guarantee survival. Failed plantings must be replaced.

3.4 Statutory Response Requirement

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

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

3.5 Supplemental Consultation

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

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the COE. Other interested users could include the Clatsop County. Individual copies of this opinion were provided to the COE. The format and naming adheres to conventional standards for style.

4.2 Integrity

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

4.3 Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

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APPENDIX A

Background

As we did not find literature reporting on predation effects associated with docks within the Lower Columbia River, we assume that empirical predation results from other areas of the Columbia River and laboratory studies provide a reasonable surrogate for the interpretation of predation related effects. In the Columbia River, out-migrating juvenile salmon are a seasonally important part of the diet of piscivorous predators including northern pikeminnow and smallmouth bass. Historically, pikeminnow accounted for approximately 78 percent of total salmonid losses to piscivorous predation in the Columbia River (Rieman *et al.*, 1991). In nearshore areas of the Columbia River, including four sampling sites below Bonneville dam, more than 84 percent of fish consumed by pikeminnow were juvenile salmonids, regardless of river reach and season (Zimmerman and Ward, 1999).

We utilized published peer-reviewed and technical reports of field and laboratory studies to predict likely predation of ESA-listed salmonid smolts, with and without the new, proposed structures. Pikeminnow predation predictions (expressed as a total number of juveniles consumed from April-August) were generated using calculated average abundances over a 17 year duration (Williams *et al.* 2018), calculated consumption rates based upon published consumption indexes in proximity to the action area (reported as an average [Friesen and Ward, 1999, Appendix, Williams *et al.* 2018]), and an exponential decay function published by Petersen and Gadomski (1994) which predicts the predation success of pikeminnow under varying light intensities. Key assumptions are presented in Table A1 and the conceptual model including equations, supporting material, and calculations are described below.

Table A1. Assumptions of the predation model, identifying which variable is influenced by the assumption.

Assumption	Variable(s) Influenced
1. Habitat is uniformly occupied by northern pikeminnow, and not limited by water velocity	Density
2. Pikeminnow age classes are randomly dispersed	Density, Consumption
3. Pikeminnow consumption is equal across habitats and age classes	Consumption
4. Prey (juvenile salmon smolts) are equally available to all predators	Consumption
5. Turbidity is constant throughout the outmigration	Light Intensity
6. Water stage height is constant throughout the outmigration	Light Intensity
7. Dock shading effects are only realized on sunny days	Light Intensity
8. Structures with no light penetration are assumed to have 1 percent light penetration	Light Intensity

Northern Pikeminnow Abundance Estimate

Published abundance estimates for pikeminnow within the Columbia River are outdated, and were estimated prior to the implementation of the pikeminnow sport fishery reward program (Beamesderfer *et al.*, 1996, Zimmerman and Ward, 1999). The purpose of this reward program is to remove pikeminnows in size classes known to predate juvenile salmoinds (>200mm; TL), during juvenile salmon outmigration. Removal of pikeminnows increases the outmigration survival probability of juvenile salmonids. Using exploitation data published by the pikeminnow

reward program (Annual Reports from 2000-2017; http://www.pikeminnow.org/project-reports-2/annual-reports), it was possible to estimate an average abundance of pikeminnow occupying Columbia River below Bonneville Dam from 2000-2017 ($\bar{x}$ = 586,278, sd= 197,141, range 305,034-997,869), using the following equation:

$$\frac{[\sum_{i}^{2017} NH_i/ER_i]}{2017 - i}$$

Where:

NH= number of pikeminnows harvested Below Bonneville Dam in year i
ER= exploitation rate (expressed as a decimal percent) of pikeminnow in year i

Northern Pikeminnow Habitat Availability and Density

The 17 year average abundance estimate (calculated above) was used to calculate a density of northern pikeminnow (pikeminnow/square meter), occupying the shallow water habitats of the Columbia River below Bonneville Dam. For this analysis shallow shoreline habitats were defined as aquatic habitat with depths ranging from 0.5 - 13m, as pike minnows are rarely found in depths outside that range (Ward *et al*. 1995). Pikeminnow density was utilized within this effects analysis to estimate how many pikeminnows would associate with the shaded area under the proposed dock. Spatial analysis techniques were utilized within ArcGIS (Version 10.5.1; ESRI 2011), to calculate the total amount of aquatic habitat with depths ranging from 0.5-13m. The Lower Columbia Digital Terrain Model was acquired from the Lower Columbia Estuary Partnership (estuarypartnership.org), this bathymetric model of the lower Columbia River, is the best available depth profile, incorporating NOAA acoustic multi-beam sonar, bathymetric surveys from 2008-2009, US Army Corps of Engineers crossline and channel bathymetric surveys from 2000-2009, and topographical LiDAR surveys from 2009-2010, and Lower Columbia Estuary Partnership shallow water bathymetric surveys from 2009-2010. This raster dataset is high resolution with $1m^2$ grid cells. Preferred pikeminnow depths (0.5-13m) were extracted from the bathymetric dataset to determine that $153,442,900m^2$ of available pikeminnow habitat is below the Bonneville Dam, which results in a density of 0.0038 pikeminnow per square meter of habitat

Pikeminnow Consumption Index and Light Intensity Related Consumption

To estimate the average number of juvenile salmonids that could be consumed by pikeminnow we used recently published consumption index values (Williams *et al.* 2018) to calculate a mean consumption index (1.152) of northern pikeminnow in closest proximity to the action area, as consumption rates can vary by location (Zimmerman and Ward, 1999). To convert the mean consumption index to a consumption rate related to this project we used the relationship: consumption = -0.077+0.618 * Consumption Index [CI] (Friesen and Ward, 1999, Appendix). Thus, we calculated the consumption rate (CR) of 0.6349 juvenile salmon per pikeminnow per day across the April-August outmigration period.

Predation is, in part, regulated by light intensity, as foraging in aquatic habitats often involves light-mediated mechanisms whereby fish are able to identify and respond appropriately to prey and predator encounters. Petersen and Gadomski (1994) found the rate of predation by northern pikeminnow on subyearling Chinook salmon was inversely related to light intensity in laboratory studies, and five times more salmon were eaten in the darker than in the lighter conditions. Results of the model presented by Petersen and Gadomski (1994) were expressed as an exponential decay function predicting the number of juvenile salmon eaten over 4 hours under varying light intensity by northern pikeminnow. The exponential decay function published by Petersen and Gadomski is as follows and can be viewed graphically in Figure A3:

$$PE = 0.144 * e^{-0.61*\ln(LI)}$$

Where:
PE = prey eaten
LI = light intensity

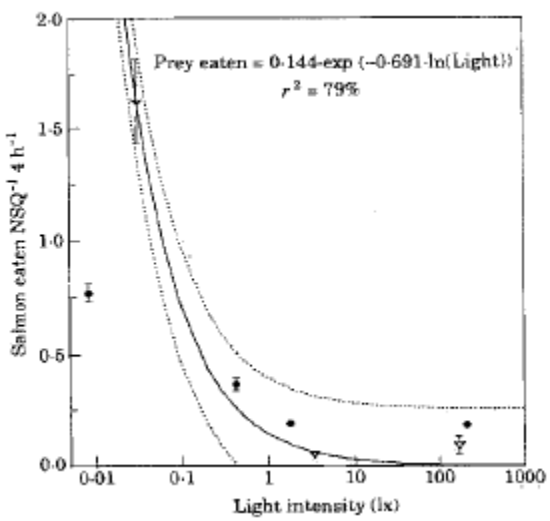

Figure A3. Exponential decay function from Petersen and Gadomski (1994)

Using the exponential decay function described above, the model input of LI, was varied by calculating the reduction in light intensity under the proposed dock when compared to the same area with no dock. By varying LI it was possible to calculate the difference in juvenile salmon predation success with and without the proposed structures. This difference was transformed to reflect consumption by pikeminnow over 24 hours as the decay function was calculated for 4 hour predation windows, the transformed consumption was then added to the consumption rate of pikeminnow within the action area. Reduction in light intensity due to shading under the dock was calculated using a standard light annulation in water equation expressed below:

$$I_z = I_0 e^{-(K_w + K_p)^z}$$

Where:

I_z = Light intensity at depth z

I_o = Light intensity at surface
K_w= Light extinction do to water scatter
K_p= Light extinction due to dissolved particles (e.g. turbidity)

To calculate the difference with and without the proposed structures we varied I_o in the above equation, while keeping all other variables constant. To do so we assumed that the light intensity at the water surface under the dock would be a function of the amount of sunlight able to penetrate the docks surface. If the proposed dock is to be constructed of 60 percent light penetrating materials, thus the light intensity at the surface under the dock would be 60 percent of that at base line, thus a 40 percent reduction in light intensity. Using the calculated light intensity values at depth with and without the proposed structure, as the LI variable within the exponential decay function described above we could determine the difference in predated juvenile salmon between conditions.

We assumed that reduced light intensity will only be significant on sunny days, and shading effects would be negligible on cloudy days. Historical NOAA climate data from the last 30 years (http://w2.weather.gov/climate/xmacis.php?wfo=pqr) from Portland, Oregon located 10 river miles downstream of the action area reports and average of 1,417 sun hours during the months of April-August. Dividing the total number of sun hours by 24 hours we calculated the number of "sun days" (59), likely to occur within the action area during juvenile salmon outmigration, which would be equivalent to the number of days the shading effects of the dock will increase the predation efficiency of pikeminnow.

Finally, to calculate the difference in predation by pike minnow under the proposed structure due to shading the following equation was used:

$$PI_i = D(CR + LIP_i) * SD - (D * CR) * SD$$

Where:
PI_i = Predation increase under structure i
CR= Pikeminnow consumption rate
LIP_i = Light related increased predation under structure i
D= Density of pikeminnow associated with area of structure
SD= Sun days

Density and consumption rates were consistent on both sides of the equation, as predation of juvenile salmon was assumed to occur in the action area regardless of the structure being present or not. However, the reduced light intensity increase in consumption rate was added to the consumption rate of pikeminnow to estimate the additional number of smolts predated by pikeminnow due to better foraging conditions created by the shading of the dock. Assuming the structure has a life of 40 years, a total amount of increased predation can be calculated.

Finally to highlight the sensitivity of the variables utilized to estimate predation losses. We varied one or a combination of density, consumption, and light intensity to identify which variable was the most sensitive resulting in greater predation losses. As shown in Table A2 light intensity is the most sensitive followed by density, consumption is the least sensitive.

Table A2. Predation differences highlighting variable sensitivity of density, consumption rate, and light intensity values. All were calculated for a 1000 sq/ft structure in 3meters of water with a constant turbidity value of 1.2 NTU. Mean values for density and consumption are calculated means presented above.

Scenario	Density	Consumption	Light Intensity	Structure Present		Difference
				No	Yes	
Mean	0.004	0.635	0.5	13	18	5
Density Low	0.002	0.635	0.5	7	9	2
Density High	0.008	0.635	0.5	26	35	9
Consumption Low	0.004	0.317	0.5	7	11	4
Consumption High	0.004	1.270	0.5	27	31	4
Light Intensity Reduction Low	0.004	0.635	0.9	13	14	1
Light Intensity Reduction High	0.004	0.635	0.1	13	29	16
All Low	0.002	0.317	0.9	3	4	1
All High	0.008	1.270	0.1	53	83	30

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