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

Refer to NMFS No:
WCRO-2020-00810

October 6, 2020

DOI: 10.25923/wae5-5a07

William D. Abadie
Regulatory Branch Chief, Portland District
U.S. Army Corps of Engineers
Attention: CENWP-OD-G
P.O. Box 2946
Portland, Oregon 97208-2946

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Wild Fish Conservancy Brownsmead Pound Net Project, 5th field HUC 1708000309.

Dear Mr. Abadie:

Thank you for coordination regarding initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the Wild Fish Conservancy Brownsmead Pound Net Project. 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 NMFS also reviewed the likely effects of the proposed action on essential fish habitat (EFH), pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)), and concluded that the action would adversely affect the EFH of Pacific Coast salmon. Therefore, we have included the results of that review in Section 3 of this document.

The NMFS concluded that the proposed action is likely to adversely affect 13 ESA-listed salmonids and their critical habitat: the Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tschawtscha*), Upper Columbia River (UCR) spring-run Chinook salmon, Upper Willamette River (UWR) spring-run Chinook salmon, Snake River (SR) spring/summer run Chinook salmon, SR fall-run Chinook salmon, Columbia River (CR) chum salmon (*O. keta),* LCR coho salmon (*O. kisutch*), SR sockeye salmon (*O. nerka*), LCR steelhead (*O. mykiss*), Middle Columbia River steelhead, UCR steelhead, UWR steelhead, and Snake River Basin (SRB) steelhead.

The NMFS also concluded that the proposed action is not likely to adversely affect the southern distinct population segment (DPS) of green sturgeon (*Acipenser medirostris*), the southern DPS of eulachon (*Thaleichthys pacificus*), and the Southern Resident killer whale (*Orcinus orca*) and their critical habitats. The proposed action will not jeopardize any species or destroy or adversely modify any critical habitats.

Please contact Amy Kocourek at the Washington Coast Lower Columbia Branch in Lacey, Washington at 360-753-4471 or amy.kocourek@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: Kurt Beardslee, Wild Fish Conservancy
Brad A. Johnson, U.S. Army Corps of Engineers
Adrian Tuohy, Wild Fish Conservancy

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

Wild Fish Conservancy Brownsmead Pound Net Project

NMFS Consultation Number: WCRO-2020-00810

Action Agencies: U.S. Army Corps of Engineers
National Marine Fisheries Service

Affected Species and Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tschawtscha*)	Threatened	Yes	No	Yes	No
Upper Columbia River (UCR) spring-run Chinook salmon	Endangered	Yes	No	Yes	No
Upper Willamette River (UWR) Spring-run Chinook salmon	Threatened	Yes	No	Yes	No
Snake River (SR) spring/summer run Chinook salmon	Threatened	Yes	No	Yes	No
SR fall-run Chinook salmon	Threatened	Yes	No	Yes	No
Columbia River (CR) chum salmon (*O. keta*)	Threatened	Yes	No	Yes	No
LCR coho salmon (*O. kisutch*)	Threatened	Yes	No	Yes	No
SR sockeye salmon (*O. nerka*)	Endangered	Yes	No	Yes	No
LCR steelhead (*O. mykiss*)	Threatened	Yes	No	Yes	No
Middle Columbia River steelhead	Threatened	Yes	No	Yes	No
UCR steelhead	Threatened	Yes	No	Yes	No
UWR steelhead	Threatened	Yes	No	Yes	No
Snake River Basin (SRB) steelhead	Threatened	Yes	No	Yes	No
Southern DPS (sDPS) of green sturgeon (*Acipenser medirostris*)	Threatened	No*	No	No	No
Southern DPS (sDPS) of Pacific eulachon (*Thaleichthys pacificus*)	Threatened	No*	No	No	No
Southern Resident killer whale (*Orcinus orca*)	Endangered	No*	No	No	No

*Please refer to Section 2.12 for the analysis of species or critical habitat that are not likely to be adversely affected.

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

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

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: October 6, 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. This project entails construction and operation of a commercial pound net funded in part through a federal grant awarded by the National Marine Fisheries Service (NMFS). The purpose of this project is to conduct research on the viability of the trap for selective harvest of hatchery reared Chinook and coho salmon stocks while reducing bycatch mortality of Endangered Species Act (ESA) federally listed species. The project includes a spring (approximately April 1- May 31) and late summer/ fall (approximately August 15- October 31) period of trap operation for research purposes.

1.1 Background

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

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

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

1.2 Consultation History

In June 2019, NMFS awarded a Sustainable Fisheries Division Bycatch Reduction Engineering Program (BREP) grant to the Wild Fish Conservancy for their research proposal "Wild Fish Conservancy: Evaluation of an Experimental Commercial Pound Net for Stock-Selective Harvest and Ecological Monitoring in the Lower Columbia River, OR," (Appendix A). Per the program requirements, obtaining required permits is the responsibility of the recipient. The grant is obligated to the recipient (the Wild Fish Conservancy) and held until necessary environmental permits are obtained. (Derek Orner, BREP coordinator, pers. Comm September 17, 2020). The Wild Fish Conservancy is an applicant for USACE and other environmental permitting.

Awarding the grant created a federal nexus for intra-agency consultation. In addition, the underlying work requires U.S. Army Corps of Engineers (USACE) permitting creating another nexus for consultation. Finally, the granting action is an action that might adversely affect species listed by the U.S. Fish and Wildlife Service (USFWS), creating a nexus for consultation with the USFWS. The NMFS and USFWS completed consultation on May 7, 2020 with both agencies concurring the action may affect those species but was not likely adversely affect them.

As both NMFS and USACE are action agencies, roles and responsibilities were discussed with USACE. NMFS is the lead federal action agency by virtue of the funding provided through the BREP program.

Finally, to complete the intra-agency consultation recorded in this opinion, the consulting biologists collaborated with Divisional and Regional colleagues to prepare the opinion. The Oregon Washington Coastal Office analyzed impacts of the proposed project's construction and the Sustainable Fisheries Division analyzed impacts of the proposed project's operation. Results of both division's efforts are presented in this biological opinion. Information sources and documents upon which NMFS based its determinations included the Wild Fish Conservancy's project narrative received as part of their application for the Bycatch Reduction Engineering Program, the Wild Fish Conservancy's application for authorization and permits for protected species (APPS), and additional background information received from the Wild Fish Conservancy. The Wild Fish Conservancy, which is an applicant, provided NMFS with additional information necessary to initiate consultation. Clarification and confirmation on measures relating to temperature, potential for changes to fish handling pending unusually low return numbers of fish stocks, and the removal or containment of trash from the project site, clarification on gear configuration and gear inspections received July 1, 2020 by email, and clarification on planned dates of research, dimensions of pound net components, monitoring protocols at the project site, and observations of marine mammal depredation received by email on July 2, 2020.

1.3 Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). NMFS proposes to fund (in part) a research project proposed by the Wild Fish Conservancy through a BREP Grant. The underlying project entails the construction and short-term operation of a pound net for selective harvest and ecological monitoring of salmonids in the lower Columbia River (LCR). Objectives of this project are to: 1) construct and monitor the performance of a new pound net trap in a currently untested location within the lower Columbia River, OR; and 2) determine the effectiveness of the trap in targeting hatchery reared Chinook and coho salmon stocks while reducing ESA-bycatch mortality. Additional details are provided in the research proposal (Appendix A). The intent of this action is harvest non-listed fish; any take of listed fish is incidental to the purpose of the action.

Wild Fish Conservancy will install the pound net on the Oregon side of the Columbia River in the Clifton Channel. Untreated wood pilings to support the pound net will be installed during the in-water work window and left in place following completion of the project. Pilings will remain until they naturally biodegrade. Trap operation will take place during the following year and not be reoccurring. The project proposal indicates a desired timeline of winter 2020-2021 trap construction followed by trap operation during 2021

Under the MSA, Federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).]

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would cause increased awareness of and interest in pound net gear use in the lower Columbia River and elsewhere. This increased awareness would not occur but for the proposed action and is reasonably certain to occur as the proposed action has already generated public interest and been the focus of media attention. Future pound nets, if any, would require consultation.

1.3.1 Project Location

The project site is located along the Oregon side of the lower Columbia River (LCR) near the community of Brownsmead in Clatsop County, Oregon within the Clifton Channel (Figure 1). It is at approximately river mile 35 and is southwest of Tenasillahe Island, which is part of the USFWS Julia Butler Hansen National Wildlife Refuge. It is approximately a half mile downstream of the old Clifton cannery and fifty feet offshore from the old Burlington Northern and Santa Fe rail line. The site is in section 31, township 9 North, range 6 West. Coordinates for the project site are 46.2195 degrees and -123.475657 degrees. The project site is the area where the pound net will be installed and operated.

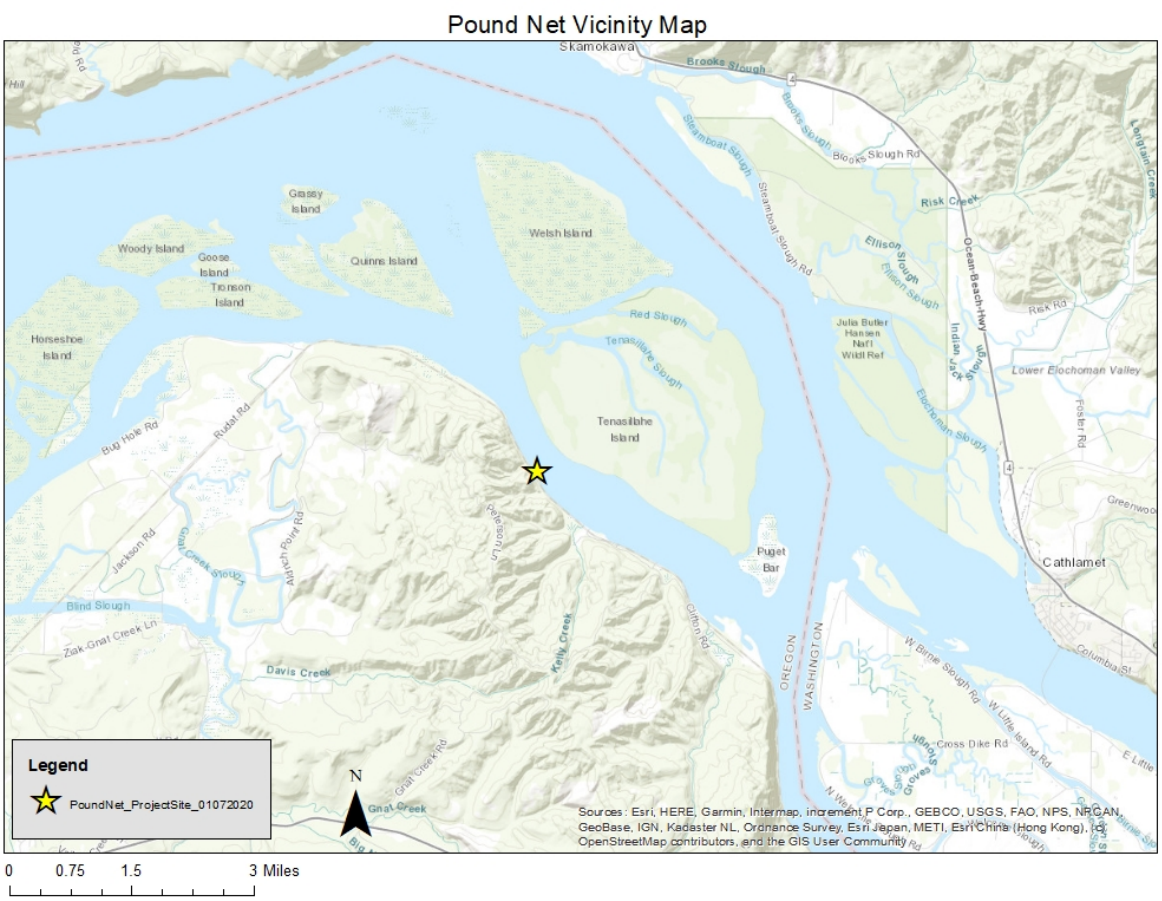

Figure 1. Vicinity map of project area.

1.3.2 Project Description

The underlying research project consists of the construction of a pound net and its subsequent operation. The pound net will be supported by a series of piles driven into the substrate of the river. Forty-six, 14-inch diameter untreated wood piles will be installed via a vibratory hammer operated by barge. Piles will be brought to the site via barge and the pile driving equipment will be operated from the barge. Pile driving will take place during November or December 2020 and is anticipated to take about three days. Should pile driving be temporarily interrupted due to bad weather or other reasons, it is anticipated that the pile driving would still be completed in about a week. Pile driving will take place during daylight hours and within the in-water work window (November 1- February 28th) for this portion of the Columbia River. The work window for this location reflects the need to reduce overall exposure of individual fish to the effects of in-water work.

The inside piling will be driven approximately fifty feet in from the mean low water line on the Oregon bank of the LCR. Piles will be driven approximately sixteen feet apart in a line perpendicular from shore. This portion of the trap is called the lead. The lead will be approximately 295 feet (90 meters) in length, leading to a series of piles driven in a modified horseshoe shape to form the heart of the trap. Nets and hardware will be attached to the piles. Black nylon mesh with a stretch of 3 1/8-inch will be applied to the lead and jigger pilings. The heart, spiller, and tunnel will be constructed with 2 ½-inch knotless nylon mesh. Nets will form the compartments, which, when the trap is in operation, will enable the passive corralling of fish for research and monitoring. A diagram of the proposed trap design as well as photographs showing the Wild Fish Conservancy's pound net in the Cathlamet channel are provided in Appendix B. The proposed project would create a similar trap, with minor modifications to allow fish entry from both the upstream and downstream side.

The heart of the trap will be comprised of a series of piles extending approximately 128 feet in length, parallel to the flow of the river, spaced and set to facilitate installing nets to form a jigger, tunnel, spiller, and live-well. A spiller will be included at the upstream as well as downstream end of the heart compartment in order to enable efficient capture of fish during both the flood and ebb tide. For the same reason, the heart compartment will have an entrance on the upstream side as well as the downstream side of the lead. Each entrance will be equipped with marine mammal deterrent gates to prevent entry of mammals while enabling fish to enter. A passive chamber at the spiller to live well connection will minimize potential air exposure, net contact, and handling of fish.

Trap operation will take place between April 1 through May 31, 2021 and August 15 through October 31, 2021. To operate the trap, a small research crew would access the trap by boat. Two focused periods of trap operation are anticipated. During the spring research period, the applicant will investigate the feasibility of this gear for ecological monitoring purposes as well as selective harvest of spring Chinook and shad. The fall research period is planned for the peak of fall Chinook salmon, coho salmon, and steelhead upriver migration. During this period, research will focus on the effectiveness of modified trap design for selective harvest of hatchery-origin salmon. Post-release survival of ESA-listed Chinook, coho, and steelhead bycatch will be estimated. Further details of the proposed research can be found in the research proposal (Appendix A).

The applicant will minimize potential for fish interaction with the trap during periods when the trap is not actively in operation (Adrian Tuohy, Wild Fish Conservancy, personal communication July 1, 2020). When the fishing season begins at the Clifton Channel trap site, the lead, heart, and spiller panels will be deployed into the water column. All trap panels are carefully designed of highly visible nylon materials that minimize drag in the water column and minimize potential entanglement. Once the fishing season begins and panels are deployed (likely mid-August 2021), WFC biologists will monitor the site every day until the conclusion of the research season (likely the end of October 2021). Each research day, WFC will conduct low tide snorkel/dive and video surveys of any panels of the trap that remain deployed. Any immediate mortalities that may occur in deployed trap panels will be documented and reported to NOAA / WDFW / ODFW along with total catch data on a weekly basis. This strategy has been utilized successfully by WFC and WDFW at the Peterson pound net in the Cathlamet channel (NMFS 2013/9872). If any significant problems are discovered, all trap panels are retrievable within a day in order to make course corrections or perform maintenance during the research season. At the conclusion of the research season, all trap panels will be removed from the pilings leaving only the untreated wood pilings in the water column.

1.3.3 Impact Avoidance and Minimization Measures

To minimize impacts of the proposed action, the following best management practices will be used:

- Pile driving will be completed with a vibratory hammer;
- Only untreated wood piles will be installed;
- Wood piles will be installed during November or December and within the in-water work window (November 1 through February 28);
- All garbage, including food scraps, will be contained or removed from the project site daily;
- After a fishing day is complete, the trap will be configured to enable free passage.
    - Both spillers will be lifted at the upstream and downstream sides of the heart and a panel of the heart farthest from shore will be opened, enabling all fish that may potentially enter the heart to pass through in any direction (upriver, downriver, shoreward, and riverward).
    - Two, approximately 25x18 foot panels of the lead (one near shore and the other at the midpoint of the lead) will be lifted, enabling passage through the lead in order to prevent fish from potentially being passively corralled into the opened heart compartment.
- During the break between spring and late-summer research periods, all trap panels will be lifted out of the water.
- Harm to marine mammals will be avoided. No ESA-listed marine mammals will be affected by this action. This ESA consultation does not express or imply any coverage under the Marine Mammal Protection Act for non-ESA listed marine mammals. The applicant (Wild Fish Conservancy) is responsible for obtaining authorization under the

Marine Mammal Protection Act if needed. Marine mammal deterrence will follow NOAA's guidance for deterring nuisance pinnipeds.

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 NMFS determined the proposed action is not likely to adversely affect the Southern Resident killer whale DPS, Southern DPS of green sturgeon, or Southern DPS of Pacific Eulachon or their critical habitats. This is documented in the "Not Likely to Adversely Affect" Determinations section (Section 2.12). In addition, the NMFS determined that the proposed action is not likely to adversely affect the Columbian white-tailed deer (*Odocoileus virginianus leucurus*), marbled murrelet (*Brachyramphus marmoratus*), Northern spotted owl (*Strix occidentalis caurina*), yellow-billed cuckoo (*Coccyzus americanus*), bull trout (*Salvelinus confluentus*), and bull trout critical habitat. The USFWS concurred with this determination as documented in their letter of concurrence received by the NMFS May 7, 2020.

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:

- Section 2.2 evaluates the current status of listed species and their critical habitat. For Pacific salmon, steelhead, and certain other species, NMFS has developed specific guidance for analyzing the status of the listed species' component populations in a "viable salmonid populations" (VSP) paper (McElhany et al. 2000). The VSP approach considers the abundance, productivity, spatial structure, and diversity of each population as part of the overall review of a species' status. For listed salmon and steelhead, the VSP criteria therefore encompass the species' "reproduction, numbers, or distribution" (50 CFR 402.02). In describing the rangewide status of listed species, we rely on viability assessments and criteria in technical recovery team documents and recovery plans, and other information where available, that describe how VSP criteria are applied to specific populations, major population groups, and species. We determine the rangewide status of critical habitat by examining the condition of the PCEs, PBFs, or essential features which were identified when the critical habitat was designated.

- Section 2.3 describes the action area, which is all areas directly or indirectly affected by the proposed action and provides a spatial boundary for effects analysis.

- Section 2.4 evaluates the environmental baseline for each species and critical habitat. The environmental baseline includes the past and present impacts of Federal, state, or private actions and other human activities in the action area. It includes the anticipated impacts of proposed Federal projects that have already undergone formal or early section 7 consultation and the impacts of state or private actions that are contemporaneous with the consultation in process.

- Section 2.5 evaluates the effects of the proposed action on species and their habitat using an "exposure-response-risk" approach. In this step, NMFS considers how the proposed action would affect the species' reproduction, numbers, and distribution or, in the case of salmon and steelhead, their VSP and other relevant characteristics. NMFS also evaluates the proposed action's effects on critical habitat features.

- Section 2.6 evaluates any cumulative effects in the action area. Cumulative effects, as defined in our implementing regulations (50 CFR 402.02), are the effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area. Future Federal actions that are unrelated to the proposed action are not considered because they require separate section 7 consultation.

- Section 2.7 integrates and synthesizes the preceding sections and evaluations. In this section, we add the effects of the action and the cumulative effects on the environmental baseline and evaluate the proposed action in with the context of the status of the species and critical habitat. The result of this evaluation will determine if the proposed action will: (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.

- Section 2.8 states the conclusions about whether species are jeopardized or critical habitat is adversely modified as a result of the proposed action. These conclusions are drawn from the logic and rationale presented in the Integration and Synthesis Section (Section 2.7). If, in completing the last step in the analysis, we determine that the action under consultation is likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat, we must identify a reasonable and prudent alternative (RPA) to the action. No RPAs were identified for this 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' current "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 current 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. 2013). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB 2007; Mote et al. 2013). 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 1.0-3.7°C by the end of the century (IPCC 2014). Habitat loss, shifts in species' ranges and abundances, and altered marine food webs could have substantial consequences to anadromous, coastal, and marine species in the Pacific Northwest (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. Recovery plans and 5-year status reviews for all 13 species of salmonids are available from the NMFS West Coast Region website and are incorporated by reference. Acronyms appearing in the table include DPS (Distinct Population Segment), ESU (Evolutionarily Significant Unit), ICTRT (Interior Columbia Technical Recovery Team), MPG (Multiple Population Grouping), NWFSC (Northwest Fisheries Science Center), TRT (Technical Recovery Team), and VSP (Viable Salmonid Population).

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
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 percent 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
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

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Snake River spring/summer-run Chinook salmon	Threatened 6/28/05	NMFS 2017a	NWFSC 2015	This ESU comprises 28 extant and four extirpated populations. All expect one extant population (Chamberlin Creek) are at high risk. 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
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
Snake River fall-run Chinook salmon	Threatened 6/28/05	NMFS 2017b	NWFSC 2015	This ESU has one extant population. Historically, large populations of fall Chinook salmon spawned in the Snake River upstream of the Hells Canyon Dam complex. The extant population is at moderate risk for both diversity and spatial structure and abundance and productivity. The overall viability rating for this population is 'viable.' 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 longer term data sets it is not possible to parse out these effects. Populations with longer term data sets exhibit stable or slightly positive abundance trends. Some trap and haul programs appear to be operating at or near replacement, although other programs still are far from that threshold and require supplementation with additional hatchery-origin spawners .Initiation of or improvement in the downstream juvenile facilities at Cowlitz Falls, Merwin, and North Fork Dam are likely to further improve the status of the associated upstream populations. While these and other recovery efforts have likely improved the status of a number of coho salmon populations, abundances are still at low levels and the majority of the populations remain at moderate or high risk. For the Lower Columbia River region land development and increasing human population pressures will likely continue to degrade habitat, especially in lowland areas. 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 2015	NWFSC 2015	This single population ESU is at very high risk dues to small population size. There is high risk across all four basic risk measures. Although the captive brood program has been successful in providing substantial numbers of hatchery produced fish for use in supplementation efforts, substantial increases in survival rates across all life history stages must occur to re-establish sustainable natural production In terms of natural production, the Snake River Sockeye ESU remains at extremely high risk although there has been substantial progress on the first phase of the proposed recovery approach – developing a hatchery based program to amplify and conserve the stock to facilitate reintroductions.	• 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 stranding • Contaminants

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Upper Willamette River steelhead	Threatened 1/5/06	NMFS 2011	NWFSC 2015	This DPS has four demographically independent populations. Three populations are at low risk and one population is at moderate risk. Declines in abundance noted in the 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
Middle Columbia River steelhead	Threatened 1/5/06	NMFS 2009	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

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Snake River basin steelhead	Threatened 1/5/06	NMFS 2017a	NWFSC 2015	This DPS comprises 24 populations. Two populations are at high risk, 15 populations are rated as maintained, 3 populations are rated between high risk and maintained, 2 populations are at moderate risk, 1 population is viable, and 1 population is highly viable. Four out of the five MPGs 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

2.2.2 Status of the Critical Habitat

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

Salmon and Steelhead

For most salmon and steelhead, NMFS's critical habitat analytical review teams (CHARTs) ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC5) in terms of the conservation value they provide to each ESA-listed species that they support (NMFS 2005). The conservation rankings were high, medium, or low. To determine the conservation value of each watershed to species viability, the CHARTs evaluated the quantity and quality of habitat features, the relationship of the area compared to other areas within the species' range, and the significance to the species of the population occupying that area. Even if a location had poor habitat quality, it could be ranked with a high conservation value if it were essential due to factors such as limited availability, a unique contribution of the population it served, or is serving another important role. Physical and biological features for listed salmonids in the LCR are delineated in Table 2. A summary of the status of critical habitats considered in this opinion, is provided in Table 3, below.

Table 2. PBFs identified for freshwater critical habitats of thirteen ESA-listed salmon and steelhead species and corresponding species life history events.

Species	Site Type	Site Attribute	Species Life History Event
LCR Chinook salmon UCR spring Chinook salmon UWR spring Chinook salmon CR chum salmon LCR coho salmon LCR steelhead MCR steelhead UWR steelhead	Adult and juvenile rearing areas and migration corridors	Forage Free of artificial obstruction Natural cover Water quality Water quantity	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
SR spring/summer Chinook salmon SR fall Chinook salmon SR sockeye salmon SRB steelhead	Adult and juvenile rearing areas and migration corridors	Access (sockeye) Cover/shelter Food (juvenile rearing) Riparian vegetation Safe passage Space (Chinook) Substrate Water quality Water quantity Water temperature Water velocity	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration

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

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Lower Columbia River Chinook salmon	9/02/05 70 FR 52630	Critical habitat encompasses 10 subbasins in Oregon and Washington containing 47 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some, or high potential for improvement. We rated conservation value of HUC5 watersheds as high for 30 watersheds, medium for 13 watersheds, and low for four watersheds.
Upper Columbia River spring-run Chinook salmon	9/02/05 70 FR 52630	Critical habitat encompasses four subbasins in Washington containing 15 occupied watersheds, as well as the Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some, or high, potential for improvement. We rated conservation value of HUC5 watersheds as high for 10 watersheds, and medium for five watersheds. Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Snake River spring/summer-run Chinook salmon	10/25/99 64 FR 57399	Critical habitat consists of river reaches of the Columbia, Snake, and Salmon rivers, and all tributaries of the Snake and Salmon rivers (except the Clearwater River) presently or historically accessible to this ESU (except reaches above impassable natural falls and Hells Canyon Dam). Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Upper Willamette River Chinook salmon	9/02/05 70 FR 52630	Critical habitat encompasses 10 subbasins in Oregon containing 56 occupied watersheds, as well as the lower Willamette/Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some, or high, potential for improvement. Watersheds are in good to excellent condition with no potential for improvement only in the upper McKenzie River and its tributaries (NMFS 2005). We rated conservation value of HUC5 watersheds as high for 22 watersheds, medium for 16 watersheds, and low for 18 watersheds.
Snake River fall-run Chinook salmon	10/25/99 64 FR 57399	Critical habitat consists of river reaches of the Columbia, Snake, and Salmon rivers, and all tributaries of the Snake and Salmon rivers presently or historically accessible to this ESU (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams). Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Columbia River chum salmon	9/02/05 70 FR 52630	Critical habitat encompasses six subbasins in Oregon and Washington containing 19 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 16 watersheds, and medium for three watersheds.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Lower Columbia River coho salmon	2/24/16 81 FR 9252	Critical habitat encompasses 10 subbasins in Oregon and Washington containing 55 occupied watersheds, as well as the lower Columbia River and estuary rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 34 watersheds, medium for 18 watersheds, and low for three watersheds.
Snake River sockeye salmon	10/25/99 64 FR 57399	Critical habitat consists of river reaches of the Columbia, Snake, and Salmon rivers; Alturas Lake Creek; Valley Creek; and Stanley, Redfish, Yellow Belly, Pettit and Alturas lakes (including their inlet and outlet creeks). Water quality in all five lakes generally is adequate for juvenile sockeye salmon, although zooplankton numbers vary considerably. Some reaches of the Salmon River and tributaries exhibit temporary elevated water temperatures and sediment loads that could restrict sockeye salmon production and survival (NMFS 2015b). Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Upper Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses 10 subbasins in Washington containing 31 occupied watersheds, as well as the Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 20 watersheds, medium for eight watersheds, and low for three watersheds.
Lower Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses nine subbasins in Oregon and Washington containing 41 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 28 watersheds, medium for 11 watersheds, and low for two watersheds.
Upper Willamette River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses seven subbasins in Oregon containing 34 occupied watersheds, as well as the lower Willamette/Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. Watersheds are in good to excellent condition with no potential for improvement only in the upper McKenzie River and its tributaries (NMFS 2005). We rated conservation value of HUC5 watersheds as high for 25 watersheds, medium for 6 watersheds, and low for 3 watersheds.
Middle Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses 15 subbasins in Oregon and Washington containing 111 occupied watersheds, as well as the Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of occupied HUC5 watersheds as high for 80 watersheds, medium for 24 watersheds, and low for 9 watersheds.
Snake River basin steelhead	9/02/05 70 FR 52630	Critical habitat encompasses 25 subbasins in Oregon, Washington, and Idaho. Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.

2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area for this proposed federal action is based on the extent of underwater and in-air sound generated during installation of piles (Figure 2). Based on NMFS guidance, we assumed ambient underwater sound to be 120 db RMS (decibels root mean square) which is an average of peak sound readings over time. Calculations were completed using the NMFS underwater sound calculator and underwater sound data gathered from California Department of Transportation studies (Buehler et al. 2015). Unfortunately, no known study to date has captured underwater sound data on 14-inch diameter wood piles driven with a vibratory hammer. Sound data from the most similar situation were used, which involved 12-inch diameter steel pipe pile driven with a vibratory hammer. Due to differences in the physical properties of steel versus timber piles and the slight difference in diameter of pile, these data are an approximate representation of the sound levels expected with the proposed action and likely over-estimate the area in which noise from pile driving would exceed ambient underwater sound levels. Actual sound levels generated by this project could be slightly above or below these approximations. An approximately 1.4 mile radius action area for underwater sound was calculated using empirically derived values from the California Department of Transportation compendium and the NMFS underwater sound calculator. In some directions, underwater sound would be attenuated prior to reaching its full extent. The action area based on underwater sound encompasses about 870 acres. Within this area, noise from pile driving during construction of the pound net is expected to exceed ambient underwater sound levels.

A subset of this area encompasses areas within which behavioral effects to fish are expected from pile driving. The distance to this behavioral threshold is about 72 feet from the project site. About 2.2 acres falls within this behavioral threshold. This distance was calculated using the same California Department of Transportation data as above, which were based on driving 12-inch diameter steel pipe pile using a vibratory hammer.

A quarter-mile disturbance distance was used to determine the extent of potential disturbance to terrestrial wildlife based on in-air sound. This distance was based on guidance received from the USFWS regarding the extent of potential disturbance to marbled murrelets and Northern spotted owls from in-air sound generated during pile driving (Figure 2). This disturbance distance buffer is used for pile driving as well as upland rock crushing and rock screening in the context of marbled murrelet and northern spotted owl habitat in the Pacific Northwest. This area encompasses about 152 acres. Of these 152 acres, about 60 acres are on land. The on-land action area is the extent of potential in-air sound above background noise; no component of the proposed action would take place on land.

The total action area encompasses the extent of underwater sound above ambient underwater sound as well as a quarter mile radius buffer extending from the project site outward to encompass the extent of in-air sound disturbance. Combining the underwater sound and in-air sound areas yields a total action area of about 930 acres.

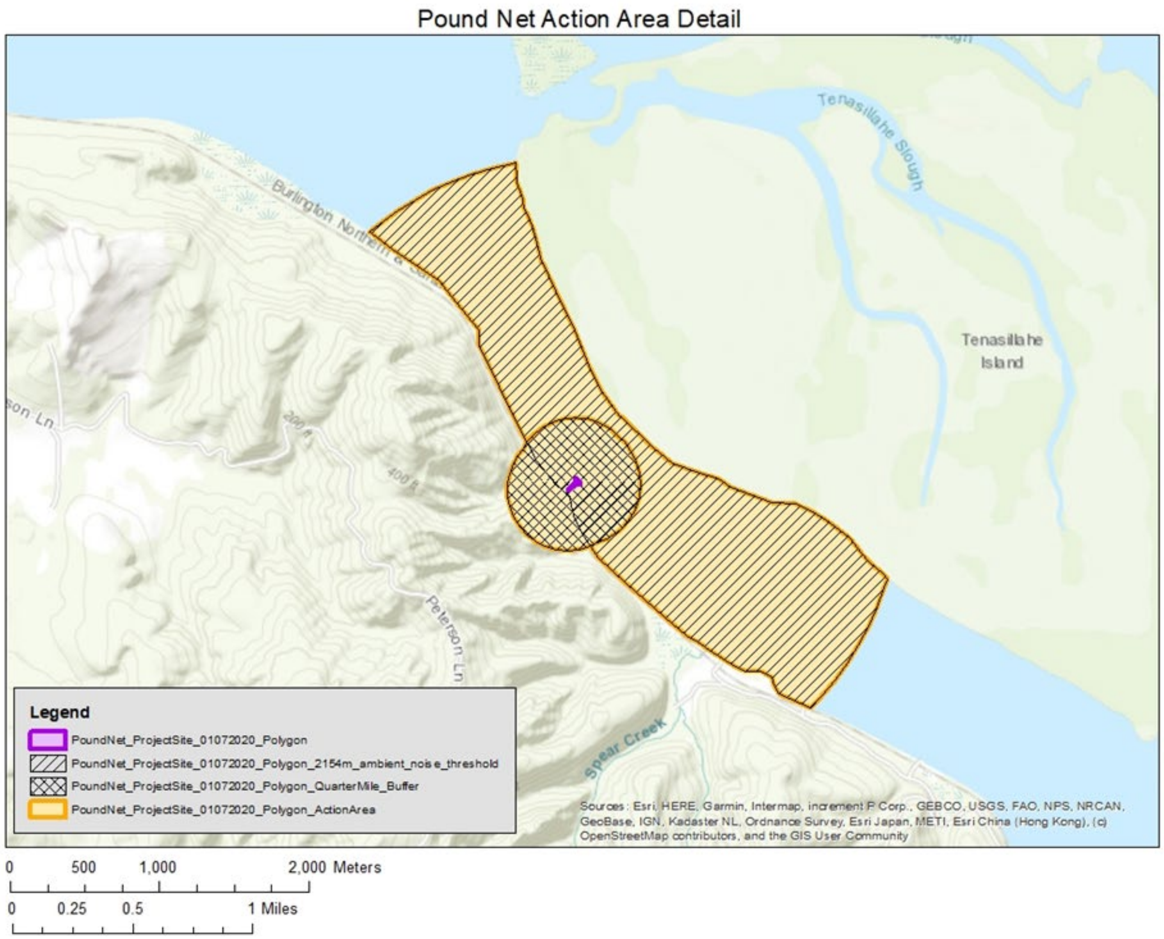

Figure 2. Action area.

2.4 Environmental Baseline

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

2.4.1 General Setting

The action area is within the LCR at approximately river mile 35. It is located off the mainstem in the Clifton Channel which flows along the south side of Tenasillahe Island. The LCR is an environment heavily influenced by human uses. Agricultural use, forest management, industrial development, and residential development have shaped the landscape and waterway. Hydropower systems have modified river flow and sediment transport. Industrial shipping, ocean-going vessels, and associated dredging to maintain a shipping channel have further modified this system. Some 68 to 70 percent of the historic vegetated tidal wetlands in the LCR have been lost, along with 55 percent of the forested uplands (Marcoe and Pilson 2013).

2.4.2 Terrestrial Species and Habitat

Terrestrial habitats near the action area are primarily conservation lands, state forest, agricultural lands, and rural residential areas. The conservation and state forest lands provide higher quality riparian and upland habitats benefitting our listed aquatic species within a matrix of mostly moderate to lower quality habitats. The action area is bordered by Tenasillahee Island to the north and a large swath of state-owned timberland to the south. Tenasillahee Island is part of the Julia Butler Hansen National Wildlife Refuge and is managed to provide habitat for the Columbian white-tailed deer and other wildlife resources. South of the action area is the Clatsop State Forest. This is a public forest managed by the Oregon Department of Forestry. At 154,000 acres, it is one of the larger remaining tracts of public forest land in Oregon. It is comprised mostly of second-growth hemlock, Doulas fir, and western red cedar. Current management of this forest aims for sustainable timber harvest and support of a range social, environmental, and economic benefits. This state forest is particularly significant as a substantial remaining area of terrestrial habitat as 55 percent of forested uplands in the LCR have been lost in the last 140 years (Marcoe and Pilson 2013). In addition to the Clatsop State Forest, the Oregon shoreline near the action area includes rural residential areas and small farms providing mostly moderate to lower quality riparian and upland habitats.

2.4.3 Aquatic Species and Habitat

The action area is located in a portion of the LCR that is tidally influenced. It is located within the Clifton Channel, which is a side channel that flows along the south side of Tenasillahe Island. The current condition of the action area is influenced by multiple factors occurring upstream and upland, in addition to features of the specific site. The LCR has become a central point of economic growth, particularly in areas between Longview, Washington and Portland, Oregon. Marine terminal facilities at the ports of Longview, Kalama, Portland, Vancouver, and Woodland dominate use of shorelines on the Columbia River. Three large industrial marine terminals and more than 10 acres of overwater structure at the Port of St. Helens, Oregon are located on the west side of the river.

The LCR has been modified substantially from historic conditions, leading to greatly reduced habitat and food resources for juvenile salmonids. Historically, the mainstem LCR was less than 20 feet deep. Broad vegetated wetlands within the floodplain served as a nursery for juvenile salmonids and supplied the estuary with an abundance of macrodetritus which is the base-level food source for juvenile salmonids (NMFS 2011). Modifications to the LCR have reduced the quality and quantity of wetland habitat and diminished juvenile salmonids' access to remaining wetland habitats. Wetland habitat has been lost through diking, dredging, filling for agricultural, urban, and industrial purposes, as well as hydroregulation for power generation and flood control. About 74 percent of vegetated wetlands in the Columbia River estuary have been lost (Brophy 2019).

Regulation of river flow has reduced spring freshet flows to about 50 percent of the natural level, and has increased fall minimum flows by 10 to 50 percent (Simenstad et al. 1992). Flow regulation along with increased nutrients, water clarity, and temperature have led to diminished macrodetritus in the estuary which translates to diminished food resources for juvenile salmonids. The current base-level food source in the LCR is microdetritus such as phytoplankton and zooplankton transported from areas throughout the Columbia watershed (Sherwood et al. 1990; Weitkamp 1994). The combined effects of water withdrawals for irrigation, hydroregulation, diking and filling have reduced the surface area of the estuary by approximately 20 percent over the past 200 years, resulting in decreased access to up to 77 percent of historical tidal swamps and peripheral wetlands (Fresh et al. 2005).

Presently, limiting factors in the action area include a lack of habitat and reduced habitat quality in the mainstem LCR (NMFS 2011b). Overbank flooding that normally would aid juveniles in accessing off-channel refugia and food resources has been virtually eliminated, and sediment transport processes that build habitat and constitute refugia habitat have been impaired (NMFS 2011). Bottom et al. (2005) noted the near complete elimination of overbank flood events in the LCR and the separation of the river from its floodplain, both conditions that have altered the food web by reducing macrodetrital inputs by approximately 84 percent. Currently, phytoplankton detrital sources from upstream reservoirs now dominate the base of the food chain. This change from a food web based on macrodetritus to one based on microdetritus has profound effects on the estuary ecosystem to support migration and rearing of juvenile salmonids.

Upstream dams have prevented sediments from entering the estuary, while dredging activities have increasingly deepened the channel and exported sand and gravel out of the estuary. Since the late nineteenth century, sediment transport from the interior basin to the Columbia River estuary has decreased about 60 percent and total sediment transport has decreased about 70 percent (Kukulka and Jay 2003). Currently, sand is exported from the estuary at a rate approximately three times higher than that at which it enters the estuary. The full impact of these changes is unknown; however, sediment transport is a primary habitat-shaping force that determines the type, location, and availability of habitats distributed in the estuary and plume. It is thought that reductions in the amount of fine sediment have increased water clarity, allowing avian and aquatic predators to more easily locate and consume salmonids during both adult and juvenile life stages.

A Columbia Basin-wide assessment of avian predation on juvenile salmonids indicates that the most significant impacts to smolt survival occur in the Columbia River estuary (Collis et al. 2009). Although actions to reduce avian predation in the Columbia River Basin have been ongoing with implementation of the Federal Columbia River Power System (FCRPS) Biological

Opinions, high levels of avian predation by Caspian terns and double-crested cormorants continue to affect lower Columbia River listed salmonid ESUs and DPS. Further, predation remains a concern due to a general increase in pinniped populations along the West Coast. Non-indigenous fish affect salmon and their ecosystems through many mechanisms.

Toxic contaminants are widespread in the estuary, both geographically and in the food chain, with the urban and industrial portions of the estuary contributing significantly to juvenile salmon's toxic load (LCREP 2007). Some of these contaminants are water-soluble agricultural pesticides and fertilizers, such as simazine, atrazine, and diazinon, and copper-based chemicals (Hecht et al. 2007). Industrial contaminants include polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). Also present are pharmaceuticals, personal care products, brominated fire retardants, and other emerging contaminants. Concentrations of toxic contaminants in the bodies of juvenile salmonids in the estuary sometimes are above levels estimated to cause health effects. In a 2007 study, this was the case for PCBs, PAHs, and DDT, and juveniles showed evidence of exposure to hormone-disrupting compounds (LCREP 2007). Salmon and steelhead experience both short-term exposure to toxic substances and long-term exposure to contaminants that accumulate over time and magnify through the food chain. Even when exposures are sublethal, they can cause significant developmental, behavioral, health, and reproductive impairments.

2.5 Effects of the Action

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

The proposed action comprises two separate components: construction related-activities from installation of pilings to support the pound net and the operation of the pound net gear. In this section, we evaluate the effects of these two components independently because they have distinct effects on ESA-listed species and occur at different times, thus having the potential to affect different ESA-listed species. Summaries of effects to species and critical habitats are provided in Tables 7 and 9, respectively. The following subsections describe the evaluation of effects on ESA-listed species and their critical habitats from the installation of the pound net gear (Section 2.5.1 and 2.5.2) and the operation of the pound net gear (Section 2.5.3).

2.5.1 Effects of Construction-related Activities on Listed Species

Installing the pound net is expected to cause a short-term increase in turbidity as well as underwater and in-air sound. Installing the pound net is expected to result in a minor but long-term alteration of the aquatic environment at the project site as the piles will be left in place. This section identifies listed species and critical habitats present or potentially present in the action area, identifies those species, life history phases, and critical habitats likely to be exposed to consequences of trap construction, and addresses the impacts of those consequences on individuals of listed species and primary biological features (PBFs) of critical habitat present, or potentially present, in the action area. As different life stages of a species can respond in different ways to the same effects, we identified the life stages of listed species that will encounter these effects and described anticipated effects by life stage. This effects analysis reviews actions expected to lead to minor changes in fish behavior and habitat modifications.

Establishing Exposure--Species Presence and Habitat Use in the Action Area

Thirteen salmonid species pass through the action area as juveniles and adults. (Table 5). Those salmon and steelhead life history phases are present at different times of the year. Numerous early life history strategies expressed by juvenile salmonids in the LCR have been lost as a result of past management actions (Bottom et al. 2005). Bottom et al. (2005) suggests that as many as six distinct life histories were exhibited by juvenile salmonids during their migration to the ocean. Today, three remain: yearling, subyearling, and fry migrants. Nearly all juvenile salmonids exhibit a yearling (stream-maturing) or subyearling (ocean-maturing) life history. Habitat preferences of juvenile salmonids are closely associated with life history strategies (Dawley et al. 1986; Ledgerwood et al. 1991). These researchers found that larger yearling migrants such as Chinook salmon and steelhead were more likely to use deeper mid-water habitats, while subyearling Chinook salmon were most often found in nearshore, shallow water areas. Still others, such as sockeye salmon and steelhead inhabited mid-water areas 98 percent of the time. All species cease migrating at night, and occupy deeper waters during this period (Ledgerwood et al. 1991).

Most species are present in the action area for migration and pass through the action area within hours to days (Dawley et al. 1986). Others, particularly juvenile Chinook salmon, migrate as subyearlings and rear in the LCR for days to weeks (McNatt et al. 2016). Presence of juvenile salmon in the LCR is summarized by NMFS (2017) and is included in Table 5. Juvenile salmon are most abundant during one or two periods from late winter through summer, with lesser presence in the fall (http://www.cbr.washington.edu/dart). Juvenile sockeye salmon and steelhead likely spend the least amount of time in the estuary. Various life history types of Chinook salmon and most chum salmon may remain for longer periods, while they actively feed and grow before ocean entrance.

Some species, such as UWR Chinook salmon and LCR Chinook salmon, continue to maintain populations exhibiting both ocean-type and stream-type life histories as juveniles (LCFRB 2010; Schroeder et al. 2016). Stream-type salmon and steelhead typically rear in upstream tributary habitats for over a year. These include LCR Chinook salmon (spring runs), LCR steelhead, LCR coho salmon, MCR steelhead, UWR steelhead, UWR Chinook salmon, SR spring/summer Chinook salmon, UCR Chinook salmon, SR steelhead, SR sockeye, and UCR steelhead. These fish tend to be 100 to 200 mm in size during migration through the action area. Species exhibiting a stream-type life history typically migrate as smolts, which migrate quickly downstream, and will pass through the action area within one to two days. Ocean-type juvenile salmon tend to move out of spawning streams and migrate towards the LCR estuary as subyearlings and are actively rearing within the Lower Columbia River. This includes LCR Chinook salmon (fall runs), CR Chum salmon, SR fall-run Chinook salmon, and UWR Chinook salmon that are smaller in size (less than 100 mm) and more likely to spend days to weeks in the action area foraging (Carter et al. 2009, McNatt et al. 2016, NMFS 2013; Schroeder et al. 2007; 2016).

Lower CR steelhead display two distinct life history types of steelhead (e.g., summer and winter runs) that differ in degree of sexual maturity at freshwater entry, spawning time, and frequency of repeat spawning. Most summer-run steelhead from the LCR steelhead DPS re-enter freshwater between May and October and require several months to mature before spawning, generally between late February and early April. Most winter-run steelhead re-enter freshwater between December and May as sexually mature fish; peak spawning occurs later than for summer steelhead, in late April and early May (NMFS 2013). Observations of steelhead in the LCR suggest that the species used mid-river habitats 98 percent of the time (Ledgerwood et al. 1991).

In addition to variations in outmigration timing, juvenile ESA-listed species also have a wide horizontal and vertical distribution in the CR related to size and life history stage. Generally speaking, juvenile salmonids occur across the width of the river and to average depths of up to 35 feet (Carter et al. 2009). Smaller-sized fish use the shallow inshore habitats and larger fish use the channel margins and main channel. The pattern of use generally shifts between day and night. The smaller salmonids congregate along the nearshore areas in shallow water and extend into the channel margins (Bottom et al. 2011). At night these younger fish swim into the deeper areas of the river away from the shoreline and are closer to the bottom of the channel (Carter et al. 2009). Yet, as Carlson et al. (2001) indicated, there is higher use of the channel margins than previously thought and considering the parameters above, relative juvenile position in the water column suggests higher subyearling use in areas of 20 to 30 feet deep.

Specific populations mostly likely to occur in the action area as juveniles (for rearing and migration) are summarized below in Table 4.

Table 4. Number of populations of salmon and steelhead originating in the LCR. Shaded rows indicate populations with individuals potentially exposed to effects of the proposed action.

Population origin	LCR Chinook Salmon number of populations	LCR coho salmon number of populations	LCR Steelhead number of populations	CR chum salmon number of populations
Youngs River	1	1	-	1
Big Creek	1	1	-	1
Grays River	1	1	-	1
Elochoman River	1	1	-	1
Clatskanie River	1	1	-	1
Mill/Abernathy/Germany creeks	1	1	-	1
Scappoose Creek	1	1	-	1
Cowlitz River	5	4	4	2
Coweeman River	1	1	1	-
Toutle River	1	2	2	-
Kalama River	2	1	2	1

Population origin	LCR Chinook Salmon number of populations	LCR coho salmon number of populations	LCR Steelhead number of populations	CR chum salmon number of populations
Lewis River	**2**	**2**	**4**	**1**
Salmon Creek	**1**	**1**	**1**	**1**
Clackamas River	**1**	**1**	**1**	**1**
Washougal River	**1**	**1**	**2**	**1**
Sandy River	**2**	**1**	**1**	**1**
Gorge tributaries	**2**	**3**	**2**	**2**
Wind River	**-**	**-**	**1**	**-**
White Salmon River	**2**	**-**	**2**	**-**
Hood River	**2**	**-**	**-**	**-**
Number of potentially exposed populations	**13**	**9**	**14**	**7**

Presence of adult salmonids in the action area will most likely range from early spring to early fall (http://www.cbr.washington.edu/dart) for those species originating upstream of Bonneville Dam. Chinook salmon species returning to locations upstream of Bonneville Dam (i.e., SR spring/summer Chinook salmon, SR fall Chinook salmon, UCR spring Chinook salmon) migrate through the action area during the spring and early summer. Adult SR sockeye salmon migrate through the action area during late spring through late summer. Adult steelhead (MCR steelhead, SRB steelhead, and UCR steelhead) migrate through the action area from mid-June through early October.

Lower CR Chinook salmon include populations that return to freshwater as adults in the spring, fall, or late fall. Spring-run adults enter the LCR from March through June, fall–run adults enter freshwater from August to September, and late-fall run adults enter the Columbia River from August to October (NMFS 2013). LCR coho salmon are typically categorized into early and late-returning stocks (NMFS 2013). Early-returning (Type S) adult coho salmon enter the Columbia River in mid-August and begin entering tributaries in early September, with peak spawning from mid-October to early November (NMFS 2013). Late-returning (Type N) coho salmon pass through the lower Columbia from late September through December and enter tributaries from October through January. Adult CR chum salmon are a fall-run species that enter fresh water from mid-October through November and spawn from early November to late December (LCFRB 2010). LCR steelhead are present from May through October (summer run) and December through May (winter run) (NMFS 2013).

Other species that utilize the action area include UWR Chinook salmon and UWR steelhead. Adult UWR Chinook salmon appear in the action area during January, with fish entering the Clackamas River as early as March (NMFS 2011a). Adult UWR steelhead are present from mid-February to mid-May (NMFS 2011a). CR chum salmon are from the Cowlitz, Kalama, Lewis, Salmon Creek, Washougal, lower Gorge tributaries and upper Gorge tributaries. Of these, the populations are virtually extirpated with the exception of the Washougal and lower Gorge populations.

Table 5. 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].

Species/Life Stage	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Eulachon																								
Adult migration/holding[1,2]	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/ subadult rearing[2]	-	-	-	-	-	-	-	-	P	P	R	R	R	R	R	R	R	R	R	-	-	-	-	-
Adult migration	-	-	-	-	-	-	-	-	P	P	P	P	P	P	P	P	P	P	P	-	-	-	-	-
LCR Chinook Salmon																								
Adult migration/holding	-	-	-	-	R	R	R	R	A	A	A	A	A	R	R	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	-	-	-	-	A	A	R	A	A	A	A	A	A	A	A	A	R	R	R	R	R	R	-	-
UCR Chinook salmon																								
Adult migration/holding	-	-	-	-	-	-	-	-	R	A	A	-	-	-	-	-	-	-	-	-	-	-	-	-
Adult spawning	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eggs & pre-emergence	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Juvenile rearing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Juvenile emigration	-	-	-	-	A	A	R	A	A	A	A	A	A	A	A	A	R	R	R	R	R	R	-	-
UWR Chinook Salmon																								
Adult migration/holding	-	-	-	-	R	R	R	R	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	-	-	R	R	R	R	R	A	A	A	A	R	R	P	P	P	P	P	P	P	P	P	-	-
SR spr/sum Chinook Salmon																								
Adult migration/holding	-	-	-	-	R	R	A	A	A	R	R	R	R	R	R	R	R	R	-	-	-	-	-	-
Adult spawning	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eggs & pre-emergence	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Juvenile rearing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Juvenile emigration					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 Chinook salmon																								
Adult migration/holding	-	-	-	-	-	-	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
CR chum salmon																								
Adult migration/holding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		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	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LCR coho salmon																								
Adult migration/holding	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	-	-	-	-
SR sockeye salmon																								
Adult migration/holding	-	-	-	-	-	-	-	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	-	-	-	-	-
LCR steelhead																								
Adult migration/holding	-	-	-	-	-	-	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 steelhead																								
Adult migration/holding	-	-	-	-	-	-	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	-	-	-	-

Species/Life Stage	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
UCR steelhead																								
Adult migration/holding	-	-	-	-				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	-	-	-	-
UWR steelhead																								
Adult migration/holding	-	-	-	R	R	R	R	R	A	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	-	-	-	-
SRB steelhead																								
Adult migration/holding	-	-	-	-	-	-	-	R	A	A	A	-	-	-	-	-	-	-	-	-	-	-	-	-
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	-	-	-	-

[1] Eulachon Status Review Update, 20 January 2010. Available at: http://www.nwr.noaa.gov/Other-Marine-Species/upload/eulachon-review-update.pdf

[2] Personal communication. Conversation between WDFW (Brad James, Olaf Langness, and Steve West), ODFW (Tom Rien), and NMFS (Rob Markle, Bridgette Lohrman) regarding green sturgeon and eulachon presence in the Columbia River. June 23, 2009.

[3] Eulachon egg incubation estimated relative to spawning timing and 20 to 40 day incubation period.

[4] Carter et al. 2009 (Seasonal juvenile salmonid presence and migratory behavior in the lower Columbia River).

Species Presence in the Action Area during Trap Construction

As described in the previous section, 13 species of salmon and steelhead occupy or pass through the action area at different times of the year. However, trap installation will only affect individuals of those species present in the action area while pile driving is taking place. Pile driving for trap construction will take place during November or December and is anticipated to take up to one week. This timing is within the in-water work window, which is November 1 through February 28 for this section of the Columbia River. This work window is intended to minimize listed species' exposure to stressors. Early in the in-water work window, fewer species are present including fewer species present in their more vulnerable juvenile life history phase. Driving piles early in the work window is optimum as it minimizes the number of species present or potentially present and therefore potentially exposed to stressors stemming from trap construction.

During pile driving, both adult and juvenile salmonids are expected to be present in the action area. Adult Columbia River chum and LCR coho as well as juvenile LCR chinook, Upper Columbia River chinook, Upper Willamette River (UWR) chinook, Snake River fall chinook, LCR coho, and LCR steelhead are also expected to be present in the action area during November and December. Of the total suite of salmonid species potentially present in the action area at various times of year (Table 5), these species and life stages are likely to be exposed to stressors stemming from trap construction. This does not preclude the possible presence of other salmonid species during trap construction such as very early or very late returning individuals of other species. The size of the juvenile salmonids will vary with life history strategy which may impact their vulnerability to certain stressors stemming from the proposed action.

As discussed in section 2.4.1, salmon and steelhead can exhibit ocean-type or stream-type life history strategies which influence the size of the juvenile while it is in the estuary as well as how long the juvenile spends in the estuary. Some species, such as LCR Chinook and UWR Chinook, display both ocean-type and stream-type life histories. The size of the juvenile, timing of its entry into the estuary, and duration of time it is present in the estuary all influence the probability of the individual's exposure to stressors stemming from pound net construction.

Ocean-type juveniles tend to move out of spawning streams and migrate towards the LCR estuary as subyearlings. These fish actively rear as subyearlings in the LCR. This includes LCR chinook salmon (fall runs), Upper Willamette River chinook, and Snake River fall chinook. While rearing in the LCR estuary these fish can be smaller in size (less than 100mm) and are more likely to spend days and weeks in the action area foraging.

Stream-type juveniles typically rear in upstream tributary habitats for over a year. They tend to migrate as smolts and move quickly through the estuary. Stream-type juveniles are likely to be 100 to 200 mm in size as they pass through the action area. This includes LCR Chinook salmon, UCR Chinook, UWR Chinook, LCR coho, and LCR steelhead.

Fish Response to Increased Sound Pressure Levels

The proposed action will temporarily increase sound pressure levels in the action area. Adult Columbia River chum and LCR coho as well as juvenile LCR chinook, Upper Columbia River chinook, Upper Willamette River (UWR) chinook, Snake River fall chinook, LCR coho, and LCR steelhead are expected to be present in the action area during pile driving and potentially exposed to increased sound pressure levels. Pile driving will cause temporary underwater and airborne noise, of which only underwater noise is expected to impact listed fish. Forty-six, 14-inch diameter untreated wood piles will be installed. Pile installation will be completed with a vibratory pile driver in November or December 2020.

Fishes with swimbladders (including salmonids) are sensitive to underwater impulsive sounds (*i.e.*, sounds with a sharp sound pressure peak occurring in a short interval of time). As a pressure wave passes through a fish, the swimbladder is rapidly compressed due to the high pressure, and then rapidly expanded as the "under pressure" component of the wave passes through the fish. The injuries caused by such pressure waves are known as barotraumas. They include the hemorrhage and rupture of internal organs, damage to the auditory system, and death for individuals that are sufficiently close to the source (Abbott *et al.* 2002; Caltrans 2004). Death can occur instantaneously, within minutes after exposure, or several days later.

A multi-agency work group identified criteria to define sound pressure levels in which effects to fish are likely to occur from pile driving activities (Hydroacoustic Working Group, 2008). Keep in mind these thresholds represent the initial onset of injury, and not the levels at which fish will be severely injured or killed. The most harmful level of effects is where a single strike generates peak noise levels greater than 206 dB_{peak}[1] where direct injury or death of fish can occur. Besides peak levels, sound exposure levels (SEL) (the amount of energy dose the fish receive) can also injure fish. These criteria are either 187 dB_{SEL}[2] for fish larger than 2 grams or 183 dB_{SEL} for fish smaller than 2 grams for cumulative strikes (Hydroacoustic Working Group, 2008). In addition, any salmonid within a certain distance of the source (*i.e.* the radius where the root mean square (RMS) sound pressure level will exceed 150 dB_{RMS}[3]) will be exposed to levels that change the fish's behavior or cause physical injury (*i.e.* harm). The result of exposure could be a temporary threshold shift in hearing due to fatigue of the auditory system, which can increase the risk of predation and reduce foraging or spawning success (Stadler and Woodbury, 2009). When these effects take place, they are likely to reduce the survival, growth, and reproduction of the affected fish.

To analyze the effects from pile driving, we consulted the Washington State Department of Transportation pile driving guidance (Washington State Department of Transportation, 2014) and the California Department of Transportation Compendium for Pile Driving Sound Data (Illingworth and Rodkin, 2007) for information on sound generated when driving pile with a vibratory hammer. Data on 14" diameter wood piles was not available so we used the most

[1] dB_{peak} is referenced to 1 micropascal (re: 1μPa or one millionth of a pascal) throughout the rest of this document. A pascal is equal to 1 newton of force per square meter).
[2] dB_{SEL} is referenced to 1 micropascal-squared·seconds (re: $1\mu Pa^2\cdot sec$) throughout the rest of this document
[3] dB_{RMS} is referenced to 1 micropascal (re: 1μPa) throughout the rest of this document

similar available data, which was steel pipe piles of 12” diameter driven with a vibratory hammer (Table 6; Illingworth and Rodkin, 2007).

Table 6. Pile driving sound pressure levels and sound exposure data from Illingworth and Rodkin (2007)

Source	dB_{peak}	dB_{RMS}	dB_{SEL}
12-inch steel pipe pile with vibratory hammer	171	155	155

We used the following assumptions for estimating the effects of the pile driving component of the proposed action on juvenile and adult salmon and steelhead:

- Sound pressure levels from driving 12-inch steel pipe piles will approximate sound pressure levels from driving 14-inch wood piles
- Pilings will not exceed 14-inches in diameter.
- Pilings will be driven with a vibratory hammer.
- Pile driving will take place during November or December.
- Pile driving will take place over several days, and up to one week with pile driving occurring no more than ten hours per day, daily, within that period.
- Adult as well as juvenile salmonids will be present during pile driving (2.4.2).
- Some juvenile salmonids present during pile driving may be less than 100mm in length but all are assumed to be at least two grams (2.4.2).

The proposed action will increase sound pressure levels during pile driving. We estimated that pile driving will emit sound pressure levels of 171 dB_{peak}, 155 dB_{SEL}, and 155 dB_{RMS}. We assume a high likelihood of injury to salmonids from instantaneous pulses of sound above 206 dB_{peak} (FHWG 2008); however the use of a vibratory hammer ensures sound pressure will be well below this threshold. Therefore, the proposed action will not injure or wound fish exposed to pile driving.

Vibratory hammering has not been observed to injure or kill fishes or other aquatic organisms. This may be due to the slower rise time (the time taken for the impulse to reach its peak pressure) and the fact that the energy produced is spread out over the time it takes to drive the pile (Washington State Department of Transportation, 2014). Sound energy from a vibratory pile driver is concentrated at a lower frequency than that from an impact pile driver and also differs in intensity, frequency, and total energy content of the pressure wave (Teachout 2012). There are no established injury criteria for vibratory pile driving (Buehler et al 2015).

We calculated the total area within which underwater sound from pile driving would be greater than ambient background underwater sound, which was assumed to be 120 db RMS. An approximately 1.4 mile radius area totaling about 870 acres will be exposed to underwater sound greater than 120 db RMS. Underwater noise substantial enough to cause behavioral effects to fish is expected within about 72 feet of the pound net during the installation of pile, totaling approximately 2.2 acres. Within this area we anticipate that vibratory pile driving will cause minor, short-term behavioral effects to fish. As the pile driving will take from several days to up to a week, these effects will be short-term, temporary, and not reoccurring. We expect varying levels of behavioral responses from no change, to mild awareness, or a startle response (Hastings and Popper, 2005). These responses may alter the fitness of some individuals, particularly juvenile fish which may startle and relocate into areas with greater risk of predation by birds or larger fish. As mentioned previously, juvenile LCR chinook, Upper Columbia River chinook, Upper Willamette River chinook, Snake River fall chinook, LCR coho, and LCR steelhead are expected to be present during pile driving. Individuals of these species may experience greater risk of predation due to pile driving.

Fish Response to Decreased Water Quality--Turbidity and Suspended Sediment from Pile Driving

Pile driving causes short-term and localized increases in turbidity and total suspended solids (TSS). The effects of suspended sediment on fish increase in severity with sediment concentration and exposure time and can progressively include behavioral avoidance and/or disorientation, physiological stress (e.g., coughing), gill abrasion, and death—at extremely high concentrations. Newcombe and Jensen (1996) analyzed numerous reports on documented fish responses to suspended sediment in streams and estuaries, and identified a scale of ill effects based on sediment concentration and duration of exposure, or dose. Exposure to concentrations of suspended sediments expected during the proposed pile driving could elicit sublethal effects such as a short-term reduction in feeding rate or success, or minor physiological stress such as coughing or increased respiration. Studies show that salmonids have an ability to detect and distinguish turbidity and other water quality gradients (Quinn, 1988; Simenstad, 1988), and that larger juvenile salmonids are more tolerant to suspended sediment than smaller juveniles (Servizi and Martens, 1991; Newcombe and Jensen, 1996).

Very little data exists regarding the temporary increase in suspended sediment associated with pile driving. To estimate the magnitude of suspended sediment associated with the proposed pile driving, NMFS reviewed results from a vibratory pile removal project near the mouth of Jimmycomelately Creek in Sequim Bay (Weston_Solutions, 2006). In that study, TSS concentrations associated with activation of the vibratory hammer to loosen the pile from the substrate ranged from 13 to 42 milligrams per liter (mg/L) and averaged 25 mg/L. During the pile driving, elevated levels of TSS averaging 40 mg/L were recorded near the pile and 26 mg/L at the sensors located 16 to 33 feet from the pile. Concentrations during extraction ranged from 20 to 82.9 mg/L, and were sometimes visible in the water column as a 10- to 16-foot diameter plume that extended at least 15 to 20 feet from the actual pulling event. Although concentrations decreased after pile extraction, the time interval was unavailable due to tug movement as soon as the pile cleared the water’s surface.

To consider how the TSS generated from vibratory pile driving might affect juvenile salmonids, NMFS used the Weston Solutions (2006) data as an estimate for the range of expected TSS and Newcombe and Jensens (1996) ‘scale of ill effects’ to determine likely associated biological responses. For an exposure duration of up to two hours and an increase in TSS over background of up to 240 mg/L, the calculated severity of ill effect for juvenile salmon does not exceed a behavioral effect of short-term reduction in feeding rates and feeding success (the fish is startled, experiences reduced vision, stops feeding to reorient, and may swim away). The maximum increase in TSS reported in Weston Solutions (2006) is 83 mg/L. Even if the pile driving that is part of the proposed action would result in double the TSS as reported for vibratory pile driving in Weston Solutions (2006), the likely level of TSS is well below levels and durations that could result in injurious physiological stress. Further, any elevations in turbidity and TSS generated by the pile driving will be localized, short-term and similar to the variations that occur normally within the environmental baseline of the marine nearshore—which is regularly subject to strong winds and currents that generate suspended sediments. Thus, the juvenile salmonids likely will have encountered similar turbidity before. As mentioned in the previous section, pile driving will take from several days to up to a week and the associated effects will be short-term, temporary, and not reoccurring. In summary, the short duration of the proposed pile driving (a few minutes per piling), generally low level expected increase in TSS, and small affected area renders the effects of the increased TSS on juvenile salmonids not meaningful. Effects of turbidity on adult salmonids, if present, are anticipated to be similarly temporary and minor. Effects to populations will be so minor as to be imperceptible and will not rise to the level that any VSP parameters will be affected.

Table 7. Summary of consequences of proposed action on individual salmonids and salmonid populations with green shading indicating low, yellow moderate, and red high.

Activity	Stressor	Species	Life Stage	Likelihood of exposure (high, medium, low)	Magnitude of response (high, medium, low)	Consequence at the individual fitness level (high, medium, low)	Population level consequences (high, medium, low)
Pile driving	Temporary increase in underwater sound during vibratory driving of piles for up to one week in November or December 2020.	Adult salmonids	Adult	High. Adults will be present or potentially present.	Low. Sound pressure levels will be well below threshold for instantaneous injury (i.e. barotrauma). Vibratory hammering has not been observed to cause injury or death to fishes or other aquatic organisms.	Low. We expect that exposed adults will display varying levels of behavioral responses from no change, to mild awareness, or a startle response. Adults may relocate away from noise. We conclude that this response will not alter the fitness of individuals. Consequence at individual fitness level is low.	Low. Temporarily increased underwater sound, turbidity, and suspended sediment may lead to reduced fitness or death of some individual juvenile fish due to increased predation risk; however the method, timing, and limited duration of pile driving minimizes the number of individuals potentially exposed to these risks. Consequences to abundance, productivity, spatial structure, and diversity at the population level are highly unlikely.
Pile driving	Temporary increase in underwater sound during vibratory driving of piles for up to one week in November or December 2020.	Juvenile salmonids LCR chinook, Upper Columbia River chinook, Upper Willamette River chinook, Snake River fall chinook, LCR coho, and LCR steelhead	Juvenile	High. Juvenile salmonids will be present or potentially present	Low to medium Sound pressure levels will be well below threshold for instantaneous injury (i.e. barotrauma). Vibratory hammering have not been observed to cause injury or death to fishes or other aquatic organisms.	Low to high. We expect that exposed juveniles will display varying levels of behavioral responses from no change, to mild awareness, or a startle response. Fish may relocate away from noise. Fish may relocate to areas with greater risk of predation by birds or larger fish resulting in injury or death of some individuals. We conclude that this stressor will cause a range of consequences at the individual fitness level up to and potentially including death.	
Pile driving	Temporary increase in turbidity and suspended sediment during installation of piles for up to a week during November or December 2020.	Adult salmonids Columbia River chum and LCR coho	Adult	High. Adult salmonids will be present or potentially present	Low. Only minor and short-term increases in turbidity and suspended sediment are anticipated. These levels are not expected to be substantial enough to exceed background variability in turbidity and suspended sediment	Low. We expect exposed adult salmonids will experience short-term, very minor behavioral responses including reduced vision or swim away from. We conclude that these responses are unlikely to reduce an exposed individual's fitness	

Pile driving	Temporary increase in turbidity and suspended sediment during installation of piles for up to a week during November or December 2020.	Juvenile salmonids present or potentially present in November or December including Juvenile LCR chinook, Upper Columbia River chinook, Upper Willamette River chinook, Snake River fall chinook, LCR coho, and LCR steelhead	Juvenile	High Juvenile salmonids will be present or potentially present.	Low	Low. Only minor and short-term increases in turbidity and suspended sediment are anticipated. These increases may not be substantial enough to exceed background variability in turbidity and suspended sediment. Anticipated behavioral effects include short-term reduction in feeding rates and feeding success. Individuals may startle, experience reduced vision, stops feeding to reorient, and may swim away.	
Pile installation	Reduction of benthic invertebrate habitat	All adult salmonids present in LCR (year round)	Adult	High	Low	Low. Piles will occupy about 180 square feet of benthic habitat and will remain in place following completion of the project. Piles will occupy space that could otherwise support a benthic invertebrate community contributing to forage for listed species. Low consequence to individual fitness.	Low. Reduction of benthic invertebrate habitat due to pile installation will have a very minor effect on forage opportunities for salmonids. Consequences to abundance, productivity, spatial structure, and diversity at the population level are highly unlikely.
Pile installation	Reduction of benthic invertebrate habitat	All juvenile salmonids present in the LCR (year round)	Juvenile	High	Low	Low. Piles will occupy about 180 square feet of benthic habitat that could otherwise support a benthic invertebrate community contributing to forage for listed species. Low consequence to individual fitness.	
Trap operation	Trapping and handling	All adult salmonids present in LCR during trap operation (April through October)	Adult	Low	Low to high.	Low to high. While there is some risk of trap-related injury or death, risk to individual fish will be minimized through trap design and handling protocols. Trap is designed to minimize handling of fish and minimize chances of injury or incidental mortality. Wild fish will be released from the trap.	Low. Trapping and handling of salmonids may result in injury or death, however trap design and handling protocols strongly minimize this risk. Consequences to abundance, productivity, spatial structure, and diversity at the population level are highly unlikely.
Trap operation	Trapping and handling	All juvenile salmonids present in the LCR during trap operation (April through October)	Juvenile	Low	Low	Low. Juvenile salmonids entering the trap may experience increased injury and predation risk due to potential interactions with adults in the trap. However, predation by adult salmonids is unlikely as salmonids generally stop feeding once they begin their freshwater migration. Also, juvenile salmonids will be able to escape from the trap by swimming through the netting.	

2.5.2. Effects on Critical Habitat

Older designations of critical habitat use either the term primary constituent element or the term essential features. The new critical habitat regulations (81 FR 7214; February 11, 2016) replace 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 primary constituent elements, physical or biological features, or essential features. In this biological opinion, we use the term PBF to mean primary constituent elements or essential feature, as appropriate for the specific critical habitat.

The lower Columbia River provides habitat and migratory passage for a diverse suite of listed salmonids. It supports multiple life history phases of these listed species. Designated critical habitat within the action area for ESA-listed salmonids considered in this opinion consists of juvenile rearing areas, juvenile and adult migration corridors, and estuarine areas (Table 8). Effects of the proposed action that may impact PBFs of these sites are the installation of piles and their continued presence in the action area until they biodegrade as the proposed action does not include removal of the piles.

Pile driving will temporarily reduce safe passage conditions during trap construction due to underwater sound and also have a minor and temporary impact to water quality in the action area through sediment release and associated turbidity. Spaced 16 feet apart, the piles pose no threat to the function of the area as a migratory corridor. The piles may indirectly impact habitat quality in the estuary by occupying a small portion of the benthic habitat which could otherwise support aquatic invertebrates providing forage for juvenile and adult listed salmonids. The forty-six, 14-inch diameter wood piles will occupy a total of 25,860 square inches or approximately 180 square feet. This is less than 1/100th of 1 percent of the total 870 acre underwater action area. A loss of potential benthic invertebrate prey habitat of this magnitude is so small as to not be significant in the context of the action area or the greater LCR. As the piles will be untreated wood we expect no impact (i.e. toxins) from the piles on water quality. NMFS finds the effects of pile driving and presence of piles on critical habitat to be minor.

Table 8. PBFs identified for freshwater critical habitats of thirteen ESA-listed salmon and steelhead species and corresponding species life history events.

Species	**Site Type**	**Site Attribute**	**Species Life History Event**
LCR Chinook salmon UCR spring Chinook salmon UWR spring Chinook salmon CR chum salmon LCR coho salmon LCR steelhead MCR steelhead UWR steelhead	Adult and juvenile rearing areas, migration corridors, and estuarine areas	Forage Free of artificial obstruction Natural cover Salinity Water quality Water quantity	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration Physiological transitions between fresh and salt water
SR spring/summer Chinook salmon SR fall Chinook salmon SR sockeye salmon SRB steelhead	Adult and juvenile rearing areas and migration corridors	Access (sockeye) Cover/shelter Food (juvenile migration and rearing) Riparian vegetation Safe passage Space (Chinook) Substrate Water quality Water quantity Water temperature Water velocity	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration

Table 9. Summary of consequences to physical and biological features of designated critical habitat. Green shading indicates low, yellow moderate, and red high.

				Critical Habitat Analysis by PBFs			
Activity	Stressor	Species	DCH attribute	Relevant PBFs	Likelihood of exposure (Yes/No)	Magnitude of effect (high, medium, low)	Consequence of exposure and effect to PBF (high, medium, Low)
Pile driving	Temporary increase in underwater sound during vibratory driving of piles for up to one week in November or December 2020.	Snake River Sockeye, Snake River Spring/ summer chinook salmon, and Snake River Fall Chinook salmon	Juvenile migration corridors Adult migration corridors	Safe passage conditions	Yes	Low	Low. Temporary reduction of safe passage conditions during trap construction due to underwater sound.
Pile driving	Temporary increase in turbidity and suspended sediment during installation of piles for up to a week during November or December 2020.	Snake River Sockeye, Snake River Spring/ summer chinook salmon, and Snake River Fall Chinook salmon	Spawning and juvenile rearing areas Juvenile migration corridors	Water quality	Yes	Low	Low. Temporary and minor reduction of water quality during pile driving due to turbidity and suspended sediment.
Pile driving	Temporary increase in turbidity and suspended sediment during installation of piles for up to a week during November pr December 2020.	LCR Coho, LCR Chinook salmon, Upper Willamette River Chinook salmon, Upper Columbia River spring-run Chinook salmon, Columbia River chum salmon, Upper Columbia River steelhead, Snake River Basin steelhead, Middle Columbia River steelhead, Lower Columbia River steelhead, Upper Willamette River steelhead	Freshwater migration corridors Estuarine areas	Water quality	Yes	Low	Low. Temporary and minor reduction of water quality during pile driving due to turbidity and suspended sediment.
Trap installation	Permanent presence of piles	Snake River Sockeye, Snake River Spring/ summer chinook salmon, and Snake River Fall Chinook salmon	Spawning and juvenile rearing areas Juvenile migration corridors	Food	Yes	Low	Low. Permanent, minor reduction in food resources due to 180 square feet of benthic invertebrate habitat transitioned to piles.

				Critical Habitat Analysis by PBFs			
Trap installation	Permanent presence of piles	LCR Coho, LCR Chinook salmon, Upper Willamette River Chinook salmon, Upper Columbia River spring-run Chinook salmon, Columbia River chum salmon, Upper Columbia River O. mykiss, Snake River Basin O. mykiss, Middle Columbia River O. mykiss, Lower Columbia River O. mykiss, Upper Willamette River O. mykiss	Estuarine areas	Forage for juveniles and adults including aquatic invertebrates and fishes	Yes	Low	Low. Permanent, minor reduction in food resources due to 180 square feet of benthic invertebrate habitat transitioned to piles.
Trap operation	Trapping and handling (April-October 2021)	Snake River Sockeye, Snake River Spring/ summer chinook salmon, and Snake River Fall Chinook salmon	Juvenile migration corridors Adult migration corridors	Safe passage conditions	Yes	Low	Low. Temporary, minor reduction of safe passage conditions when trap is in operation (April-October 2021). Freshwater migration corridors will not be fully obstructed because the pound net is designed to be lifted daily and will not continually block the riverine littoral zone from passage of fish up or downstream. Susceptibility of fish to predation from pinnipeds, birds, or other fish may occur during gear operation. Predation by pinnipeds will be minimized by active deterrence by WFC staff as has been carried out at the Cathlamet pound net.
Trap operation	Trapping and handling (April-October 2021)	LCR Coho, LCR Chinook salmon, Upper Willamette River Chinook salmon, Upper Columbia River spring-run Chinook salmon, Columbia River chum salmon, Upper Columbia River O. mykiss, Snake River Basin O. mykiss, Middle Columbia River O. mykiss, Lower Columbia River O. mykiss, Upper Willamette River O. mykiss	Freshwater migration corridors	Free of obstruction	Yes	Low	Low. Temporary, minor reduction to the function of the site as a migratory corridor free of obstruction when the trap is in operation (April-October 2021). Freshwater migration corridors will not be fully obstructed because the pound net is designed to be lifted daily and will not continually block the riverine littoral zone from passage of fish up or downstream. Susceptibility of fish to predation from pinnipeds, birds, or other fish may occur during gear operation. Predation by pinnipeds will be minimized by active deterrence by WFC staff as has been carried out at the Cathlamet pound net.

2.5.3 Effects of Gear Operation on Listed Species and Critical Habitats

In this subsection, we evaluate the effects of the operation of the pound net gear (hereafter "gear operation"), on salmon and steelhead and their designated critical habitat. To do this, we describe the evaluation approach and underlying assumptions, discuss the species that will be affected, describe the mechanisms by which gear operation will affect individuals, then we describe the consequences of effects on each affected species.

Evaluation Approach and Underlying Assumptions

Fisheries, research, and monitoring in the Columbia River are managed subject to provisions of the 2018-2027 United States v. Oregon (US v Oregon) Management Agreement (NMFS 2018). A Biological Assessment (TAC 2017) by the US v Oregon Technical Advisory Committee (TAC) assessed the effects on listed species of the management framework and NMFS consulted on the effects in a 2018 Biological Opinion (NMFS 2018). We refer to this here as the analyses, concepts, and research in the NMFS 2018 opinion are applicable to this proposed action as described in the following sections.

Under the NMFS 2018 opinion, WFC operates a pound net that is analogous to the design and operation and proximal (across the Columbia River in the Cathlamet Channel) to the location of the pound net in the proposed action. Because of these similarities, it is reasonable to expect that the species encountered and effects from the proposed action would be similar to the pre-existing pound net. We can use the information from the operation of the Cathlamet pound to help evaluate the effects from the proposed action. Specifically, we can use the data on number and species of fish caught to determine if the proposed catch is likely to occur. Catch from the Cathlamet pound net is shown in Table 10.

Gear operation incorporates fish capture and handling. Capture and handling can increase stress, causing injury or death of individual fish. To estimate the number of fish that will die as a result of gear operation we apply incidental mortality rates to the number of fish expected to encounter the gear. For the proposed action, we will use rates of incidental mortality established for fish released from pound net gear in the Columbia River at the Cathlamet site (TAC 2017). The incidental mortality rates are shown in Table 11.

Overlapping run-timing (Figure 3) of many species of salmonids in the Columbia River makes it difficult to separate ESUs and DPSs into their individual units (TAC 2017). In the Columbia River, fisheries management is very complex and stock surrogates are used to represent fish populations that can be managed as a group because they are exposed to similar fishery-related impacts and/or they represent the smallest unit of fish that can be enumerated and monitored. Stock surrogates can be used at different levels of resolution depending on the resolution of the available data. The use of stocks as surrogates to assess effects on ESA-listed salmon and steelhead species has been useful and effective (NMFS 2008; TAC 2017; NMFS 2018). We will use the same surrogates for the effects analysis in this opinion. Table 12 lists the stock surrogates for the Colombia River ESUs and DPSs that are used to assess impacts in Columbia River fisheries and research.

Effects on ESA-Listed species

Effects on Juvenile Salmon and Steelhead

Juvenile salmon and steelhead will encounter the pound net during gear deployment and operation. Individual juvenile salmonids are small enough to pass through the webbing of the net so effects will be limited to those resulting from encounter with the gear including stress and momentary changes in behavior. Effects on individual juvenile salmonids would be spread across multiple cohorts from all the DPSs and ESUs originating in the Columbia River basin. This would make the effect from encounter with the gear even smaller for any individual ESU or DPS. The occurrence will be a negligible percent of the individuals that encounter the gear.

Effects on Adult Salmon and Steelhead

Adult salmon and steelhead will be captured, handled, and sampled under the proposed action. In this subsection, we describe the effects on individual salmon and steelhead collectively without making distinction between the species. During gear operation, fish will be guided into a trap, captured, collected, handled, and released. Collectively, these actions can lead to stress, changes in behavior, injury, and/or death of individual fish if they become exhausted in the net or if they sustain injuries such as abrasion, scale loss, or fin damage.

After fish are captured they will be handled for the purpose of sorting and biological sampling. This handling during sampling can result in physical trauma, fish being held out of the water, and potential infections leading to stress, injury, or death. Stress in fish can be debilitating, can increase the vulnerability to subsequent challenges, and, if severe enough, can lead to death (Sharpe et al. 1998). In addition, stress in salmonids increases rapidly at water temperatures exceeding 64°F (18°C) and at reduced levels of dissolved oxygen. Stress can be minimized by careful handling, minimizing the time that fish are held out of the water, reducing operations when water temperatures exceed exceeds 64°F (18°C), and by preventing overcrowding of fish in holding pens.

During sampling, fish will be fin-clipped and tagged with Passive Integrated Transponder (PIT) tags. All sampling, tagging, and clipping procedures have an inherent potential to stress, injure, or even kill fish (Sharpe et al. 1998). However, fin clips have been shown to heal quickly and without long lasting effects (Stolte 1973) and PIT tagging has been shown to have diminutive effects on growth, survival, or behavior (Prentice et al. 1990). Potential effects from fin-clipping and tagging can be minimized through careful procedures. Retention of fish or intentional mortality is not part of the proposed action and is not anticipated to occur. However, the effects described above can result in incidental mortality that occurs immediately or later in time. Methods for estimating this incidental mortality are described above.

Analysis of Effects

The gear operation and the amount of fish expected to be captured, handled, sampled and released (hereafter, handling) are described in WFC's applications to NOAA Bycatch Engineering Program (BREP) and NOAA Authorizations and Permits for Protected Species

(APPS) (WFC 2019 and APPS File # 22997). We summarized the total proposed handling by species in Table 10. This can be compared to the handling from the existing Cathlamet pound net. The amount of handling anticipated from the proposed gear operation is similar to the actual handling that occurred during operations of the pound net in Cathlamet Channel (Table 13). The exception to this is sockeye. The Cathlamet pound net was operated in 2019 during June and July when sockeye are typically migrating through the Columbia River. The gear operation in the proposed action will not occur from June through August 14. As a result, proposed handle of sockeye is limited to 40 fish.

Effects of the gear operation on ESA-listed species are estimated by calculating a handling rate for each affected surrogate stock. For each stock, we use the proposed handling and estimated abundance of the stock (average run size) to estimate the percent of that stock that will be affected during gear operation. Using the established rates for incidental mortality (discussed above), we can apply this to the handling rate to estimate the percent of each stock that will die as a result of the gear operation. Table 14 lists the ESU/DPS, surrogate stock, abundance, handling, incidental mortality rate, and total estimated mortality for each species that will be affected by the proposed action. Rates of handle and incidental mortality are expressed as the percent of the ESU or DPS affected. These rates are based on recent-year average run sizes and established rates for release mortality by ESU/DPS. Handle rates across all species is expected to range from 0.03% to 1.81%. Incidental mortalities resulting from handling range from .004% to 0.163%. For example, we expect the highest level of effects to occur on LCR coho with expected handling and mortality rates of <2% and <0.2%, respectively. The effects from the proposed gear operation will only occur during a single return year.

Table 10. Number of adult salmonids and sturgeon captured at a pound net operation in Cathlamet Channel, Washington, during 2016 to 2019.

Species	Run	Year			
		2016	2017	2018	2019
Chinook	Spring				75
	Summer				61
	Fall	425	2,669	1,508	434
Chum	Fall			2	2
Coho	Fall	546	3,497	972	3,494
Sockeye	Summer				894
Steelhead	Winter				83
	Summer	816	921	325	494
White Sturgeon	N/A				1

Table 11. Incidental mortality rates established for fish release from pound net gear in the Columbia River (TAC 2017).

Species	Incidental Mortality Rate
Chinook Salmon	7.0%
Coho Salmon	9.0%
Sockeye Salmon	13.0%
Steelhead	6.0%

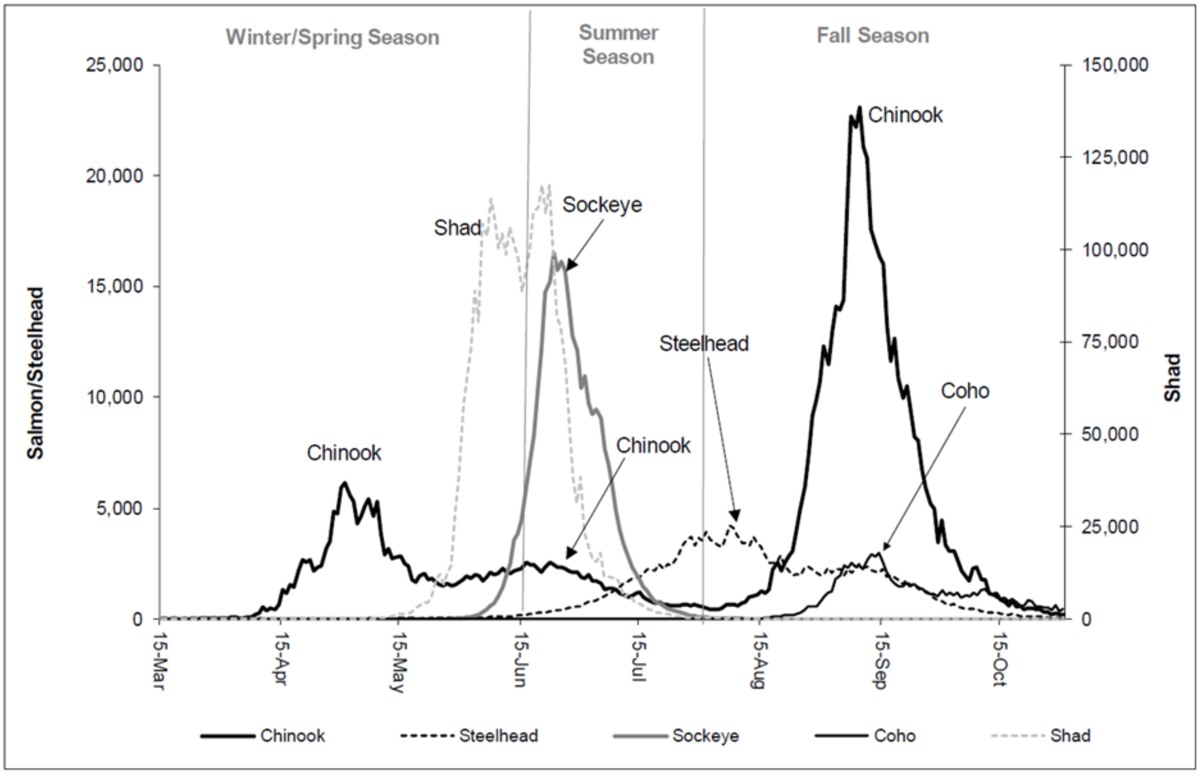

Figure 1. Average daily counts of salmon, steelhead, and American Shad at Bonneville Dam, 2008–2019 (ODFW and WDFW 2020b).

Table 12. Species, surrogate stock, and stock descriptions for ESA-Listed salmon and steelhead in the Columbia River (NMFS 2018).

Species	ESA-listed ESU or DPS	Stock Surrogate	Stock description
Steelhead	UWR Steelhead DPS	Winter Steelhead	Steelhead handled in the LCR from November 1 through April 30 and in the Bonneville Pool from November 1 through March 31
	LCR Steelhead DPS (winter component)	Winter Steelhead	Steelhead handled in the LCR from November 1 through April 30 and in the Bonneville Pool from November 1 through March 31
	LCR Steelhead DPS (summer component)	Summer Skamania Steelhead	Steelhead handled in the LCR from May 1 through June 30 and in the Bonneville Pool from April 1 through June 30
	MCR Steelhead DPS (winter component)	Winter Steelhead	Steelhead handled in the LCR from November 1 through April 30 and in the Bonneville Pool from November 1 through March 31
	MCR Steelhead DPS (summer component)	Summer A-Index Steelhead	Steelhead destined to cross Bonneville Dam between July 1 through October 31 and measuring less than or 78 cm fork length
	MCR Steelhead DPS (minor component of Index)	Summer B-Index Steelhead	Steelhead destined to cross Bonneville Dam between July 1 through October 31 measuring greater than or 78 cm fork length
	UCR Steelhead DPS	Summer A-Index Steelhead	Steelhead destined to cross Bonneville Dam between July 1 through October 31 measuring less than or 78 cm fork length
	UCR Steelhead DPS (minor component of Index)	Summer B-Index Steelhead	Steelhead destined to cross Bonneville Dam between July 1 through October 31 measuring greater than or 78 cm fork length
	Snake River Basin Steelhead DPS	Summer A-Index Steelhead	Steelhead destined to cross Bonneville Dam between July 1 through October 31 measuring less than or 78 cm fork length
	Snake River Basin Steelhead DPS (primary Component of Index)	Summer B-Index Steelhead	Steelhead destined to cross Bonneville Dam between July 1 through October 31 measuring greater than or 78 cm fork length
Chinook	LCR Chinook Salmon ESU (bright component)	Lower River Wild Fall Chinook	Late fall bright Chinook salmon returning to the North Fork Lewis and Sandy rivers
	LCR Chinook Salmon ESU (tule component)	Lower River Hatchery Fall Chinook	Tule fall Chinook salmon returning to hatcheries and spawning areas below Bonneville Dam
	Snake River fall-run Chinook Salmon ESU	Upriver Bright Fall Chinook	Chinook salmon destined for the Hanford Reach section of the Columbia River and for the Deschutes, Snake, and Yakima rivers.
	Snake River spring/summer-run Chinook Salmon ESU	Upriver spring/summer Chinook	Chinook salmon entering the Columbia River destined to cross Bonneville Dam between January 1 and June 15
	UCR spring-run Chinook Salmon ESU	Upriver spring/summer Chinook	Chinook salmon entering the Columbia River destined to cross Bonneville Dam between January 1 and June 15
Coho	LCR Coho Salmon ESU	Lower River Coho	Coho salmon entering the Columbia River not destined to pass Bonneville Dam
	LCR Coho Salmon ESU	Upriver Coho	Coho salmon destined to pass Bonneville Dam

Species	ESA-listed ESU or DPS	Stock Surrogate	Stock description
Sockeye	Snake River Sockeye Salmon ESU	Sockeye	Sockeye salmon entering the Columbia River
Chum	Columbia River Chum Salmon ESU	Chum	Chum salmon returning to the Columbia River

Table 13. Proposed handling of adult salmonids during gear operation of the proposed action in Clifton Channel, Oregon (APPS # 22997).

Species	Run	Life Stage	Proposed Handling
Chinook	Spring	Adult	1,000
	Fall	Adult	3,000
Chum	Fall	Adult	40
Coho	Fall	Adult	3,500
Sockeye	Summer	Adult	40
Steelhead	Winter	Adult	350
	Summer	Adult	1,300

Table 14. Rates of handling and mortalities of salmon and steelhead stocks for ESA-listed species affected by the gear operation during the proposed action. Run size information and release mortality rates are compiled from TAC resources (TAC 2017).

Species	ESU/DPS	Stock Surrogate	Run size information	Return Years	Average Run Size	Proposed Take	Incidental Mortality Rate	Handling as % of ESU/DPS	Mortalities as % of ESU/DPS
Chinook Salmon	Upper Columbia River spring-run	Spring Chinook	Upriver spring Chinook entering the Columbia River	2017 - 2019	101,344	1,000	7.0%	0.60%	0.042%
	Snake River spring/summer run								
	Upper Willamette River		Lower river spring Chinook entering the Columbia River	2017 - 2019	65,216				
	Snake River fall-run	Fall Chinook	Fall Chinook entering the Columbia River	2016 - 2018	470,800	3,000	7.0%	0.64%	0.045%
	Lower Columbia River								
Chum Salmon	Columbia River	N/A	Chum salmon returning to the Columbia River	2015-2018	22,190	40	4.0%	0.18%	0.007%
Coho Salmon	Lower Columbia River	N/A	Coho entering the Columbia River	2016 - 2018	193,000	3,500	9.0%	1.81%	0.163%
Sockeye Salmon	Snake River	N/A	Sockeye entering the Columbia River	2017 - 2019	120,800	40	13.0%	0.03%	0.004%
Steelhead	Upper Willamette River	Winter Steelhead	Wild winter steelhead returning to the Columbia River	2016 - 2018	43,150	350	6.0%	0.81%	0.049%
	Middle Columbia River								
	Lower Columbia River								
	Lower Columbia River	Summer Steelhead	Summer steelhead returning to Bonneville Dam	2016 - 2018	133,789	1,300	6.0%	0.97%	0.058%
	Middle Columbia River								
	Upper Columbia River								

Species	ESU/DPS	Stock Surrogate	Run size information	Return Years	Average Run Size	Proposed Take	Incidental Mortality Rate	Handling as % of ESU/DPS	Mortalities as % of ESU/DPS
	Snake River Basin								
	Middle Columbia River								
	Upper Columbia River								
	Snake River Basin								

Effects on PBFs of Designated Critical Habitat from Gear Operation

Critical habitat has been designated for the ESA-listed species considered in this opinion (Section 2.2.4). The PBFs for freshwater critical habitat in the action area include: (1) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rock and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival, and (2) Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility, water quality and forage supporting juvenile development, and natural cover such as shade, submerged and overhanging large wood, and log jams.

The impacts on critical habitat resulting from gear operation will be limited to the immediate vicinity of the gear location, and will be transitory in duration. The activities associated with the pound net operation would be capturing and sampling fish, operating boats, and deploying the gear. Freshwater migration corridors will not be obstructed because the pound net is designed to be lifted daily and will not continually block the riverine littoral zone from passage of fish up or downstream.

As described in the Environmental Baseline, the migration corridor is already affected by predation from pinnipeds, birds, and other fish. Nothing in the proposed action will exacerbate these migration corridor issues, although they are reasonably certain to persist during gear operation. However, WFC staff will minimize pinniped predation using active deterrence following NMFS guidance. These techniques are already in use at the Cathlamet pound net.

The gear will cause only minor disturbance to streambank vegetation and channel substrate. It will not remove or measurably alter the existing littoral habitat structure in the project area. Water quality may be temporarily affected due to an increase in suspended sediments from the gear operation. However, sedimentation and turbidity will be confined to a small area adjacent to the construction site and will quickly dissipate.

Based on the foregoing, none of the activities will measurably affect any salmonid critical habitat PBFs.

2.6 Cumulative Effects

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

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the future environmental conditions in the action area caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. We can reasonably expect climate change to create more variable conditions in water temperatures, volumes (flood levels and low water levels), and possible long term changes in salinity, all of which can modify foodwebs and in turn put greater stress on salmonid populations.

Future state and private activities outside of the action area are expected to cause habitat and water quality changes that are expressed as cumulative effects within the action area. Our analysis considers: (1) how future activities in the Columbia River basin are likely to influence habitat conditions in the action area, and (2) cumulative effects caused by specific future activities in the action area.

Approximately six million people live in the Columbia River basin, concentrated largely in urban centers. During the past 10 years the human population within the seven counties comprising the Portland-Vancouver metropolitan area increased annually by about five percent (PMC 2016). The human population in the Columbia River watershed is projected to continue increasing although at a somewhat slower rate. The past effect of that population is expressed as changes to physical habitat and loadings of pollutants contributed to the Columbia River. These changes were caused by residential, commercial, industrial, agricultural, and other land uses for economic development, and are described in the Environmental Baseline (Section 2.4). Additional degradation to physical and biological features is likely to continue to occur as the human population in the area continues to increase.

Effects associated with increased human population are continued development, such as increased pollutants, shoreline habitat degradation, underwater noise, and wake stranding will likely increase from greater commercial and recreational boat and ship traffic. The collective effects of these activities tend to be expressed most strongly in lower river systems where the impacts of numerous upstream land management actions aggregate to influence natural habitat processes and water quality. As such, these effects accrue within the action area, though most are generated from actions upstream.

As previously discussed in Section 2.2, changing climate conditions will put additional stress on the ability of critical habitat to support all of the physical and biological features necessary to sustain listed species in the Columbia River watershed. Summer low flows throughout much of the Columbia watershed may decrease between 35-75 percent (Beechie et al. 2013). As human population in the Portland-Vancouver area continues to grow residential development will reduce the quality and quantity of floodplain habitat as riparian vegetation is cleared and streambank armoring actions are approved to reduce erosion. Some researchers suggest increased connectivity to floodplain areas has high potential to offset for lack of growth areas were habitat characteristics and growth potential is lacking (Katz et al. 2017).

While widespread degradation of aquatic habitat associated with intense natural resource uses is no longer common, ongoing and future land management actions are likely to continue to have adverse effects on aquatic habitat quality in the Columbia River basin and within the action area. Improvements in the quality of available aquatic habitat is likely to be slow in most areas.

2.7 Integration and Synthesis

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

The salmon and steelhead considered in this opinion are listed as threatened or endangered based on declines from historical abundance, low productivity, loss of spatial structure, and reduced diversity. A variety of factors limit the survival and recovery of these salmonids. Common themes include adverse effects related to the mainstem Columbia River hydropower system; diminished access, quality, or quantity of spawning and rearing habitat; and hatchery and harvest-related effects. In this biological opinion, NMFS determined that individuals from 13 species of salmon in the Columbia River may be exposed to the effects of the action.

Species at greatest risk of temporary effects from pile driving for trap construction are those species expected to be present in the action area during November or December. In addition to those species typically present in the action area during this time period, individuals from additional listed salmonid species may be present in low abundances during trap installation. Risk to these additional species is very low due to the low likelihood of their presence during trap construction. We found that effects to exposed individuals would be minor as piles will be driven with a vibratory hammer, which will have sound pressure levels well below the threshold for barotrauma. Behavioral responses are anticipated such as startling and relocating away from the noise, which may lead to increased risk of predation particularly for juveniles. Salmonids also have a high likelihood of exposure to temporarily increased turbidity and suspended sediment during pile driving. Affected juveniles may experience a short-term reduction in feeding rates and feeding success. As the increased sediment will be temporary and salmonids will be able to relocate away from the sediment plume, consequences to individual fitness were found to be negligible. Therefore, consequences at the population and species level are also negligible to low.

Salmonids will also be affected by the permanent presence of piles. Piles will permanently occupy about 180 square feet of benthic habitat that might otherwise support a benthic invertebrate community providing forage for salmonids. In the context of the LCR this is a very minor loss of benthic invertebrate habitat and the effect to individuals, population, and species affected is low or negligible.

All adult salmonids present during trap operation will potentially be exposed to handling stress and/or incidental mortality as a result of trap operation. Anticipated rates of mortality by ESU/ DPS are detailed in the analysis of effects section. While some mortality is anticipated as a result of trapping and handling, rates at the ESU/ DPS level are very low and range from 0.004% to 0.163%. The proposed action is of limited duration and does not represent a recurring or annual event. Trap operation will reduce the fitness and/or result in mortality of individuals, however, effects to populations and at the species level will be minor and not recurring.

In summary, fitness level consequences to exposed individuals are anticipated at low levels save for increased risk of predation to juveniles during pile driving and potential for harm or death of adult salmonids during trapping and handling. Very few individuals are expected to experience these higher level fitness consequences. None of the populations are expected to experience reductions in VSP parameters. The NMFS concludes that the proposed action, including trap operation, is not anticipated to reduce appreciably the likelihood of both the survival and recovery of these listed salmonids in the wild.

Several features of salmonid critical habitat will be slightly diminished or degraded in response to effects of the proposed action: safe passage conditions, water quality, food or forage, and freshwater migration corridors free of obstruction. Safe passage will be slightly degraded during pile driving and trap operation. The function of the area as a freshwater migration corridor free of obstruction will also be slightly degraded by trap operation. Migration corridors will not be fully obstructed because the pound net is designed to be lifted daily and will not continually block the riverine littoral zone from passage of fish up or downstream. Water quality impairments through sediment release will be minor, brief, and quickly dispersed by currents. Food or forage will be diminished through the installation of piles but the lost benthic invertebrate community (180 square feet) is negligible. Gear operation will not measurably affect any critical habitat PBFs.

Therefore, PBFs will not be diminished to a degree that reduces the overall conservation value of any designated critical habitat because these effects will be of low magnitude and/or temporary. We conclude that the conservation value the designated critical habitats will be retained despite these effects on features of salmonid critical habitat being added to the baseline.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of the species considered in this biological opinion or destroy or adversely modify designated critical habitat.

2.9 Incidental Take Statement

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

2.9.1 Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take in the form of harm, injury, or death is reasonably certain to occur from construction-related activities during installation and from activities during operation of the pound net:

1. Underwater noise, turbidity, and suspended sediment.

    Installation of piles is reasonably certain to harm juvenile salmonids sensitive to sound pressure levels and turbidity created from vibratory hammering, including LCR Chinook salmon, LCR coho salmon, SR fall-run Chinook salmon, and UWR Chinook salmon which are expected to be present in the action area during piling installation. Death may occur should juvenile salmonids temporarily display behavior putting them at higher risk of predation such as swimming into deeper water where predators occur. We cannot estimate the number of fish likely to be predated on because the number of fish present at the time the pile driving occurs can be highly variable. The potential harm to salmonids is related to the amount, or duration, of vibratory hammer use per day and in total. We measured the extent of take instead by a maximum of 10 hours of pile driving with a vibratory hammer per day for a maximum of seven days.

2. Capture and handling of fish.

    NMFS is reasonably certain that incidental take of ESA-listed salmon and steelhead will occur as a result of activities associated with operating the pound net. Take is expected to occur as a result of capture and handling of the ESA-listed species listed in Table 15. Handling will be monitored and enumerated during daily operations of the pound net. Stock surrogates are used to represent each ESU and DPS and the abundance of each stock will be represented as the adult return of the stock to the Columbia River during the year of operations. The abundance of the stocks are forecast each year and are adjusted in-season during regular management of fisheries in the Columbia River. The use of stock surrogates is explained in Section 2.5.3 of this biological opinion. The surrogates are defined in Table 12 and the average returns for each stock are in table 14. The extent of take is calculated as the percentage of the surrogate stock that will be handled during the proposed action and is shown in Table 15 below. If the rate of handle for any stock approaches the extent in Table 15 operations will cease to ensure that the extent of take is not exceeded.

Table 15. Incidental take limits based on expected handle and mortality of ESA-listed salmonids under the proposed action. Values are expressed as a percent of the corresponding surrogate stock.

Species	ESU/DPS	Surrogate Stock	Handle as % of ESU/DPS	Mortality as % of ESU/DPS
Chinook Salmon	Upper Columbia River spring-run	Spring Chinook	0.60%	0.042%
	Snake River spring/summer run			
	Upper Willamette River			
	Snake River fall-run	Fall Chinook	0.64%	0.045%
	Lower Columbia River			
Coho Salmon	Lower Columbia River	N/A	1.81%	0.163%
Sockeye Salmon	Snake River	N/A	0.03%	0.004%
Chum Salmon	Columbia River	N/A	0.18%	0.007%
Steelhead	Upper Willamette River	Winter Steelhead	0.81%	0.049%
	Middle Columbia River			
	Lower Columbia River			
	Lower Columbia River	Summer Steelhead	0.97%	0.058%
	Middle Columbia River			
	Upper Columbia River			
	Snake River Basin			
	Middle Columbia River			
	Upper Columbia River			
	Snake River Basin			

2.9.2 Effect of the Take

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

2.9.3 Reasonable and Prudent Measures

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

NMFS and the USACE are the Federal agencies responsible for ensuring that these reasonable and prudent measures are carried out, however, it is the applicant or its contractors that will be driving piles, conducting monitoring of catch, tracking incidental mortalities, and managing other effects of the operation. NMFS concludes that the following reasonable and prudent measures are necessary and appropriate to minimize the impacts to listed species from construction-related actions and operating the net pen:

1. The action agencies will minimize take from underwater noise, increased turbidity, and suspended sediment;
2. NMFS, in cooperation with the applicant, shall ensure impacts on listed species are monitored and minimized using the best available measures and will ensure that take does not exceed the amounts specified in this statement;
3. The applicant will continually monitor and inspect the project site and the fishing gear.
4. The applicant will prepare and provide NMFS with a post-season report documenting the research activities, data collected, and a summary of findings.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the applicant must comply with them in order to implement the RPMs (50 CFR 402.14). The USACE, NMFS, and the applicant have 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) back to NMFS. 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 may lapse.

1. The following terms and conditions will implement RPM 1 (minimize take from underwater noise and increased turbidity). The USACE shall ensure the applicant or contractor shall:

    a. Use a vibratory hammer to install all piles.

    b. Minimize the duration of vibratory hammer operation.

    c. Carry out pile driving operations as early in the in-water work window as possible.

2. The following terms and conditions will implement RPM 2 (ensure impacts on listed species are monitored and minimized using the best available measures):

    a. NMFS shall consult with the applicant to account for the catch of ESA-listed species and take will not exceed the level described in Table 15 of Section 2.9.1 of this ITS.

    b. NMFS will notify the applicant if the expected run size has changed during in-season assessments to ensure take remains within the level described in Table 15 of Section 2.9.1 of this ITS.

    c. The applicant must not intentionally kill any listed species and must handle listed fish with extreme care during sampling and processing procedures.

    d. The applicant must cease operations when the water temperature is higher than 70°F (21°C) at the capture site.

e. If listed fish are anesthetized during handling, the fish must be allowed to recover before being released. Fish that are only counted must remain in water and not be anesthetized.

f. The applicant must use a sterilized needle for each individual injection when PIT-tags are inserted into listed fish.

g. The applicant shall obtain written approval from NMFS before changing research protocols as described in the applicants' project narrative received as part of their application for the Bycatch Reduction Engineering Program.

h. The applicant, upon request, must allow any NMFS employee or representative to accompany field personnel while they conduct the research activities.

i. The applicant must obtain all other Federal, state, and local permits/authorizations needed for the research activities.

3. The following terms and conditions will implement RPM 3 (continually monitor and inspect the project site and the fishing gear).

    a. The applicant must inspect all webbing throughout the operation of the gear. Fish that are caught, entangled, wedged, or otherwise ensnared in the gear must be identified and enumerated.

    b. The applicant will enumerate and describe all interactions with marine mammals. Descriptions should include the duration of the encounter and the type of interaction that occurred (E.g., encounter with lead nets and marine mammal gate and if/when marine mammal entered the heart, spiller, live box etc.) In addition, an attempt must be made to enumerate and identify any fish that are preyed upon by marine mammals.

4. The following terms and conditions will implement RPM 4 (prepare and provide NMFS with a post-season report):

    On or before September 30, 2021, the applicant must submit a post season report to NMFS. This comprehensive final report should describe the research activities; incidents when operation was suspended; issues encountered during operation and steps taken to ameliorate the issue; the number of fish encountered, captured, sampled and released including the date of occurrence; the number of fish unintentionally killed (including the date); and a summary of the research results. The report must be submitted electronically to the NOAA Grants OnLine portal.

2.10 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02). To further reduce impacts to salmonids, particularly more vulnerable juvenile salmonids, NMFS recommends the use of a bubble curtain during the installation of piles.

2.11 Reinitiation of Consultation

This concludes formal consultation for the Wild Fish Conservancy Brownsmead Pound Net Project.

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

2.12 "Not Likely to Adversely Affect" Determinations

2.12.1 Southern Resident Killer Whale DPS

Southern Resident killer whales (SRKW) are not a target of the research in the proposed action and their presence in the action area is not anticipated. No direct impacts to SRKW or their critical habitat are anticipated from the construction or operation of this gear. However, the proposed action may impact the SRKW indirectly by impacting salmonid stocks upon which the SRKW feeds. Southern Resident killer whales feed on chum, coho, steelhead, and other species such as halibut and ling cod; however their preferred prey is Chinook salmon. NMFS analyzed Chinook salmon stocks from southeast Alaska through California and identified those stocks most important to Southern Resident killer whales (NMFS and WDFW 2018). Several Columbia River chinook stocks are identified in this priority ranking, including Lower Columbia River fall tule and fall brights which are ranked as the third-highest priority chinook stock. The proposed action may impact LCR fall tules and fall brights and other Chinook stocks identified as priority stocks for Southern Resident killer whales. While the proposed action may cause behavioral modification or harm to individual Chinook salmon from stocks of importance to Southern Resident killer whales, the collective impact of the proposed action on the Southern Resident killer whale's diet is expected to be so minor as to not be meaningfully measurable. Anticipated mortalities of fall Chinook is 0.045% of the ESU/ DPS and this represents Lower Columbia River fall Chinook as well as Snake River fall run Chinook, which are not identified as a priority stock for SRKW. This represents a very minor diminishment of fall Chinook potentially available as prey for SRKW. As described in the proposed action, pound net operation will be short term (April through October 2021) and the 0.045% mortality will only effect Chinook returning during 2021. The proposed action is neither long-term nor reoccurring. The proposed action is not likely to adversely affect the Southern Resident killer whale DPS and their critical habitat.

Critical habitat for the SRKW was designated in 2006 and a proposed rule to revise designated critical habitat for this species was published in 2019. Salmon leaving the Columbia River would enter into the Coastal Washington/ Northern Oregon inshore and offshore areas which are part of the SRKW proposed revised designated critical habitat. During their life cycle, salmon from the Columbia River can migrate into other areas of proposed revised or original DCH for SRKW where they would potentially contribute to prey resources for SRKW. Of the three physical and biological features (PBFs; water quality, prey, and passage) of this proposed revised designated critical habitat, the proposed action would affect prey species for the SRKW. As described in the preceding paragraph, effects of the proposed action on SRKW prey species are expected to be so small as to not be meaningfully measurable. NMFS determined that the proposed action may affect and is not likely to adversely affect proposed SRKW critical habitat.

2.12.2 Southern DPS of Green Sturgeon

Southern DPS green sturgeon are not a target of the research in the proposed action and encounters are unlikely. Green sturgeon have not been encountered at the Cathlamet pound net and only 4 white sturgeon have been caught. Using data from 2019 recreational fisheries in the Columbia River we can estimate that the encounter rate for green sturgeon is 1 for every 1,800 white sturgeon (ODFW and WDFW 2020a). Any sturgeon encountered by the gear will be allowed to swim passively from the gear if encountered. Thus, effects on individual sturgeon would be limited to those resulting from encounters with the gear or present during installation of the gear including stress and momentary changes in behavior. Given the extremely unlikely event that a southern DPS green sturgeon will be encountered and the transitory nature of the encounter, the proposed action is not likely to adversely affect Southern DPS green Sturgeon. For the reasons in the next paragraph, any potential effects related to green sturgeon habitat are expected to be insignificant

Critical habitat for the southern DPS of green sturgeon includes the lower Columbia River estuary. Primary constituent elements (PCEs) identified as present in this area are food, passage, sediment quality, and water quality. Installation of pilings to support the pound net and benthic invertebrate habitat lost due to piling installation may have a minor effect on food resources for the green sturgeon. The presence of piles spaced 16 feet apart in the lead and heart and approximately 8 feet apart in the upstream and downstream pots will not impede passage of green sturgeon. There will be a temporary and minor increase in turbidity during pile installation. This temporary increase in turbidity is anticipated to be so small as to not have a meaningfully measureable impact on sediment quality or water quality PCEs for the green sturgeon. Because all potential effects to PCEs are expected to be insignificant, the proposed action is not likely to adversely affect critical habitat for the Southern DPS green sturgeon.

2.12.3 Southern DPS of Pacific Eulachon

Southern DPS Pacific eulachon are not a target of the research in the proposed action and encounters are highly unlikely. Trap operation will take place April 1 through October 31 which is outside of the typical migration timing for eulachon. Eulachon typically enter the Columbia River system in the winter with peak entry and spawning during February and March (Gustafson et al. 2010). Pile driving for trap construction will take place in November or December, when eulachon are less likely to be present. Eulachon have not been encountered in the Cathlamet pound net operations. In addition, individual eulachon are small enough to pass through the webbing if they are encountered so effects are limited to those resulting from encounter with the gear, including stress and momentary changes in behavior. Given the unlikely event that Pacific eulachon will be encountered and the transitory nature of the encounter, the proposed action is not likely to adversely affect Southern DPS Pacific Eulachon.

Critical habitat for the southern DPS of eulachon was designated in 2011. In the Columbia River, designated critical habitat for this species extends from the mouth of the river to Bonneville dam. PCEs of eulachon critical habitat are freshwater spawning and incubation sites, freshwater and estuarine migration corridors, and nearshore and offshore marine foraging habitat. The proposed action will occur in an area not known to provide eulachon spawning and incubation; however adult eulachon may migrate upstream through the action area and egg/ larval eulachon may drift downstream through the action area. All life history phases of eulachon are small enough to pass through the netting of the pound net so the net poses no threat to their upstream or downstream migration. Adult eulachon stop feeding when they return to freshwater, and it is believed that newly hatched eulachon larvae are absorbing their yolk sac during outbound migration so project impacts on benthic habitat (and associated potential forage) are not relevant for eulachon. NMFS determined that the proposed action is not likely to adversely affect southern DPS eulachon designated critical habitat.

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

Section 305(b) of the MSA directs Federal agencies to consult with 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 conducted by NMFS 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 NMFS determined that the proposed action would adversely affect EFH designated for five species of Chinook salmon (LCR, SR fall-run, SR spring/summer-run, UCR, and UWR) and LCR coho salmon. The action area includes those designated as EFH for various life history stages of Chinook salmon and coho salmon (PFMC 2014). The effects of the proposed action on EFH are the same as those described above in the ESA portion of this document. As discussed above in the ESA effects analysis (Section 2.5) in greater detail, the proposed action will adversely affect aquatic habitat and Chinook salmon and coho salmon migrating through the action area during trap construction and operation.

3.2 Adverse Effects on Essential Fish Habitat

Based on the information provided in grantee's research proposal and the analysis of effects presented in the ESA portion of this document, the NMFS concludes the proposed action will have adverse effects on EFH designated for Chinook salmon and coho salmon. These effects include:

1. Suspended sediment (reduced water quality)
2. Reduced function of migratory habitat (obstructions and predation)
3. Reduction in forage from benthic sources
4. Underwater noise

3.3 Essential Fish Habitat Conservation Recommendations

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2, above, approximately 870 acres of designated EFH for Pacific Coast salmon.

The NMFS recommends the COE require the following actions to minimize effects on Pacific Coast salmon EFH:

1. Use only untreated wood piles.
2. Ensure pile driving is completed in an efficient manner minimizing total days of pile driving.

Fully implementing these EFH conservation recommendations would protect, by minimizing the adverse effects described in Section 3.2, above, approximately 870 acres of designated EFH for Pacific Coast salmon.

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

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

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the NMFS and USACE. Other interested users could include the Wild Fish Conservancy. Individual copies of this opinion were provided to the USACE. The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adheres to conventional standards for style.

4.2 Integrity

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

4.3 Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

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Appendices

Appendix A. Research proposal (double click to open).

Wild Fish Conservancy: Evaluation of an Experimental Commercial Pound Net for Stock-Selective Harvest and Ecological Monitoring in the Lower Columbia River, OR.

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The Problem: Bycatch impacts from non-selective conventional gears in Pacific Northwest salmon fisheries impede the recovery of ESA-listed salmonids and Southern Resident killer whales (SRKW), constraining commercial fishing opportunities (Program Priority I.B.1.b).

Solution/Project objectives: Wild Fish Conservancy (WFC) and partners propose further testing of pound net traps for selective harvest and ecological monitoring in lower Columbia salmon fisheries from April-October 2020. Specifically, objectives are to 1) construct and monitor the performance of a substantially modified pound net trap in a currently untested location within the lower Columbia River, OR; and 2) determine the effectiveness of the trap in targeting hatchery reared Chinook and coho salmon stocks while reducing ESA-bycatch mortality.

Summary of work: A 2nd experimental pound net will be constructed in a new location of the lower Columbia River and evaluated through a test fishing period in which catch composition, bycatch, immediate survival, and ESA-salmonid post-release survival are monitored.

Benefits: If the gear proves effective in capturing hatchery-origin Chinook and coho salmon with improved survivorship of salmonid bycatch relative to previously tested gears, a viable selective gear may be implemented throughout the lower Columbia Basin and beyond, benefiting wild salmonid recovery, SRKW, and coastal fisheries in both WA and OR.

Federal Budget Information: $180,000 (2020); $19,836 (2021).

1

Appendix B. Diagrams of proposed trap and photographs of example trap (double click to open).