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

Refer to NMFS No.:
WCR-2018-8958

May 15, 2018

William Abadie
Acting Chief, Regulatory Branch
Portland District, Corps of Engineers
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FEMA Region X
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Phillip Ditzler
Oregon Division Administrator
Federal Highways Administration
530 Center Street, Suite 420
Salem, Oregon 97301

Re: Endangered Species Act Section 7 Programmatic Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Tidal Area Restoration Authorized, Funded, or Implemented by the Corps of Engineers, Federal Emergency Management Agency, and Federal Highways Administration, in Oregon and the Lower Columbia River

Dear Mr. Abadie, Mr. Eberlein, and Mr. Ditzler:

The enclosed document contains a programmatic biological opinion (opinion) prepared by the National Marine Fisheries Service (NMFS) pursuant to section 7(a)(2) of the Endangered Species Act (ESA) on the effects of authorizing, funding, and/or implementing tidal area restoration actions by the Corps of Engineers (Corps), Federal Emergency Management Agency (FEMA), and Federal Highways Administration (FHWA) in Oregon and the lower Columbia River.

In this opinion, we concluded the proposed actions are not likely to jeopardize the continued existence of the following 17 species, or result in the destruction or adverse modification of their proposed or designated critical habitats:

1. Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*)
2. Upper Willamette River (UWR) Chinook salmon
3. Upper Columbia River (UCR) spring-run Chinook
4. Snake River (SR) spring/summer-run Chinook salmon
5. SR fall-run Chinook salmon
6. Columbia River (CR) chum salmon (*O. keta*)
7. LCR coho salmon (*O. kisutch*)
8. Oregon Coast (OC) coho salmon

9. Southern Oregon/Northern California Coast (SONCC) coho salmon
10. SR sockeye salmon (*O. nerka*)
11. LCR steelhead (*O. mykiss*)
12. UWR steelhead
13. Middle Columbia River (MCR) steelhead
14. UCR steelhead
15. Snake River Basin (SRB) steelhead
16. Southern distinct population segment Pacific eulachon (*Thaleichthys pacificus*)
17. Southern distinct population segment green sturgeon (*Acipenser medirostris*)

As required by section 7 of the ESA, we are providing an incidental take statement (ITS) with the opinion. The ITS describes reasonable and prudent measures NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this program. The ITS also sets forth nondiscretionary terms and conditions, including reporting requirements, that the Federal action agencies must comply with to carry out the reasonable and prudent measures. Incidental take from actions that meet these terms and conditions will be exempt from the ESA's prohibition against the take of the listed species considered in this opinion.

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

If the response is inconsistent with the EFH conservation recommendations, the action agency must explain why the recommendations will not be followed, including the scientific justification for any disagreements over the effects of the program and the recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, we established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we request that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

Please direct questions regarding this opinion to Chuck Wheeler at 541.957.3379 of my staff in the Oregon Coast Branch of the Oregon Washington Coastal Office.

Sincerely,

Barry A. Thom
Regional Administrator

cc: Jaimee Davis, COE
Barry Gall, FEMA
Tom Loynes, NMFS
Teena Monical, COE

WCR-2018-8958

Endangered Species Act – Section 7 Programmatic Biological Opinion, Letter of Concurrence and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation
for

Tidal Area Restoration Authorized, Funded, or Implemented by the Corps of Engineers, Federal Emergency Management Agency, and Federal Highways Administration in Oregon and the Lower Columbia River

NMFS Consultation Number: WCR-2018-8958

Action Agencies: Corps of Engineers, Portland District
Federal Emergency Management Agency, Region X
Federal Highways Administration, Oregon Division

Affected Species and NMFS' Determinations:

ESA-Listed Species	ESA - Status	Is the action likely to adversely affect this species or its critical habitat?	Is the action likely to jeopardize this species?	Is action likely to destroy or adversely modify critical habitat for this species?
Lower Columbia River Chinook salmon	T	Yes	No	No
Upper Willamette River Chinook salmon	T	Yes	No	No
Upper Columbia River spring-run Chinook salmon	E	Yes	No	No
Snake River spring/summer run Chinook salmon	T	Yes	No	No
Snake River fall-run Chinook salmon	T	Yes	No	No
Columbia River chum salmon	T	Yes	No	No
Lower Columbia River coho salmon	T	Yes	No	No
Oregon Coast coho salmon	T	Yes	No	No
Southern Oregon/Northern California Coast coho salmon	T	Yes	No	No
Snake River sockeye salmon	E	Yes	No	No
Lower Columbia River steelhead	T	Yes	No	No
Upper Willamette River steelhead	T	Yes	No	No
Middle Columbia River steelhead	T	Yes	No	No
Upper Columbia River steelhead	T	Yes	No	No
Snake River Basin steelhead	T	Yes	No	No
Green sturgeon	T	Yes	No	No
Eulachon	T	Yes	No	No

Fishery Management Plan That Describes EFH in the Project Area	Would the action adversely affect EFH?	Are EFH conservation recommendations provided?
Pacific Coast Salmon	Yes	Yes
Coastal Pelagic Species	Yes	Yes
Pacific Coast Groundfish	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service
West Coast Region

Issued By:

Barry A. Thom
Regional Administrator

Date: May 15, 2018

WCR-2018-8958

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1. INTRODUCTION

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

1.1 Background

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

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). A complete record of this consultation is on file at the Oregon Coast Branch of the Oregon Washington Coastal Office in Roseburg, Oregon.

The actions covered under this opinion result from one or more of the authorities of the action agencies:

The Portland District Corps of Engineers (Corps) administers activities regulated under section 10 of the Rivers and Harbors Act of 1899 (RHA) and section 404 of the Clean Water Act of 1972 (CWA) in areas occupied by ESA-listed species or their designated critical habitats. Section 10 of the RHA requires authorization from the Secretary of the Army for the creation of any structure, excavation, or fills within the limits defined for navigable waters of the U.S, if the structure or work will affect the course, location, or condition of the waterbody. The law applies to any dredging or disposal of dredged material, excavation, filling, channelization, or any other modification of a navigable water of the U.S., and applies to all structures, from the smallest floating dock to the largest commercial undertaking. It further includes, without limitation, any wharf, dolphin, weir, boom, breakwater, jetty, groin, bank stabilization, mooring structures (such as pilings), aerial or subaqueous power transmission lines, intake or outfall pipes, permanently moored floating vessel, tunnel, artificial canal, boat ramp, aids to navigation, and any other permanent or semi-permanent obstacle or obstruction.

Section 404 of the CWA requires authorization from the Secretary of the Army, acting through the Corps, for the discharge of dredged or fill material into all waters of the U.S., including adjacent wetlands. Discharges of fill material generally include, without limitation, any placement of fill that is necessary for construction of any type of structure, development, property protection, reclamation, or other work involving the discharge of fill or dredged material. A Corps permit is required whether the work is permanent or temporary. Examples of temporary discharges included dewatering of dredged material before final disposal, and temporary fills for access roadways, cofferdams, storage, and work areas.

The Oregon Division of the Federal Highways Administration (FHWA) proposes to use the Federal Aid Highway Program (FAHP) to fund or authorize capital improvements of the transportation system in the State of Oregon, including aquatic habitat restoration and fish passage projects, especially those associated with tidegate repair and replacement. The projects are intended to contribute towards the conservation of ESA-listed species. The Oregon Division is one of 52 such offices, and is responsible for administrating the FAHP to help maintain the integrity and safety of roads and bridges in the State of Oregon. The FAHP consists of Federal grants apportioned to states by legislative formulas, at the discretion of the FHWA, or by Congressional earmark. The program is governed by Title 23 of the United States Code.

The Federal Emergency Management Agency (FEMA) has an existing programmatic opinion (refer to NMFS No.: WCR-2016-6048) covering many of the activities included below. However, major activities, such as tide/flood gate replacement and retrofit, are not. FEMA requested inclusion in this opinion to help implement the full suite of restoration activities. FEMA may use one or more grant programs under the Stafford Act or other authorities for actions covered under this opinion. The Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1974 requires authorization from the U.S. Department of Homeland Security, acting through FEMA, to direct resources and coordinate government-efforts to enable communities to prepare for, protect against, respond to, and recover from presidentially declared emergencies and disasters. Funding provided through FEMA's programs (44 CFR Part 206) supports a wide range of disaster-related activities that have the potential to affect local environmental conditions.

The FEMA provides assistance for disaster relief, technical assistance, and mitigation to states, tribes, local governments, and certain private nonprofit organizations after a presidentially declared major disaster. Major disasters are defined as any natural catastrophe or fire, flood, or explosion, regardless of cause, which is of sufficient severity to warrant assistance under the Stafford Act to alleviate the damage, loss, or hardship caused by the event.

There are two main programs FEMA uses to provide assistance for disaster relief, the Public Assistance program (PA) and the Hazard Mitigation Grant Program (HMGP). The PA provides grants to state, local, and federally recognized tribal governments and certain private non-profit entities in assisting them with response and recovery from disasters. The HMGP funds retrofits and upgrades of existing facilities, or in the case of stormwater management and minor flood control projects, HMGP will fund completely new facilities to address known hazards. The HMGP does not fund "repairs", unless the repairs are done as part of an overall design-level-of-protection upgrade for a specific facility. Other grant programs FEMA may use to provide assistance for disaster relief and non-disaster related projects include but are not limited to the following programs: the Individual Assistance (IA), the Pre-Disaster Mitigation (PDM) grant program, and the Flood Mitigation Assistance Grant Program (FMA).

1.2 Consultation History

On July 20, 2017, we met with the Corps to discuss an outline of proposed activities, including tide/flood gate replacements, the agencies wanted to cover in a programmatic consultation. Between July 20, 2017, and January 2018, staff from the Corps and NMFS continued refining the proposed action. A final proposed action was agreed upon on January 19, 2018. Preliminary discussion of a tide/flood gate programmatic between FHWA and us began on April 26, 2017. We initially inquired FEMA about inclusion into this effort on December 4, 2017. We initiated consultation on February 9, 2018, upon receiving a request from the Corps.

Each action agency requested ESA section 7 consultation on an agreed proposed action. We received the Corps request on February 9, 2018. We received FEMA's request on February 15, 2018. We received FHWA's request on April 10, 2018. The action agencies concluded that the proposed actions "may affect, and are likely to adversely affect" the following ESA-listed species and their designated critical habitats.

1. Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*)
2. Upper Willamette River (UWR) Chinook salmon
3. Upper Columbia River (UCR) spring-run Chinook
4. Snake River (SR) spring/summer-run Chinook salmon
5. SR fall-run Chinook salmon
6. Columbia River (CR) chum salmon (*O. keta*)
7. LCR coho salmon (*O. kisutch*)
8. Oregon Coast (OC) coho salmon
9. Southern Oregon/Northern California Coast (SONCC) coho salmon
10. SR sockeye salmon (*O. nerka*)
11. LCR steelhead (*O. mykiss*)
12. UWR steelhead
13. Middle Columbia River (MCR) steelhead
14. UCR steelhead
15. Snake River Basin (SRB) steelhead
16. Southern distinct population segment Pacific eulachon (*Thaleichthys pacificus*)
17. Southern distinct population segment green sturgeon (*Acipenser medirostris*)

1.3 Proposed Federal Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). "Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR 402.02). We have not identified any interrelated or interdependent actions for this consultation. We relied on the following description of the proposed action, including all project design criteria (PDCs), to complete this consultation.

The proposed Federal Action to be included in this programmatic consultation is implementation of a series of individual projects, collectively known as the Tidal Area Restoration Program

(TARP). For this consultation, the action agencies will authorize, fund, or carry out twelve categories of activities within the tidally influenced areas of the Oregon Coast, Lower Columbia River, and Lower Willamette River under their authorities specified in section 1.1. Each action agency independently reported to us the number of projects they expect to implement per year. See Table 1 for the breakdown of projects per recovery domain.

Table 1. Number of projects per year and agency, by recovery domain.

Recovery Domain	Corps	FWHA	FEMA
WLC	35	4	6
OC	35	14	6
SONCC	20	4	6

The stated goal of every project covered under this opinion must be to provide a long-term benefit to the listed species and critical habitat (for Corps actions, see description under Nationwide 27[1]). Categories of proposed activities include:

1. Tide/Flood Gate[2] Removal, Replacement, or Retrofit projects may include the removal, replacement, or the upgrade of existing tide and flood gates by modifying gate components (including the culvert/pipe) and mechanisms where full tidal exchange and/or flooding is incompatible with current land use. To be covered, the structure must meet NMFS' fish passage criteria (NMFS 2011a or subsequent) and benefit fish passage or habitat without degrading the other from existing conditions (benefitting both is possible and recommended). Habitat is benefited by increases in tidal inundation depth and duration during critical juvenile rearing or out-migration periods. Upstream passage is benefited by decreasing pipe velocity or increasing the duration of gate openness during critical migration periods. Placement of new gates where none previously existed is not covered in this consultation (moving gates, particularly with levee setbacks, is allowed, as is changing the number of gates as long as the area serviced by the gates is not increased).

2. Set-Back or Removal of Dikes and Levees to reconnect stream channels and estuaries with historical wetlands. Such activities take place where estuaries and floodplains have been disconnected from adjacent rivers by constructing berms, typically including drain pipes and tide/flood gates.

3. Large Wood (LW) and Engineered Logjams (ELJ) in stream channels and adjacent floodplains to increase channel stability, rearing habitat, pool formation, channel complexity,

[1] All actions covered under the Corps Nationwide Permit 27 must: "be planned, designed, and implemented so that it results in aquatic habitat that resembles an ecological reference. An ecological reference may be based on the characteristics of an intact aquatic habitat or riparian area of the same type that exists in the region. An ecological reference may be based on a conceptual model developed from regional ecological knowledge of the target aquatic habitat type or riparian area."

[2] A tidegate is defined as a structure which allows water to flow freely out of an upstream channel at low tide but regulates tidal flow into that channel from the downstream side. A floodgate is defined as a structure that allows a floodplain to drain on the upstream side, but regulates flood waters flowing in from the downstream side.

hiding cover, low velocity areas, and floodplain function. Such activities will occur in areas where channel structure is lacking due to past stream cleaning (LW removal) and/or riparian timber removal.

4. Dam and Legacy Structure Removal includes removal of dams, channel-spanning weirs, legacy habitat structures, earthen embankments, subsurface drainage features, spillway systems, outfalls, pipes, instream flow redirection structures (e.g., drop structure, gabion, groin), or similar devices used to control, discharge, or maintain water levels. Legacy structures include past projects, such as LW, boulder, rock gabions, and other in-channel and floodplain structures. Removal projects will be implemented to reconnect stream corridors, floodplains, and estuaries, reestablish wetlands, improve aquatic organism passage, and restore more natural channel and flow conditions.

5. Channel Reconstruction/Relocation of existing channels through excavation and structure placement (LW and boulders) or relocation (rerouting of flow) into historical or newly constructed channels that increase habitat quality. These activities apply to channel systems that have been straightened, channelized, dredged, or otherwise modified for the purpose of flood control, increasing arable land, realignment, or other land use management goals, or for channels that are incised or otherwise disconnected from their floodplains due to watershed disturbances.

6. Off- and Side-Channel Habitat Restoration implemented to reconnect historical side-channels with floodplains by removing off-channel fill and plugs. New side-channels and alcoves can be constructed in geomorphic settings that will benefit from such features. This activity category typically applies to areas where side channels, alcoves, and other backwater habitats have been filled or blocked from the main channel, disconnecting them from most if not all flow events.

7. Streambank Restoration to return streambanks to a normal rate of erosion by establishing or improving riparian vegetation. Such activities typically occur in areas where riparian vegetation is lacking due to anthropogenic removal or other flow alterations creating increased pressure on streambanks.

8. Livestock Fencing, Stream Crossings and Off-Channel Livestock Watering Facilities implemented by constructing fences and crossings (including structures that meet NMFS' fish passage criteria [NMFS 2011a or subsequent]) to exclude riparian grazing, provide controlled access for livestock and ranch vehicles transiting across streams and through riparian areas, and reduce livestock use in riparian areas and stream channels by providing upslope water facilities.

9. Piling and other Structure Removal to remove pilings, piers, vessels, boat docks, derelict fishing gear, as well as similar structures comprised of untreated and chemically treated wood, plastic, concrete, and other material. Pilings and other structures are typically used in association with boat docks, structures, and other facilities.

10. Beaver Habitat Restoration (BHR) includes installation of beaver dam analogs, riparian vegetation, and other materials to encourage beavers to build dams in stream channels, wetlands, and across floodplain surfaces.

11. Wetland Restoration restores degraded wetlands by (a) excavation and removal of fill materials; (b) contouring to reestablish more natural topography; (c) grading to prevent fish trapping (d) planting native wetland species; or (e) a combination of the above methods.

12. Temporary Safety Stabilization to complete an immediate unplanned short-term repair of a tide/flood gate, dike, levee, or other structure. These include in-water repairs that must be made before the next in-water work period to resolve critical conditions that, unless corrected, are likely to cause loss of human life, unacceptable loss of property, or natural resources. Stabilization techniques are likely to include other categories within this program, but may also consist of placing large rock, sheet pile, or rebuilding levees and dikes. Causes may include, but are not limited to, a flood that causes scour erosion and significantly weakens the foundation of a dike or levee; culvert failure due to blockage by fluvial debris, overtopping, rusting or crushing; and tide/flood gate failure due to rusting, debris damage or accumulation, or structural breakdown. Any temporary safety stabilization will include an assessment of the project's effects to listed species and critical habitats and a plan to bring the site into conformance with all other applicable PDCs in this opinion based on the existing conditions prior to the stabilization.

1.3.1 Proposed Design Criteria

The action agencies propose to apply the following PDC, in relevant part, to every project authorized, funded, or implemented under this opinion. Measures described under "Administration" apply to all the agencies as we manage projects under this opinion. PDCs described under "General Construction" apply to projects that involve construction. PDCs described under "Activity Categories" are measures that apply to the 12 specific activity categories.

1.3.1.1 Program Administration

This proposed program includes a process designed to ensure that only activities that properly fall under the completed programmatic opinion get treated as such and also to provide a mechanism by which the agencies can track the number and nature of projects proceeding under the program. In sum, the review and verification process involves early coordination, the action agency making a determination as to whether each project meets the criteria of the programmatic opinion, and then NMFS verifying that determination for certain activities. This process is not an ESA consultation and does not involve either agency making likely to adversely affect/not likely to adversely affect or jeopardy/no jeopardy decisions about a project; rather, it provides a protocol by which action agencies make decisions about whether it is appropriate to treat projects as being already covered by this completed ESA programmatic consultation.

1. **Initial Rollout.** The action agencies, and NMFS will provide an initial rollout of this opinion for staff to ensure that these criteria are considered at the onset of each project, incorporated into all phases of project design, and that any constraints, such as the need for fish passage or hydraulic engineering, are resolved early on.
2. **Failure to Report May Trigger Reinitiation.** The NMFS may recommend reinitiation of this consultation if the action agencies fail to provide all notifications and reports, or attend an annual coordination meeting.

3. **Full Implementation Required.** Failure to comply with all applicable conditions for a specific project may invalidate protective coverage of ESA section 7(o)(2) regarding "take" of listed species, and may lead us to a different conclusion regarding the effects of that project.
4. **Review and Verification.** Various levels of review are required for projects covered under this opinion.
   a. Action Agency Review. The action agency project managers will review each project to be covered under this opinion prior to submission of the Action Notification Form to NMFS to ensure:
      i. The project may affect one of the ESA-listed species considered in this opinion, or their designated critical habitat.
      ii. The project will provide a long-term benefit to the listed species and critical habitat.
      iii. The project design meets all applicable PDCs.
      iv. The effects are likely to be within the range of effects considered in this opinion.
      v. None of the following activities are included in the project (these activities are available for individual consultation):
         1. Installation of a new tide/flood gate that does not replace an existing tide/flood gate.
         2. Conducting in-water work in the Willamette River downstream of Willamette Falls between Dec 1 and Jan 31.
   b. Pre-Notification Coordination. Some structures require significant engineering and/or increased design and review. Upon becoming aware of a project that includes the following activities, the action agencies will begin coordinating with NMFS, ODFW, and any other pertinent entity. The action agency will submit a pre-notification coordination request to the "TARP mailbox," at tarp.wcr@noaa.gov, at least 30-days prior to submission of the Action Notification Form to NMFS for any project with any of the following categories or activities:
      i. Tide/flood gate removal, replacement or retrofit projects
      ii. Channel reconstruction/relocation
      iii. Dam removal
      iv. Off- and side-channel habitat restoration
      v. LW or ELJs that occupy >25% of the bankfull area
      vi. Alluvium placement projects that occupy more than 25% of the channel bed or more than 25% of the bankfull cross sectional area
      vii. Livestock stream crossing using a bridge or culvert
      viii. Fish screen for pump intake(s) to dewater at a rate >3 cubic feet per second (cfs)
      ix. Any project that uses "flexible uplift" (PDC 29)
      x. Precedent or policy setting activities, such as the application of new technology
   c. NMFS Verification. The action agency will submit the Action Notification Form to the "TARP mailbox," at tarp.wcr@noaa.gov, at least 30 days before start of construction with sufficient detail for NMFS to verify that the project is consistent

with all provisions of this opinion for projects that include the following activities:

i. Tide/flood gate replacement or retrofit
ii. Channel reconstruction/relocation
iii. Off- and side-channel habitat restoration
iv. Piling installation
v. Dam and legacy structure removal
vi. ”Flexible uplift”
vii. LW and ELJs that occupy >25% of the bankfull area
viii. Alluvium placement projects that occupy more than 25% of the channel bed or more than 25% of the bankfull cross sectional area
ix. Livestock stream crossing using a bridge or culvert
x. Beaver dam analogs
xi. Temporary safety stabilization
xii. Any earthwork at an U.S. Environmental Protection Agency (EPA)-designated Superfund Site, a state-designated clean-up area, or in the likely impact zone of a significant contaminant source, as identified by historical information or best professional judgment

d. No Verification Required. When the project does not include any verification-required activities (PDC 4c), the action agency will submit an Action Notification Form for the following categories of activities, but is not required to wait for NMFS verification:

i. Tide/flood gate removal
ii. Set-back or removal of dikes and levees
iii. LW and ELJs that occupy <25% of the bankfull area
iv. Streambank restoration
v. Livestock fencing and off-channel livestock watering facilities
vi. Livestock stream crossing without using a bridge or culvert (ford)
vii. Piling and other structure removal
viii. Beaver habitat restoration without beaver dam analogs
ix. Wetland restoration

5. **Monitoring and Reporting.** The action agency will ensure the following information is submitted to NMFS for each project completed under this opinion.
All project reports are to be submitted electronically to the “TARP mailbox,” at tarp.wcr@noaa.gov, including:

a. Project completion report within 60-days of end of construction (Appendix A, Part 1 and Part 2).
b. Fish salvage report within 60-days of work area isolation with fish capture even if no fish were captured (Appendix A, Part 1 and Part 3).

6. **Annual Program Report.** Each action agency will submit monitoring reports to the “TARP mailbox,” at tarp.wcr@noaa.gov by March 15 each year. The reports will describe efforts to carry out this opinion, including an assessment of overall program activity, a map showing the location and type of each project authorized, funded or implemented under this opinion, and any other data or analyses the agencies deem necessary or helpful to assess habitat trends as a result of projects carried out under this opinion.

7. **Annual Coordination Meeting.** Each action agency will attend an annual coordination meeting with NMFS by May 15 each year to discuss annual reports and any actions that can improve conservation under this opinion, or make the program more efficient or accountable.

1.3.1.2 Project Design Criteria - General Construction Measures

8. **Project Design**
    a. Current regional climate change projections, such as changes in flow magnitude, duration, and sea level rise will be considered during project design for the life of the project. Project proponents must demonstrate the design will function as anticipated while accommodating changing climatic conditions and corresponding changes in stream flows and channel conditions.
    b. Assess whether the project area is contaminated by chemical substances that may cause harm if released. The assessment will be commensurate with site history and may include the following:
        i. Review available records, *e.g.*, the history of existing structures and contamination events.
        ii. If the project area was used for industrial processes, inspect to determine the environmental condition of the property.
        iii. Interview people who are knowledgeable about the site, *e.g.*, site owners, operators, and occupants, neighbors, or local government officials.
        iv. If contamination is found or suspected, consult with a suitably qualified and experienced contamination professional and NMFS before carrying out ground disturbing activities.
    c. Obtain all applicable local, state and Federal regulatory permits and official project authorizations before beginning construction.
9. **Site Layout and Flagging**
    a. Before any significant ground disturbance or entry of mechanized equipment or vehicles into the construction area, clearly mark with flagging or survey marking paint the following areas:
        i. Sensitive areas, *e.g.*, wetlands, water bodies, ordinary high water, spawning areas
        ii. Equipment entry and exit points
        iii. Road and stream crossing alignments
        iv. Staging, storage, and stockpile areas
    b. Herbicide buffer distances are described in PDC #23 Invasive and Non-Native Plant Control.
10. **Staging, Storage, and Stockpile Areas**
    a. Designate and use staging areas to store hazardous materials, or to store, fuel, or service heavy equipment, vehicles and other power equipment with tanks larger than 5 gallons, that are at least 150 feet from any natural water body or wetland, or on an established paved area, such that sediment and other contaminants from the staging area cannot be deposited in the floodplain or stream.
    b. Natural materials displaced by construction and reserved for restoration, *e.g.*, LW, gravel, and boulders, may be temporarily stockpiled within the 100-year

floodplain if measures are taken to avoid runoff of sediment and natural materials due to precipitation.

c. After construction is complete, obliterate all staging, storage, or stockpile areas, stabilize the soil, and revegetate the area.[3]
d. Dispose of any material not used in restoration, including unused fill, outside of the functional floodplain, [4] prior to project completion.

11. Erosion Control

a. Use site planning and site erosion control measures commensurate with the scope of the project to minimize damage to natural vegetation and permeable soils, and prevent erosion and sediment discharge from the project site.
b. Before significant earthwork begins, install appropriate, temporary erosion controls downslope to prevent sediment deposition in the riparian area, wetlands, or water body.
c. During construction:
    i. Complete earthwork in wetlands, riparian areas, and stream channels as quickly as possible.
    ii. Cease project operations when high flows may inundate the project area, except for efforts to avoid or minimize resource damage.
    iii. If eroded sediment appears likely to be deposited in the stream during construction, install additional sediment barriers as necessary.
    iv. Temporary erosion control measures may include fiber wattles, silt fences, jute matting, wood fiber mulch and soil binder, or geotextiles and geosynthetic fabric.
    v. Soil stabilization using wood fiber mulch and tackifier (hydro-applied) may be used to reduce erosion of bare soil, if the materials are free of noxious weeds and nontoxic to aquatic and terrestrial animals, soil microorganisms, and vegetation.
    vi. Inspect and monitor pollution and erosion control measures throughout the length of the project.
    vii. Remove sediment from erosion controls if it reaches one-third of the exposed height of the control.
    viii. Whenever surface water is present, maintain a supply of sediment control materials and an oil-absorbing floating boom at the project site.
    ix. Stabilize all disturbed soils following any break in work unless construction will resume within four days.
d. Remove temporary erosion controls after construction is complete and the site is fully stabilized.

12. Hazardous Material Spill Prevention and Control

a. At the project site:

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[3] Road and path obliteration refers to the most comprehensive degree of decommissioning and involves decompacting the surface and ditch, pulling the fill material onto the running surface, and reshaping to match the original contour.

[4] Functional floodplain as defined in this document comprises the areas of the project delineated by the greatest of the following three boundaries: the floodplain for a 10-year flood event; 150 feet on each side of the active channel; or a site-potential tree height within the project area. Site-potential tree height is the average maximum height of the tallest dominant trees (200 years or older) for a given site class.

i. Post written procedures for notifying environmental response agencies, including an inventory and description of all hazardous materials present, and the storage and handling procedures for their use.
ii. Maintain a spill containment kit, with supplies and instructions for cleanup and disposal, adequate for the types and quantity of hazardous materials present.
iii. Train workers in spill containment procedures, including the location and use of the spill containment kits.

b. Temporarily contain any waste liquids generated under an impervious cover, such as a tarpaulin, in the staging area until the wastes can be properly transported to, and disposed of, at an approved receiving facility.

13. Equipment, Vehicles, and Power Tools

a. Select, operate and maintain all heavy equipment, vehicles, and power tools to minimize adverse effects on the environment, *e.g.*, low pressure tires, minimal hard-turn paths for track vehicles, use of temporary mats or plates to protect wet soils.
b. Before entering wetlands or working within 150 feet of a water body:
   i. Power wash all heavy equipment, vehicles and power tools, allow them to fully dry, and inspect them for fluid leaks, and to make certain no plants, soil, or other organic material are adhering to any surface.
   ii. Ensure all equipment to be operated below ordinary high water is leak free or operating with biodegradable products.[5] This does not apply to vehicles and equipment that are doing road work and/or passing through a project area (e.g., dozers, graders, etc.).
c. Repeat cleaning as often as necessary during operation to keep all equipment, vehicles, and power tools free of external fluids and grease, and to prevent a leak or spill from entering the water.
d. Avoid use of heavy equipment, vehicles or power tools below ordinary high water (OHW) (riverine) or the highest astronomical tide (HAT) (marine) unless project specialists determine such work is necessary, or would result in less risk of sedimentation or other ecological damage than work above that elevation.
e. Before entering the water, inspect any watercraft, waders, boots, or other gear to be used in or near water and remove any plants, soil, or other organic material adhering to the surface.
f. Ensure that any generator, crane or other stationary heavy equipment that is operated, maintained, or stored within 150 feet of any water body is also protected as necessary to prevent any leak or spill from entering the water.

14. Temporary Access Roads and Paths

a. Whenever reasonable, use existing access roads and paths preferentially.

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[5] For additional information and suppliers of biodegradable hydraulic fluids, motor oil, lubricant, or grease, see, Environmentally Acceptable Lubricants by the U.S. EPA (2011a); *e.g.*, mineral oil, polyglycol, vegetable oil, synthetic ester; Mobil® biodegradable hydraulic oils, Total® hydraulic fluid, Terresolve Technologies Ltd.® bio-based biodegradable lubricants, Cougar Lubrication® 2XT Bio engine oil, Series 4300 Synthetic Bio-degradable Hydraulic Oil, 8060-2 Synthetic Bio-Degradable Grease No. 2, *etc*. The use of trade, firm, or corporation names in this opinion is for the information and convenience of the action agency and grantees and does not constitute an official endorsement or approval by the U.S. Department of Commerce or NMFS of any product or service to the exclusion of others that may be suitable.

b. Minimize the number and length of temporary access roads and paths through riparian areas and floodplains.
c. Minimize removal of riparian vegetation.
d. When it is necessary to remove vegetation, cut at ground level (no grubbing).
e. Do not build temporary access roads or paths where grade, soil, or other features suggest slope instability.
f. Any road on a slope steeper than 30% will be designed by a civil engineer with experience in steep road design.
g. After construction is complete, obliterate all temporary access roads and paths, stabilize the soil, and revegetate the area.
h. Temporary roads and paths in wet areas or areas prone to flooding will be obliterated by the end of the in-water work window. Decompact road surfaces and drainage areas, pull fill material onto the running surface, and reshape to match the original contours.

15. Dust Abatement

a. Employ dust abatement measures commensurate with soil type, equipment use, wind conditions, and the effects of other erosion control measures.
b. Sequence and schedule work to reduce the exposure of bare soil to wind erosion.
c. Maintain spill containment supplies on-site whenever dust abatement chemicals are applied.
d. Do not use petroleum-based products.
e. Do not apply dust-abatement chemicals, *e.g.*, magnesium chloride, calcium chloride salts, ligninsulfonate, within 25 feet of a water body, or in other areas where they may runoff into a wetland or water body.
f. Do not apply ligninsulfonate at rates exceeding 0.5 gallons per square yard of road surface, assuming a 50:50 solution of ligninsulfonate to water.

16. Temporary Stream Crossings

a. Do not place temporary crossings in areas that may increase the risk of channel re-routing or avulsion, or in potential spawning habitat, *e.g.*, pools and pool tailouts.
b. Minimize the number of temporary stream crossings; use existing stream crossings whenever reasonable.
c. Install temporary bridges and culverts to allow for equipment and vehicle crossing over perennial streams to access construction areas.
d. Wherever possible, vehicles and machinery will cross streams at right angles to the main channel.
e. Equipment and vehicles may cross the stream in the wet only where the streambed is bedrock, where the streambed is naturally stable, or where mats or off-site logs are placed in the stream and used as a crossing.
f. Obliterate all temporary stream crossings as soon as they are no longer needed, and restore any damage to affected stream banks or channel.

17. Surface Water Withdrawal

a. Surface water may be diverted to meet construction needs, but only if project proponents are able to clearly demonstrate developed sources are unavailable or inadequate.

b. Diversions may not exceed 10% of the flow at the time of diversion and will have a juvenile fish exclusion device that is consistent with NMFS' criteria (NMFS 2011a or subsequent).[6]

18. Construction Discharge Water

a. Pump seepage water from the de-watered work area to a temporary storage and treatment site or into upland areas and allow water to filter through vegetation prior to reentering the stream channel.
b. Treat all discharge water using best management practices to remove debris, sediment, petroleum products, and any other pollutants likely to be present (e.g., green concrete, contaminated water, silt, welding slag, sandblasting abrasive, grout cured less than 24 hours, drilling fluids), to avoid or minimize pollutants discharged to any perennial or intermittent water body.
c. Treat water used to cure concrete until pH stabilizes to background levels.

19. Fish Passage

a. Provide fish passage for any adult or juvenile ESA-listed fish likely to be present in the project area during construction, unless passage did not exist before construction, or the stream is naturally impassable at the time of construction.
b. After construction, provide fish passage that meets NMFS' fish passage criteria for any adult or juvenile ESA-listed fish (NMFS 2011a or subsequent), for the life of the fish passage structure.

20. Timing of In-Water Work

a. For projects within Oregon, complete all work within the wetted channel during the non-estuarine summer in-water work periods listed in the most recent version of *Oregon In-water Work Guidelines* (ODFW 2008) (except that in-water work in the Willamette River below Willamette Falls is not approved between December 1 and January 31). For projects within Washington, complete all work within the wetted channel during the in-water work periods listed in the most recent version of *Times When Spawning or Incubating Salmonids are Least Likely to be Present in Washington State Freshwaters* (WDFW 2017).
b. Hydraulic and topographic measurements and placement of LW may be completed anytime, provided the affected area is not occupied by adult fish as determined by a NMFS, ODFW, or Washington Department of Fish and Wildlife biologist.
c. Temporary safety stabilization may be completed anytime in consultation with NMFS.
d. Exceptions to the published in-water work windows may be requested when the change benefits listed species and/or critical habitat.
    i. The action agency will submit a justification detailing why the exception is needed and how it benefits aquatic resources to the appropriate NMFS Branch Chief.
    ii. The NMFS Branch Chief will review fish distribution, weather, current steam flows, and project activities related to in-water work to verify effects are within the scope analyzed in this opinion.

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[6] National Marine Fisheries Service. 2011. Anadromous salmonid passage facility design. Northwest Region.

21. Work Area Isolation

a. Isolate any work area within the wetted channel from the active stream whenever ESA-listed fish are reasonably certain to be present, unless the action agency and NMFS agree in writing (email) that the work can be done with less potential risk to listed fish without isolating and dewatering the work area (e.g., placing large woody debris).
b. Engineering design plans for work area isolation will include design plans for all isolation elements and fish release areas.
c. Dewater the smallest extent of work area practicable, unless wetted in-stream work is deemed to be minimally harmful to fish, and is beneficial to other aquatic species.[7]
    i. Use a coffer dam and a by-pass culvert or pipe, or a lined, non-erodible diversion ditch to divert flow around the dewatered area. Dissipate flow energy to prevent damage to riparian vegetation or stream channel and provide for safe downstream reentry for fish, preferably into pool habitat with cover.
    ii. Where gravity feed is not possible, pump water around the isolation area to avoid rewatering and to sustain stream flow. Maintain a fish screen on the pump intake to avoid juvenile fish entrainment (NMFS 2011a or subsequent).
    iii. Pump seepage water to a temporary storage and treatment site, or into upland areas, to allow water to percolate through soil or to filter through vegetation before reentering the stream channel. Acceptable designs include treatment systems comprised of either a hay bale basin or other sediment control device.
    iv. Monitor below the construction site to prevent stranding of aquatic organisms.
    v. When construction is complete, re-water the construction site slowly to prevent loss of surface flow downstream, and to prevent a sudden increase in suspended sediment.
d. Whenever a pump is used to dewater the isolation area and ESA-listed fish may be present, a fish screen will be used that meets the most current version of NMFS' fish screen criteria (NMFS 2011a or subsequent). The NMFS engineering review is required for pumping that exceeds 3 cfs.

22. Fish Capture and Release

a. If practicable, allow listed fish species to migrate out of the work area or remove fish before dewatering; otherwise remove fish from an exclusion area as it is slowly dewatered with methods such as hand or dip-nets, seining, or trapping with minnow traps (or gee-minnow traps). Electrofishing should only occur after other means of fish removal are determined as not feasible or ineffective.
b. Fish capture will be supervised by a qualified fisheries biologist, with experience in work area isolation and competent to ensure the safe handling of all fish.

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[7] For instructions on how to dewater areas occupied by lamprey, see *Best management practices to minimize adverse effects to Pacific lamprey* (*Entosphenus tridentatus*) (USFWS 2010).

c. Schedule work that will require fish capture and similar activities to periods of the day with the coolest air and water temperatures possible, normally early in the morning to minimize stress and injury of species present.
d. Monitor block nets frequently enough to ensure they stay secured to the banks and free of organic accumulation.
e. Electrofishing will be used during the coolest time of day, and only after other means of fish capture are determined to be not feasible or ineffective.
    i. Do not electrofish when the water appears turbid, *e.g.*, when objects are not visible at depth of 12 inches.
    ii. Do not intentionally contact fish with the anode.
    iii. Follow NMFS (2000) electrofishing guidelines, including use of only direct current or pulsed direct current within the following ranges:
        1. If conductivity is less than 100 microsecond (µs), use 900 to 1100 volts.
        2. If conductivity is between 100 and 300 µs, use 500 to 800 volts.
        3. If conductivity greater than 300 µs, use less than 400 volts.
    iv. Begin electrofishing with a minimum pulse width and recommended voltage, then gradually increase to the point where fish are immobilized.
    v. Immediately discontinue electrofishing if fish are killed or injured, *i.e.*, dark bands visible on the body, spinal deformations, significant de-scaling, torpid or inability to maintain upright attitude after sufficient recovery time. Recheck machine settings, water temperature and conductivity, and adjust or postpone procedures as necessary to reduce injuries.
f. If buckets are used to transport fish:
    i. Minimize the time fish are in a transport bucket.
    ii. Keep buckets in shaded areas. Construct a canopy for cover if area is not shaded.
    iii. Limit the number of fish within a bucket; keep fish relatively comparable in size to minimize predation.
    iv. Use aerators or replace the water in the buckets at least every 15 minutes with cold clear water.
    v. Release fish in an area upstream with adequate cover and flow refuge; downstream release is acceptable provided the release site is below the influence of construction.
    vi. Be careful to avoid mortality counting errors.
g. Manage isolation areas in a manner to avoid multiple salvage events (e.g. do not let water or fish into the isolation during non-work times).
h. When salvaging in the lower Columbia and Willamette rivers, count all *Oncorhynchus mykiss* as steelhead (not rainbow trout).
i. Monitor and record fish presence, handling, and injury during all phases of fish capture. Even if no fish are caught, submit the fish salvage report (Appendix A, Part 1 and Part 3) to NMFS within 60 days of capture that documents date, time of day, fish handling procedures, air and water temperatures, and total numbers of each ESA-listed fish injured or killed.

23. Invasive and non-native plant control

a. *Pre-Application Measures:*
   i. Demarcate vegetation clearing limits prior to disturbance.
   ii. Clearly mark trees identified for removal and demarcate tree removal disturbance limits and staging areas.
   iii. Implement appropriate measures to minimize the introduction and broadcast of weed/propagules, including inspection of vehicles before entering construction areas and appropriate equipment cleaning measures.

b. *Non-herbicide methods*. Limit removal of desirable vegetation and soil disturbance within the riparian zone. Where removal of vegetation is necessary complete it manually, mechanical, or hydro-mechanical plant control (*e.g.*, hand pulling, bending[8], clipping, stabbing, digging, brush-cutting, mulching, radiant heat, portable flame burner, super-heated steam, pressurized hot water, or hot foam (Arsenault *et al.* 2008; Donohoe *et al.* 2010))[9]. Do not allow cut, mowed, or pulled vegetation to enter waterways.

c. *Herbicide Label.* Herbicide applicators will comply with all label instructions.

d. *Maximum herbicide treatment area*. Considering all actions under this program, do not exceed treating 1% of the acres of riparian habitat within a 6^{th-}field HUC with herbicides per year.

e. *Herbicide applicator qualifications.* Herbicides may only be applied by an appropriately licensed applicator, or under the direct supervision of a licensed applicator, using an herbicide specifically targeted for a particular plant species that will cause the least impact.

f. *Herbicide transportation and safety plan.* The applicator will prepare and carry out an herbicide safety/spill response plan to reduce the likelihood of spills or misapplication, to take remedial actions in the event of spills, and to fully report the event.

g. *Herbicides.* The only herbicides allowed for use under this opinion are (some common trade names are shown in parentheses):[10]
   i. Aquatic imazapyr (*e.g*., Habitat)
   ii. Aquatic glyphosate (*e.g*., AquaMaster, AquaPro, Rodeo)
   iii. Aquatic triclopyr-TEA (*e.g*., Renovate 3)
   iv. Chlorsulfuron (*e.g*., Telar, Glean, Corsair)
   v. Clopyralid (*e.g*., Transline)
   vi. Imazapic (*e.g*., Plateau)
   vii. Imazapyr (*e.g*., Arsenal, Chopper)
   viii. Metsulfuron-methyl (*e.g*., Escort)
   ix. Picloram (*e.g*., Tordon)
   x. Sethoxydim (*e.g*., Poast, Vantage)
   xi. Sulfometuron-methyl (*e.g*., Oust, Oust XP)

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[8] Knotweed treatment pre-treatment; See Nickelson (2013).

[9] See http://ahmct.ucdavis.edu/limtask/equipmentdetails.html

[10] The use of trade, firm, or corporation names in this opinion is for the information and convenience of the action agency and applicants and does not constitute an official endorsement or approval by the U.S. Department of Commerce or NMFS of any product or service to the exclusion of others that may be suitable.

h. *Herbicide adjuvants.* When recommended by the label, an approved aquatic surfactant or drift retardant can be used to improve herbicidal activity or application characteristics. Adjuvants that contain alky amine etholoxylates, *i.e.*, polyethoxylated tallow amine (POEA), alkylphenol ethoxylate (including alkyl phenol ethoxylate phosphate esters), or herbicides that contain these compounds are **not** covered by this opinion. Examples of products that meet this standard as are covered by this opinion include:

1. Agri-Dex
2. AquaSurf
3. Bond
4. Bronc Max
5. Bronc Plus Dry-EDT
6. Class Act NG
7. Competitor
8. Cut Rate
9. Cygnet Plus
10. Destiny HC
11. Exciter
12. Fraction
13. InterLock
14. Kinetic
15. Level 7
16. Liberate
17. Magnify
18. One-AP XL
19. Pro AMS Plus
20. Spray-Rite
21. Superb HC
22. Tactic
23. Tronic

i. *Herbicide carriers.* Herbicide carriers (solvents) are limited to water or specifically labeled vegetable oil. Use of diesel oil as an herbicide carrier is not covered by this opinion.

j. *Dyes.* Use a non-hazardous indicator dye (*e.g.*, Hi-Light or Dynamark) with herbicides within 100-feet of water. The presence of dye makes it easier to see where the herbicide has been applied and where or whether it has dripped, spilled, or leaked. Dye also makes it easier to detect missed spots, avoid spraying a plant or area more than once, and minimize over-spraying (SERA 1997).

k. *Herbicide mixing.* Mix herbicides and adjuvants, carriers, and/or dyes more than 150-feet from any perennial or intermittent waterbody to minimize the risk of an accidental discharge.

l. *Tank Mixtures.* The potential interactive relationships that exist among most active ingredient combinations have not been defined and are uncertain. Therefore, combinations of herbicides in a tank mix are not covered by this opinion.

m. *Spill Cleanup Kit.* Provide a spill cleanup kit whenever herbicides are used, transported, or stored. At a minimum, cleanup kits will include Material Safety Data Sheets, the herbicide label, emergency phone numbers, and absorbent material such as cat litter to contain spills.

n. *Herbicide application rates.* Apply herbicides at the lowest effective label rates.

o. *Herbicide application methods.* Apply liquid or granular forms of herbicides as follows:

   i. Broadcast spraying – hand held nozzles attached to back pack tanks or vehicles, or by using vehicle mounted booms.

ii. Spot spraying – hand held nozzles attached to back pack tanks or vehicles, hand-pumped spray, or squirt bottles to spray herbicide directly onto small patches or individual plants.
iii. Hand/selective – wicking and wiping, basal bark, fill ("hack and squirt"), stem injection, cut-stump.
iv. Triclopyr – will not be applied by broadcast spraying.
v. Keep the spray nozzle within four feet of the ground when applying herbicide. If spot or patch spraying tall vegetation more than 15 feet away from the high water mark, keep the spray nozzle within 6 feet of the ground.
vi. Apply spray in swaths parallel towards the project area, away from the waterbody and desirable vegetation, *i.e.*, the person applying the spray will generally have their back to the creek or other sensitive resource.
vii. Avoid unnecessary run off during cut surface, basal bark, and hack-squirt/injection applications.

p. *Washing spray tanks.* Wash spray tanks 300-feet or more away from any surface water.

q. *Minimization of herbicide drift and leaching.* Minimize herbicide drift and leaching as follows:
    i. Do not spray when wind speeds exceed 10 miles per hour, or are less than 2 miles per hour.
    ii. Be aware of wind directions and potential for herbicides to affect aquatic habitat area downwind.
    iii. Keep boom or spray as low as possible to reduce wind effects.
    iv. Increase spray droplet size whenever possible by decreasing spray pressure, using high flow rate nozzles, using water diluents instead of oil, and adding thickening agents.
    v. Do not apply herbicides during temperature inversions, or when air temperature exceeds 80 degrees Fahrenheit.
    vi. Wind and other weather data will be monitored and reported for all broadcast applications.

r. *Rain.* Do not apply herbicides when the soil is saturated or when a precipitation event likely to produce direct runoff to surface waters from the treated area is forecasted by National Oceanic and Atmospheric Administration (NOAA) National Weather Service or other similar forecasting service within 48 hours following application. Soil-activated herbicides may follow label instructions. Do not conduct hack-squirt/injection applications during periods of heavy rainfall.

s. *Herbicide buffer distances.* Observe the following no-application buffer-widths, measured in feet, as map distance perpendicular to the bankfull elevation for streams, the upland boundary for wetlands, or the upper bank for roadside ditches. Widths are based on herbicide formula, stream type, and application method, during herbicide applications (Table 2). Before herbicide application begins, flag or mark the upland boundary of each applicable herbicide buffer to ensure that all buffers are in place and functional during treatment.

Table 2. Herbicide buffer distances by herbicide formula, stream type, and application method.

Herbicide	No Application Buffer Width (feet)					
	Streams and Roadside Ditches with flowing or standing water present and Wetlands			Dry Streams, Roadside Ditches, and Wetlands		
	Broadcast Spraying	Spot Spraying	Hand Selective	Broadcast Spraying	Spot Spraying	Hand Selective
Labeled for Aquatic Use						
Aquatic Glyphosate	100	waterline	waterline	50	None	none
Aquatic Imazapyr	100	15	waterline	50	None	none
Aquatic Triclopyr-TEA	**Not Allowed**	15	waterline	**Not Allowed**	None	none
Low Risk to Aquatic Organisms						
Imazapic	100	15	bankfull elevation	50	None	none
Clopyralid	100	15	bankfull elevation	50	None	none
Metsulfuron-methyl	100	15	bankfull elevation	50	None	none
Moderate Risk to Aquatic Organisms						
Imazapyr	100	50	bankfull elevation	50	15	bankfull elevation
Sulfometuron-methyl	100	50	5	50	15	bankfull elevation
Chlorsulfuron	100	50	bankfull elevation	50	15	bankfull elevation
High Risk to Aquatic Organisms						
Picloram	100	50	50	100	50	50
Sethoxydim	100	50	50	100	50	50

24. **Piling Installation.** Pile may be concrete, or steel round pile 24 inches in diameter or smaller, steel H-pile designated as HP24 or smaller, or wood that has not been treated with preservatives or pesticides except as described below. Pile wrappings may be used to wrap new inorganic arsenical pressure-treated wood piles (ammoniacal copper arsenate (ACA), and ammoniacal copper zinc arsenate (ACZA) in aquatic environments. Any proposal to use unwrapped treated wood pilings is not covered by this consultation and will require individual consultation.

a. Except when not practical, use a vibratory hammer for in-water pile installation. In the lower Columbia River only a vibratory hammer may be used in October.
b. Jetting may be used to install pile in areas with coarse, uncontaminated sediments that meet criteria for unconfined in-water disposal (USACE Northwest Division 2009).
c. When using an impact hammer to drive or proof a steel pile, one of the following sound attenuation methods will be used:
    i. Completely isolate the pile from flowing water by dewatering the area around the pile.
    ii. If water velocity is 1.6 feet per second or less, surround the pile being driven by a confined or unconfined bubble curtain that will distribute small air bubbles around 100% of the pile perimeter for the full depth of

the water column. See, *e.g.*, NMFS and USFWS (2006), Caltrans (2015), Wursig *et al.* (2000), and Longmuir and Lively (2001).

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

iv. Provide NMFS information regarding the timing of in-water work, the number of impact hammer strikes per pile and the estimated time required to drive piles, hours per day pile driving will occur, depth of water, and type of substrate, hydroacoustic assumptions, and the pile type, diameter, and spacing of the piles.

v. Construction activities will shut down if marine mammals enter the zone of influence.[11] Construction activities will not resume until all marine mammals have been cleared from the zone of harm and are observed to be moving away from the construction site.

d. Alternatives to pesticide and preservative-treated wood piles:

i. Pile wrappings may be used to wrap new untreated or inorganic arsenical treated wood piles (ACA and ACZA) in aquatic environments. Pile wraps cannot be used for new creosote, creosote solutions, or oil-borne preservatives under this biological opinion. The following criteria applies to the use of pile wrappings for pile maintenance and installation:

1. Wraps can be pre-formed plastic such as polyvinyl chloride (PVC), fiber glass-reinforced plastic, or a high density polyethylene (HDPE) with an epoxy fill, petrolatum saturated tape (PST), or an inner wrap in the void between the wrapping and the pile.
    a. Exterior pilings, pilings that will come into direct contact with ocean and barge vessels, may only use high density polyethylene pile wrappings, steel-reinforced concrete, or steel-cased pilings. [12]
    b. The material used for interior pilings must be durable enough to maintain the integrity for at least 10 years and a minimum of 1/10 of an inch thick with all joints sealed to prevent leakage.
    c. Sealing or capping the tops of the pilings shall prevent treated wood surface exposure within the water column and prevent dripping.
2. Pile wrappings will extend above and below the portion of the piling in contact with the water. The wrapping shall extend down into the substrate at least 18 inches below the mudline to contain treatment chemicals. The wrapping may extend to either the top of the piling or to a minimum height above the OHW (riverine) or the

[11] During vibratory pile driving, the zone of influence extends to the 120dB isopleth and extends to the 160dB isopleth during impact pile driving.

[12] CCC (California Coastal Commission). 2005. Regular Coastal Development Permit Application number 3-04-072.

HAT (estuarine) line to protect the treated wood from water contact.[13]

3. All operations to prepare pile wrappings for placement cutting, drilling, and placement of epoxy fill will occur in a staging area away from the waterbody.
4. All pile wrappings will require an inspection and maintenance program. The program is designed to identify potential failures within the pile barrier system as soon as possible after a breach occurs. It is recommended that the maintenance of wrapped piles be performed by an experienced and licensed marine contractor. All submerged portions of the wrapped pilings will be inspected every 1-2 years beginning 3-5 years after installation, particularly in active facilities where there is the potential for abrasion or boat collisions that can damage the barrier.
    a. <u>Freshwater Inspections</u>. Freshwater inspections can occur using regular snorkeling gear. The inspector should concentrate on the upper portion of the wood nearer to the surface where activity is greatest and should look all around each pile to determine if any of the barrier has abraded or been torn away. Wood with evidence of barrier disruption should be marked so that repairs can be made.
    b. <u>Saltwater Inspections</u>. Saltwater inspection should concentrate on the tidal zone where the risk of impacts from floating debris or boats is greatest. Inspections should take place at low tide (i.e. a minus tide). The inspector should move around the pile examining the surface for evidence of tears or gaps in the barrier that might indicate damage. These zones should be more closely probed with a scraper that can remove any surface marine fouling organisms. Care should be taken to minimize damage to the barrier surface.
    c. <u>When to Repair</u>. Small gaps or tears in the barrier will have little effect on potential migration of preservative. Damage to 25% or more of the barrier surface on an individual pile should result in action to repair the surface by adding additional coating or barrier material to mitigate any future preservative loss. Missing or damaged wraps should be replaced as soon as possible.
    d. The inspection and maintenance program will be reviewed and verified by NMFS.

ii. Polyurea barrier systems may be used to coat new untreated or inorganic arsenical pressure-treated wood piles in aquatic environments. The coating must be an impact-resistant, biologically inert coating that lasts or is maintained for a specified amount of time (NMFS 2009a). All polyurea

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[13] CCC (California Coastal Commission). 2012. Nonpoint Source Program. Water Quality Fact Sheet: Pilings- Treated Wood and Alternatives.

coated treated wood piles will require an inspection and maintenance program (refer to PDC #24(d)(v) for inspection and maintenance requirements).

1. The polyurea coating should be specified by the manufacturer for in-water use to avoid degradation of the coating and over water spills. Prefabrication will be used whenever possible to minimize cutting, drilling and field preservative treatment.
2. Polyurea products must be coated on dry piles, free of loose wood, splinters, or sawdust and mechanical damage.
3. Only products treated in accordance with WWPI *et al.* (2011) best management practices will be accepted for coating.
4. The polyurea coating must be ultraviolet light resistant and a minimum of 250 millimeter thick in the area that is submerged (Morrell 2017).

25. Broken or Intractable Pile

a. If a pile breaks above the surface of uncontaminated sediment, or less than 2 feet below the surface, make every attempt short of excavation to remove it entirely. If the pile cannot be removed without excavation, drive the pile deeper if possible.
b. If a pile in contaminated sediment is intractable or breaks above the surface, cut the pile or stump off at the sediment line.
c. If a pile breaks within contaminated sediment, make no further effort to remove it and cover the hole with a cap of clean substrate appropriate for the site.
d. If dredging is likely where broken piles are buried, use a global positioning system device to note the location of all broken piles for future use in site debris characterization.

26. Projects Requiring Post-Construction Stormwater Management (PCSM)

a. Provide PCSM for any project that will:
   i. Increase the impervious area within the project area, including public roads, parking lots, sidewalks, and other impervious public structures.
      1. Gravel surfaces are considered impervious and stormwater treatment and management is required identical to an asphalt or concrete roadway. When modeling stormwater runoff from gravel roads, refer to your state department of transportation's guidance for determining the runoff coefficient C for gravel roads.[14]
   ii. Construct new impervious surfaces that increase capacity or widens the prism of a public road.
   iii. Reconstruct existing public road surfaces down to subgrade.
   iv. Rehabilitate or restore the stream crossing of a public road to repair structural or functional deficiencies that are too complicated to be corrected through normal maintenance, except for seismic retrofits that make a bridge more resistant to earthquake damage (e.g., external post-

[14] Refer to Appendix F-Rational Method from the Oregon Department of Transportation Hydraulics Manual (2011), Appendix D from the Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (2005), and Department of Ecology Eastern and Western Washington stormwater manuals (20012 & 2014) to determine the runoff coefficient.

tensioning, supplementary dampening) but do not affect the bridge deck or drainage.

v. Change stormwater conveyance.

b. PCSM is not required for projects that replace or make minor repairs to existing impervious areas, not including ones covered with coal tar or galvanized material unless that material has been sealed or otherwise confined so that it will not leach into runoff. Minor repairs include chip seal, grind/inlay, overlay and resurfacing (i.e., nonstructural pavement preservation, a single lift or inlay).

c. To provide PCSM, prepare and carry out a plan that is commensurate with the scope of the project and includes site sketches, drawings, specifications, and other data as needed to explain how post-construction runoff from all impervious area within the project area will be treated with stormwater control measures (SCMs) for water quality (pollution reduction) and quantity (detention or retention) as follows:

    i. For water quality, first reduce by treating post-construction runoff using on-site infiltration to the maximum extent feasible. Any runoff not infiltrated on-site must be treated at least 50% of the cumulative rainfall from the 2-year, 24-hour storm before being discharged off-site. If stormwater treatment is unattainable for gravel road surfaces, provide justification for why the site cannot treat stormwater and provide stormwater management that includes but is not limited to the use of waterbars, ditches lined with native vegetation or rock if the slope is >5%, diversion ditches, diversion berms, vegetated turnouts, velocity controls and energy dissipaters.

        1. All water quality SCMs must be provided with adequate pretreatment as necessary to prevent overloading, primarily by sediment, and to dissipate energy or provide additional storage.
        2. SCMs with no subdrains designed for on-site infiltration through vegetation and soil media specifically engineered for water quality treatment (soil composition and depth, water residence time) include but are not limited to the following examples:
            a. Bio-retention area
            b. Constructed wetland
            c. Drywell
            d. Green roof
            e. Infiltration trench
            f. Impervious area removal
            g. Porous pavement
            h. Rain garden
            i. Tree canopy
            j. Upland dispersal (appropriate sites only)
            k. Vegetated area
            l. Wet pond

3. SCMs for off-site discharge include but are not limited to the following examples:
    a. Any practice listed above that is also equipped with an impermeable liner or sub-drain.
    b. Dry pond
    c. Proprietary technology demonstrated to be as effective as vegetated stormwater practices.

ii. For water quantity, ensure that any discharge of post-construction runoff either directly, or indirectly through a conveyance system, into a fresh waterbody, including wetlands, does not exceed the range of discharge rated for the pre-developed site condition from 50% of the 2-year peak flow up to the 10-year peak flow.
1. This requirement does not apply to stormwater discharges into streams that are in basins with greater than 100 square miles.
2. SCMs for flow control:
    a. Catch basins or manholes with outflow controls
    b. Detention ponds, roofs, parking lots, tanks, or vaults
    c. Infiltration facilities

iii. When conveyance is necessary to discharge treated stormwater into a fresh waterbody, including a wetland, the following requirements apply:
1. Maintain natural drainage patterns.
2. Ensure that treatment for post-construction runoff from the site is completed before it is allowed to commingle with any offsite runoff in the conveyance.
3. Prevent erosion of the flow path from the site to the receiving water and, if necessary, provide a discharge facility made entirely of manufactured elements (e.g., pipes, ditches, discharge facility protection) that extends at least to ordinary high water.

iv. Include a maintenance plan and schedule for each SCM, including the name and contact information of the responsible party for that maintenance into the future.

v. Include the name and contact information of the responsible party for preparing the PCSM plan.

d. A PCSM plan prepared for projects covered under this program will need to be reviewed and verified by NMFS.

27. Site Restoration

a. Restore any significant disturbance of riparian vegetation, soils, stream banks or stream channel.
b. Remove all project related waste; *e.g.*, pick up trash, sweep roadways in the project area to avoid runoff-containing sediment, *etc.*
c. Obliterate and restore all temporary access roads, crossings, and staging areas.
d. Loosen soil in compacted areas when necessary for revegetation or infiltration. In many cases tillage will be necessary to decompact soils and restore infiltration ability and soil productivity. A variety of implements/methods are available to decompact soils, including: winged subsoilers, rock ripper, excavators with brush rakes, mulching heads, or custom attachments such as the subsoiling grapple rake

and subsoiling excavating bucket (*e.g.* Ripping soils with an excavator bucket mounted with teeth). The depth of needed tillage can be estimated by referring to the rooting depth of nearby native vegetation. In areas of dispersed soil disturbance consider spot tillage.

e. Although no single criterion is sufficient to measure restoration success, the intent is that the following features should be present, within reasonable limits of natural and management variation:
    i. Areas with signs of significant erosion are completely stabilized and healed, bare soil spaces are small and well-dispersed.
    ii. Soil movement, such as active rills and soil deposition around plants or in small basins, is absent or slight and local.
    iii. Native woody and herbaceous vegetation, and germination microsites, are present and well distributed across the site; invasive plants are minimal or absent.
    iv. Plants have normal, vigorous growth form, and a high probability of remaining vigorous, healthy and dominant over undesired competing vegetation.
    v. Plant litter or mulch is well distributed and effective in protecting the soil with little or no litter accumulated against vegetation because of active sheet erosion (“litter dams”).
    vi. A continuous corridor of shrubs and trees appropriate to the site are present to provide shade and other habitat functions for the entire streambank/shoreline.

28. Revegetation

a. Plant and/or seed disturbed areas before or at the beginning of the first growing season after construction.
b. Use a diverse assemblage of vegetation species native to the project area or region, including trees, shrubs, and herbaceous species. Vegetation, such as willow, sedge and rush mats, may be gathered from abandoned floodplains, stream channels, *etc.* When feasible, use vegetation salvaged from local areas scheduled for clearing due to development.
c. For long-term revegetation use only species native to the project area or region that will achieve shade and erosion control objectives, including forb, grass, shrub, or tree species that are appropriate for the site.
d. Short-term stabilization measures may include use of non-native sterile seed mix if native seeds are not available, weed-free certified straw, jute matting, and similar methods.
e. Do not apply surface fertilizer within 50 feet of any wetland or water body.
f. Install fencing as necessary to prevent access to revegetated sites by livestock or unauthorized persons.
g. Do not use invasive or non-native species for site restoration.[15]
h. Conduct post-construction monitoring and treatment to remove or control invasive plants until native plant species are well-established.

[15] See your local Oregon State University Extension agent or http://extension.oregonstate.edu.

29. "Flexible Uplift"

a. Any project that does not fully meet all other applicable PDCs may incorporate "flexible uplift" to fulfill the requirement to provide long-term benefit to the listed species and critical habitat.
b. The action agency will conduct pre-notification coordination with NMFS at least 30 days in advance of submitting the Action Notification Form with a flexible uplift plan.
c. The flexible uplift plan will explain how the action agency will complete the activities, including site sketches, drawings, specifications, calculations, or other information commensurate with the scope of the project.
d. Include the following in flexible uplift plans:
    i. The name, address, and telephone number of a person responsible for designing this part of the project that NMFS may contact if additional information is necessary to complete the effects analysis.
    ii. To minimize delays and objections during the review process, the action agency is encouraged to seek the advice of NMFS during early planning and design of flexible uplift plans. For complex activities, such consultation may improve the likelihood of success and reduce permit-processing time.
e. Complete flexible uplift before, or concurrent with, construction whenever possible. Always complete flexible uplift within one year of completing other project activities.

1.3.1.3 Project Design Criteria – Activity Category

30. Tide/Flood Gate Removal, Replacement, or Retrofit

a. The action agency will ensure projects are consistent with *Anadromous Salmonid Passage Facility Design* (NMFS 2011a or subsequent) by coordinating with NMFS and NMFS fish passage engineers at least 30 days prior to notification.
b. Provide an assessment of existing habitat and passage conditions. The following information is necessary[16] to assist in streamlining the review:
    i. Existing structure(s): Pipe dimensions, pipe material, pipe length, and gate type, dimensions, and material.
    ii. Listed species use and timing: Identify specie(s) by life stage and periods of use (or historic use if fish are presently excluded).
    iii. Elevations: Use a common datum and report the following elevations; pipe invert, mean low low water, mean low water, mean tide level, mean high water, mean high high water and elevations of other structures (buildings, roads) which may limit inundation of the project. If inundation limits exist, discuss why.
    iv. Evaluation of existing habitat: *Tidal data used for this analysis covers the period(s) identified in b.ii. above. The range of data used in the analysis*

[16] Information in i. and ii. is required. Actions that do not provide information in iii., iv., and v. will require greater coordination with NMFS engineering and likely longer review periods.

should cover the previous 10 years of recorded tidal data.[17] *For example; if annual use of a target species and life stage includes April-June, all April-June data covering the last 10 years of recorded data is used to calculate and report the necessary metrics*. Report the absolute minimum, absolute maximum, and average inundation depths, adjacent and upstream of the gate, independently for both the high and low cycles of the tide. For each reported depth (six depth values total, three for each tide cycle) report the total water surface area and summarize inundated vegetation types and amounts. Report the % of time the absolute minimum and average inundations depths are exceeded for both the low and high cycles of the tide (four exceedance values total, two for each tide cycle).

v. Existing passage: *Tidal data used for this analysis covers periods of critical migration identified in b.ii. above. The range of data used in the analysis should cover the previous 10 years of recorded tidal data. For example; if annual migration of a target species and life stage includes October-January all October 24 hour tidal data covering the last 10 years of recorded data is averaged creating a single 24 hour tide cycle, this process is repeated for months November, December, and January. Each month is run separately to calculate and report the necessary metrics.* On a graph, plot both pipe velocity and upstream tide elevation with respect to time for each of the required monthly averaged 24 hour tide cycles. Report % of time gate is open during high and low tide using the corresponding monthly averaged tide cycle.

c. Identify long-term benefits to the listed species and critical habitat. The summary must clearly link intended habitat and passage improvements to existing conditions with respect to individual listed species and life stages.

d. For tide/flood gate removal activities, if a culvert or bridge will be constructed at the location of a removed tide gate, the structure must be large enough to allow for a full tidal exchange.

e. For tide/flood gate replacement and retrofit activities:

i. Use data of existing conditions to develop designs that maximize naturally occurring tidal exchange characteristics (elevation, cross-sectional area, water volume, and timing) and fish passage hydraulics, considering allowable inundation levels (land use and presence of structures).

ii. If the tide/flood gate will be seasonally adjusted, a water management plan is required. The plan will clearly identify and define the actions and operations required to achieve intended habitat and fish passage goals into the future. At a minimum the plan will contain the following information:

1. Responsible party
2. Operating protocols including proposed high water elevations behind gate by month
3. Monitoring protocol
4. Reporting protocol

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[17] One source of information can be found at https://tidesandcurrents.noaa.gov/map/index.shtml. This website has historic data for NOAA ocean buoys. A correction factor will be needed to transfer the buoy data to the project location. Because no standard method of tidal correction exists, we suggest early discussion with NMFS engineering.

        5. Adaptive management process
    iii. A maintenance plan is required. The plan will describe the process of ensuring fish passage and habitat improvement goals are met. At a minimum the plan will contain the following information:
        1. Responsible party
        2. Monitoring protocol, including frequency
        3. Modification process if passage or habitat conditions fail to meet project goals
        4. Reporting protocol
    iv. A copy of the tide/flood gate design, water management plan, and maintenance plan will be submitted to NMFS for engineering review during the pre-notification coordination period.

31. Set-Back or Removal of Existing Dikes, or Levees

a. Floodplains and freshwater deltas
    i. Design projects to restore floodplain function based upon the following characteristics: elevation, width, gradient, length, and roughness—in a manner that closely mimics, to the extent possible, those that would naturally occur at that stream and valley type.
    ii. Remove drain pipes, fences, and other capital projects to the extent possible.
    iii. To the extent possible, remove non-native fill material from the floodplain to an upland site.
    iv. Where it is not possible to remove or set-back all portions of dikes and levees, or in areas where existing dikes, and levees support abundant riparian vegetation, openings will be created with breaches.
        1. Breaches shall be equal to or greater than the active channel width to reduce the potential for channel avulsion during flood events.
        2. In addition to other breaches, the dike or levee shall always be breached at the downstream end of the project or at the lowest elevation of the floodplain to ensure the flows will naturally recede back into the main channel, thus minimizing fish entrapment.
    v. Loosen compacted soils once overburden material is removed unless demonstrated this action is not necessary to restore the site to pre-disturbance condition or it would have greater environmental impacts. Overburden or fill comprised of native materials, which originated from the project area, may be used within the floodplain to create set-back dikes and fill anthropogenic holes provided that floodplain function is not impeded.
b. Estuary restoration
    i. Project implementation shall be conducted in a sequence that will not preclude repairing or restoring estuary functions once dikes/levees are breached and the project area is flooded.
    ii. Culverts and tide/flood gates will be removed using best management practices for minimizing impacts to the aquatic environment including the PDC and conservation measures, where appropriate, as described in Work

Area Isolation (PDC 21), Surface Water Withdrawals (PDC 17), and Fish Capture and Release (PDC 22).

iii. Temporary roads within the project area shall be removed to allow free flow of water. Material either will be placed in a stable area above the ordinary high water line or highest measured tide or be used to restore topographic variation in wetlands.

iv. To the extent possible, remove segmented drain tiles placed to drain wetlands. Fill generated by drain tile removal will be compacted back into the ditch created by removal of the drain tile.

v. Channel construction may be done to recreate channel morphology based on aerial photograph interpretation, literature, topographic surveys, and nearby undisturbed channels. Channel dimensions (width and depth) are based on measurements of similar types of channels and the drainage area. In some instances, channel construction is simply breaching the levee. For these sites, further channel development will occur through natural processes.

vi. Fill ditches constructed and maintained to drain wetlands. Some points in an open ditch may be over-filled to enhance topography and encourage sinuosity of the developing channel.

vii. Avoid creating shallow depressions, which may result in fish stranding.

32. Large Wood (LW) and Engineered Logjams (ELJ)

a. Large wood placements are individual pieces or structures composed of LW that do not use mechanical methods as the means of providing structure stability (i.e., large rock, rebar, rope, cable, etc.). The use of native soil, alluvium with similar angularity as the natural bed material, large wood, or buttressing with adjacent trees as methods for providing structure stability are authorized. This method is predominantly for use in small to moderately sized channels and is not appropriate for application in mainstem systems. These structures are designed to provide roughness, redirect flow, and provide stability to adjacent streambed and banks or downstream reaches, while providing valuable fish and wildlife habitat.

i. When LW structures occupy greater than 25% of the bankfull area, the action agency will ensure projects are consistent with *Anadromous Salmonid Passage Facility Design* (NMFS 2011a or subsequent) by coordinating with NMFS and NMFS fish passage engineers at least 30 days prior to notification.

ii. Place LW in areas where it would naturally occur and in a manner that closely mimics natural accumulations for that particular stream type.

iii. Structure types shall simulate disturbance events to the greatest degree possible and include, but are not limited to, log jams, debris flows, wind-throw, and tree breakage.

iv. No limits are to be placed on the size or shape of structures as long as such structures are within the range of natural variability of a given location and do not block fish passage.

v. Installation can include grade control and streambank stabilization structures, while size and configuration of such structures will be commensurate with scale of the site and hydraulic forces.

vi. The partial burial of LW is permitted and may constitute the dominant means of placement. This applies to all stream systems but more so for larger stream systems where use of adjacent riparian trees or channel features is not feasible or does not provide the full stability desired.
vii. LW includes whole conifer and hardwood trees, logs, and rootwads. LW size (diameter and length) should account for bankfull width and stream discharge rates. When available, trees with rootwads should be a minimum of 1.5 times bankfull channel width, while logs without rootwads should be a minimum of 2.0 times bankfull widths.
viii. Structures may partially or completely span stream channels or be positioned along stream banks.
ix. Stabilizing or key pieces of LW will be intact, hard, with little decay, and if possible have root wads (untrimmed) to provide functional refugia habitat for fish.
x. Consider orienting key pieces such that the hydraulic forces upon the LW increase stability.

b. ELJs are structures designed to redirect flow and change scour and deposition patterns, while providing valuable fish and wildlife habitat. To the extent practical, ELJs are designed to simulate stable natural log jams and can be either naturally stable due to LW size and/or stream width or anchored in place using rebar, rock, or piles (driven into a dewatered area or the streambank, but not in water). They are also designed to create a hydraulic shadow, a low-velocity zone downstream that allows sediment to settle out and scour holes adjacent to the structure.
i. When ELJs occupy greater than 25% of the bankfull area, the action agency will ensure projects are consistent with *Anadromous Salmonid Passage Facility Design* (NMFS 2011a or subsequent) by coordinating with NMFS and NMFS fish passage engineers at least 30 days prior to notification.
ii. ELJs will be patterned, to the greatest degree possible, after stable natural log jams. Reasons for deviating shall be provided in a brief statement.
iii. Grade control ELJs are designed to arrest channel down-cutting or incision by providing a grade control that retains sediment, lowers stream energy, and increases water elevations to reconnect floodplain habitat and diffuse downstream flood peaks.
iv. Stabilizing or key pieces of LW that will be relied on to provide streambank stability or redirect flows will be intact and solid (little decay). If possible, acquire LW with untrimmed rootwads to provide functional refugia habitat for fish.
v. When available, trees with rootwads attached should be a minimum length of 1.5 times the bankfull channel width, while logs without rootwads should be a minimum of 2.0 times the bankfull width.
vi. The partial burial of LW may constitute the dominant means of placement, and key boulders (footings) or LW can be buried into the streambank or channel.

vii. Angle and offset – The LW portions of ELJ structures should be oriented such that the force of water upon the LW increases stability. If a rootwad is left exposed to the flow, the bole placed into the streambank should be oriented downstream parallel to the flow direction so the pressure on the rootwad pushes the bole into the streambank and bed.
viii. Wood members that are oriented parallel to flow are more stable than members oriented at 45 or 90 degrees to the flow.
ix. If LW anchoring is required, a variety of methods may be used. These include buttressing the wood between riparian trees, or the use of manila, sisal, or other biodegradable ropes for lashing connections. If hydraulic conditions warrant use of structural connections, rebar pinning or bolted connections may be used. Rock may be used for ballast but is limited to that needed to anchor the LW. Use of cable or chain is not covered by this opinion.

33. Dam and Legacy Structure Removal

a. Dam removal
   i. The action agency will ensure projects are consistent with *Anadromous Salmonid Passage Facility Design* (NMFS 2011a or subsequent) by coordinating with NMFS and NMFS fish passage engineers at least 30 days prior to notification.
   ii. Project Documentation – At a minimum, the following information will be necessary for review:
      1. A longitudinal profile of the stream channel thalweg for 20 channel widths downstream of the structure and 20 channel widths upstream of the reservoir area (outside of the influence of the structure) shall be used to determine the potential for channel degradation.
      2. A minimum of three cross-sections – one downstream of the structure, one through the reservoir area upstream of the structure, and one upstream of the reservoir area (outside of the influence of the structure) to characterize the channel morphology and quantify the stored sediment.
      3. Sediment characterization to determine the proportion of coarse sediment (greater than 2 millimeters (mm)) in the reservoir area.
      4. Reservoirs with a d35 greater than 2 mm (i.e., 65% of the sediment by weight exceeds 2 mm in diameter) may be removed without excavation of stored material, if the sediment contains no contaminants; reservoirs with a d35 less than 2 mm (i.e., 65% of the sediment by weight is less than 2 mm in diameter) will require partial removal of the fine sediment to create a pilot channel, in conjunction with stabilization of the newly exposed streambanks with native vegetation.
   iii. Design Guidance – If a project involves the removal of multiple barriers on one stream or in one watershed over the course of a work season, remove the most upstream barrier first if possible.

iv. Monitoring – Dams greater than 10-feet in height (measured at the upstream side of the structure at the approximate centerline of the stream) require a long-term monitoring and adaptive management plan reviewed by NMFS.

b. Removal of legacy structures

i. Remove material not typically found within the stream or floodplain at project sites (i.e., LW, boulders, concrete, etc.) from the 100-year floodplain.

ii. Materials (i.e., LW and boulders.) typically found within the stream or floodplain at that site can be reused to implement habitat improvements described under other categories in this opinion.

iii. If the structure being removed is keyed into the bank, fill in "key" holes with native materials to restore contours of streambank and floodplain. Compact the fill material adequately to prevent washing out of the soil during over-bank flooding. Do not mine material from the stream channel bed to fill in "key" holes.

iv. When removal of buried log structures may result in significant disruption to riparian vegetation or the floodplain, consider using a chainsaw to extract the portion of log within the channel and leaving the buried sections within the streambank.

v. If a project involves the removal of multiple barriers on one stream over the course of a work season, remove the most upstream barrier first if possible.

vi. If the legacy structures (log, rock, or gabion weirs) were placed to provide grade control, evaluate the site for potential headcutting and incision due to structure removal. If headcutting and channel incision are likely to occur due to structure removal, additional measures will be taken to reduce these impacts.

vii. If the structure is being removed because it has caused an over-widening of the channel, consider implementing other restoration categories to decrease the width to depth ratio of the stream to a level commensurate with the geomorphic setting.

34. Channel Reconstruction/Relocation

a. The action agency will ensure projects are consistent with *Anadromous Salmonid Passage Facility Design* (NMFS 2011a or subsequent) by coordinating with NMFS and NMFS fish passage engineers at least 30 days prior to notification.

b. Design Guidance

i. Construct geomorphically appropriate stream channels and floodplains within a watershed and reach context.

ii. Design projects to restore floodplain characteristics—elevation, width, gradient, length, and roughness—in a manner that closely mimics, to the extent possible, those that will naturally occur at that stream and valley type.

iii. To the greatest degree possible, remove nonnative fill material from the channel and floodplain to an upland site.

iv. Loosen compacted soils once overburden material is removed unless demonstrated this action is not necessary to restore the site to pre-disturbance condition or it would have greater environmental impacts. Overburden or fill comprised of native materials, which originated from the project area, may be used within the floodplain where appropriate to support the project goals and objectives.
v. Structural elements shall fit within the geomorphic context of the stream system. For bed stabilization and hydraulic control structures, constructed riffles shall be preferentially used in pool-riffle stream types, while roughened channels and boulder step structures shall be preferentially used in step-pool and cascade stream types.
vi. Material selection (LW, rock, gravel) shall also mimic natural stream system materials.
vii. Construction of the streambed should be based on Stream Simulation Design principles as described in section 6.2 of Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings (USDA-Forest Service 2008) or other appropriate design guidance documents.

c. Monitoring. A monitoring and adaptive plan will be submitted to NMFS during the pre-notification coordination. The plan will include the following:
i. Introduction
ii. Existing Monitoring Protocols
iii. Project Effectiveness Monitoring Plan
1. Immediately upon completion of the new channel construction, the contractor shall survey the project and provide as-built monitoring data, which will be supplied to NMFS for review.
2. This survey will compare as-built metrics to proposed design metrics on channel length, substrate size, residual pool depth, pieces of LW, etc.

iv. Monitoring Frequency, Timing, and Duration
v. Monitoring Technique Protocols
vi. Data Storage and Analysis
vii. Monitoring Quality Assurance Plan
viii. Literature cited

35. Off- and Side-Channel Habitat Restoration

a. The action agency will ensure projects are consistent with *Anadromous Salmonid Passage Facility Design* (NMFS 2011a or subsequent) by coordinating with NMFS and NMFS fish passage engineers at least 30 days prior to notification.
b. Reconnection of off- and side-channels habitats that have been blocked includes excavation within historical channels and removal of plugs which impede water movement through off- and side-channels.
c. Data requirements. Data requirements and analysis for off- and side-channel habitat restoration include evidence of historical channel location, such as land use surveys, historical photographs, topographic maps, remote sensing information, or personal observation.

d. Allowable excavation. Off- and side-channel improvements can include minor excavation (less than or equal to 10% of volume) of naturally accumulated sediment within historical channels, *i.e.*, based on the OHW (riverine) or the HAT (estuarine) level as the elevation datum. The calculation of the 10% excavation volume does not include manually placed fill, such as dikes or earthen plug. There is no limit as to the amount of excavation of anthropogenic fill within historical side channels as long as such channels can be clearly identified through field or aerial photographs.
e. Excavation depth will not exceed the maximum thalweg depth in the main channel.
f. Excavated material removed from off- or side-channels shall be hauled to an upland site or spread across the adjacent floodplain in a manner that does not restrict floodplain capacity.

36. Streambank Restoration

a. Without changing the location of the bank toe, restore damaged streambanks to a natural slope, pattern, and profile suitable for establishment of permanent woody vegetation.
b. Include large wood in every streambank restoration activity to the maximum extent feasible. Large wood must be intact, hard, and undecayed to partly decaying, and should have untrimmed root wads to provide functional refugia habitat for fish. Use of decayed or fragmented wood found lying on the ground or partially sunken in the ground is not acceptable. Wood that is already within the stream or suspended over the stream may be repositioned to allow for greater interaction with the stream.
c. The following streambank stabilization methods may be used individually or in combination:
    i. Bank reshaping and slope grading
    ii. Woody plantings
    iii. Herbaceous cover, in areas where the native vegetation does not include trees or shrubs
    iv. Coir logs
    v. Deformable soil reinforcement
    vi. Floodplain flow spreaders
    vii. Alluvium placement
    viii. Floodplain roughness
    ix. Roughened toe
    x. For more information on the above methods see Federal Emergency Management Agency (FEMA 2009) Engineering with Nature, Natural Resources Conservation Service (NRCS 2016) Natural Channel and Floodplain Restoration, Applied Fluvial Geomorphology, or Cramer *et al*. (2003) Washington State Aquatic Habitat Guidelines Program: Integrated Streambank Protection Guidelines. Other than those methods relying solely upon woody and herbaceous plantings, streambank stabilization projects should be designed by a qualified engineer that is appropriately registered in the state where the work is performed.

d. Rock will not be used for streambank restoration, except in a roughened toe or as ballast to stabilize LW. Stream barbs and full-spanning weirs are not allowed for stream bank stabilization under this opinion.
e. Alluvium placement can be used as a method for providing bank stabilization using imported gravel/cobble/boulder-sized material of the same composition and size as that in the channel bed and banks to halt or attenuate streambank erosion, stabilize riffles. This method is predominantly for use in small to moderately sized channels and is not appropriate for application in mainstem systems. Alluvium placement is a method designed to provide roughness, redirect flow, and provide stability to adjacent streambed and banks or downstream reaches, while providing valuable fish and wildlife habitat.
    i. When alluvium placement projects occupy more than 25% of the channel bed or more than 25% of the bankfull cross sectional area, the action agency will ensure projects are consistent with *Anadromous Salmonid Passage Facility Design* (NMFS 2011a or subsequent) by coordinating with NMFS and NMFS fish passage engineers at least 30 days prior to notification.
    ii. This design method is only covered in those areas where the natural sediment supply has been eliminated, significantly reduced through anthropogenic disruptions, or used to initiate or simulate sediment accumulations in conjunction with other structures, such as LW placements and ELJs.
    iii. Material used to construct the toe should be placed in a manner that mimics attached longitudinal bars or point bars.
    iv. Size distribution of toe material will be diverse and predominately comprised of D84 to Dmax size class material.
    v. All material will be clean alluvium with similar angularity as the natural bed material. When possible use material of the same lithology as found in the watershed. Reference Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings (USDA-Forest Service 2008) to determine gravel sizes appropriate for the stream.
    vi. Material can be mined from the floodplain at elevations above bankfull, but not in a manner that will cause stranding during future flood events.
    vii. Crushed rock is not permitted.
    viii. After placement in areas accessible to higher stream flow, allow the stream to naturally sort and distribute the material.
    ix. Imported material will be free of invasive species and non-native seeds. If necessary, wash prior to placement.
f. A roughened toe for this program is defined as a structure composed of LW with rock for ballast and stability. A roughened toe is used to withstand erosional forces where they are greatest and provide the foundation for other treatments.
    i. Structures will extend as low as the depth of scour.
    ii. Structures will extend only as high as other treatments are able to withstand shear forces, not to the ordinary high water mark.

iii. Minimum amount of wood incorporated into the treated area is equal to the number of whole trees whose cumulative summation of rootwad diameters is equal to 80% of linear-feet of treated streambank.

37. Livestock Fencing, Stream Crossings and Off-Channel Livestock Watering Facilities

a. Livestock fencing

i. To the extent possible, fences will be placed outside the channel migration zone and allow for lateral stream movement.

ii. Minimize vegetation removal, especially potential LW recruitment sources, when constructing fence lines.

iii. Where appropriate, construct fences at water gaps in a manner that allows passage of LW and other debris.

b. Livestock stream crossings

i. The number of crossings will be minimized.

ii. Locate crossings or water gaps where streambanks are naturally low. Livestock crossings or water gaps will not be located in areas where compaction or other damage can occur to sensitive soils and vegetation (e.g., wetlands) due to congregating livestock.

iii. Existing access roads and stream crossings will be used whenever possible, unless new construction will result in less habitat disturbance and the old trail or crossing is retired.

iv. Access roads or trails will be provided with a vegetated buffer that is adequate to avoid or minimize runoff of sediment and other pollutants to surface waters.

v. Essential crossings will be designed and constructed or improved to handle reasonably foreseeable flood risks, including associated bedload and debris, and to prevent the diversion of streamflow out of the channel and down the trail if the crossing fails.

vi. If necessary, the streambank and approach lanes can be stabilized with native vegetation or angular rock to reduce chronic sedimentation. The stream crossing or water gap should be armored with sufficient sized rock (e.g., cobble-size rock) and use angular rock if natural substrate is not of adequate size.

vii. When culverts or bridges—including bridges constructed from flatbed railroad cars, boxcars, or truck flatbeds—are used to create a stream crossing, The action agency will ensure projects are consistent with *Anadromous Salmonid Passage Facility Design* (NMFS 2011a or subsequent) by coordinating with NMFS and NMFS fish passage engineers at least 30 days prior to notification.

viii. Stream crossings and water gaps will be designed and constructed to a width of 10 to 15 feet in the upstream-downstream direction to minimize the time livestock will spend in the crossing or riparian area.

ix. When using pressure treated lumber for fence posts, complete all cutting/drilling offsite (to the extent possible) so that treated wood chips and debris do not enter water or flood prone areas.

x. Riparian fencing is not to be used to create livestock handling facilities.

c. Off-channel livestock watering facilities
    i. The development of a spring is not allowed if the spring is occupied by ESA-listed species.
    ii. Water withdrawals will not dewater habitats or cause low stream flow conditions that could affect ESA-listed fish. Diversions may not exceed 10% of the flow at the time of diversion.
    iii. Troughs or tanks fed from a stream or river will have an existing valid water right.
    iv. Surface water intakes will be screened to meet the most recent version of NMFS fish screen criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2011a or subsequent), and be self-cleaning or regularly maintained by removing debris buildup. A responsible party will be designated to conduct regular inspection and as-needed maintenance to ensure pumps and screens are properly functioning.
    v. Place troughs far enough from a stream or surround with a protective surface to prevent mud and sediment delivery to the stream. Avoid steep slopes and areas where compaction or damage could occur to sensitive soils, slopes, or vegetation due to congregating livestock.
    vi. Ensure that each livestock water development has a float valve or similar device, a return flow system, a fenced overflow area, or similar means to minimize water withdrawal and potential runoff and erosion.
    vii. Minimize removal of vegetation around springs and wet areas.
    viii. When necessary, construct a fence around the spring development to prevent livestock damage.

38. Piling and other Structure Removal

a. When removing an intact pile:
    i. Install a floating surface boom to capture floating surface debris.
    ii. To the extent possible, keep all equipment (e.g., bucket, steel cable, vibratory hammer) out of the water, grip piles above the waterline, and complete all work during low water and low current conditions.
    iii. Dislodge the piling with a vibratory hammer, whenever feasible. Never intentionally break a pile by twisting or bending.
    iv. Slowly lift piles from the sediment and through the water column.
    v. Place piles in a containment basin on a barge deck, pier, or shoreline without attempting to clean or remove any adhering sediment. A containment basin for the removed piles and any adhering sediment may be constructed of durable plastic sheeting with sidewalls supported by hay bales or another support structure to contain all sediment and return flow which may otherwise be directed back to the waterway.
    vi. After piling removal, fill the holes left with clean, native sediments from the project area.
    vii. Dispose of all removed piles, floating surface debris, any sediment spilled on work surfaces, and all containment supplies at a permitted upland disposal site.

b. When removing a broken pile follow PDC 25.

39. Beaver Habitat Restoration

a. Beaver habitat restoration, as defined by this document, will achieve and sustain significant recruitment of willow or other deciduous shrubs and trees that thrive in wet soils and are preferred by beaver (beaver preferred vegetation) through modification of floodplain connectivity and interaction with the adjacent hyporheic environment. Beaver preferred vegetation recruitment is critical to establishing and sustaining beaver activity. When the ecologic goal of beaver preferred vegetation recruitment and sustainment cannot be feasibly met, or has little chance of being met, the project is not defined as beaver habitat restoration.

b. Applicants must clearly detail (1) which stream processes the project site is missing that result in beaver recruitment not happening naturally, (2) which stream processes the physical beaver habitat restoration design will restore or modify, and (3) exactly how those restored or modified stream processes lead to beaver preferred vegetation recruitment and sustainment over the life of the project.

c. Typical beaver habitat restoration site characteristics include:
    i. Historical beaver use.
    ii. Absence of dense forest canopy; allowing sufficient sunlight to initiate and sustain growth of beaver preferred vegetation.
    iii. Lower gradient channels.
    iv. Moderately confined to unconfined channels.
    v. Floodplain soils which do not inhibit beaver preferred vegetation recruitment or growth.
    vi. Spatial ability to incorporate higher than natural frequency of flood inundation.
    vii. Flood magnitudes which make stabilizing in-stream structures unfeasible.

d. Beaver habitat restoration projects may likely include a mix of the following:
    i. Channel re-construction
        1. Increased floodplain connectivity (follow PDC 34)
        2. Side channel construction (follow PDC 35)
        3. Alcove construction (follow PDC 35)
    ii. Off-channel methods
        1. Removal of dikes and levees (follow PDC 31)
    iii. In-channel structures/beaver dam analogs (BDAs)
        1. The action agency will ensure projects are consistent with *Anadromous Salmonid Passage Facility Design* (NMFS 2011a or subsequent) by coordinating with NMFS and NMFS fish passage engineers.
        2. BDAs may be channel spanning when seeking to simulate an active beaver dam complex. BDAs may also be designed as barbs (non-channel spanning) when seeking to simulate abandoned, or legacy, beaver dam complexes which have been abandoned by beavers and degraded over time.
        3. BDAs are constructed primarily of wood. The use of any non-biodegradable material is not authorized. Alluvial gravels and finer

material (rounded gravels and sand) can also be incorporated into the design. BDAs designed as a fishway, are defined as fishways. The use of fishway BDAs is not authorized under this opinion.

4. Structural design components of BDAs will follow guidance as described by Pollock *et al*. (2017).
5. Fish passage is best achieved when BDA structures are coupled with other restoration techniques to simulate the diversity and function of a beaver dam complex, instead of designing discrete beaver dams. BDAs will provide the following physical characteristics:
    a. Dam elevation consistent with the adjacent floodplain elevation.
    b. Provide concentrated flows around BDA abutments at all floodplain inundating flows. Visual concept on these features is found in figure 4 of Lokteff *et al.* (2013).
    c. Provide watered side channel connections around BDA structures. Visual concept on these features is found in figures 2, 3, and 4 of Lokteff *et al.* (2013).
6. A design plan is required. The plan will clearly describe the rationale for choosing the type of structures and their locations. At a minimum the plan will contain the following information:
    a. Responsible party
    b. Channel reconstruction, off-channel, and in-stream design elements and rationale for why they were chosen.
    c. Specific BDA design elements need to be documented on channel cross sections at each BDA and a longitudinal profile that represents each site type. The following should be included on the profiles:
        i. BDA elevation relative to thalweg
        ii. Channel bankfull width and elevation
        iii. Floodprone width and elevation
        iv. Any special allowance for adult passage
        v. Average site gradient
    d. Rationale for choosing number of BDAs per site, location(s) and goals for each site (example beaver recruitment, simulating beaver habitat).
    e. A statement about conformance to Pollock et al. (2017).
    f. Monitoring protocol
    g. Adaptive management process

e. Riparian Vegetation Restoration
    i. Beaver restoration activities may include planting riparian hardwoods (species such as willow, red osier dogwood, and alder) and building exclosures (such as temporary fences) to protect and enhance existing or

planted riparian hardwoods until they are established as described by the Malheur National Forest and the Keystone Project (2007).

ii. Maintain or develop grazing plans that will ensure the success of beaver habitat restoration objectives.

40. Wetland Restoration

a. Include applicable General Construction Measures (PDCs 8-28) to ensure that all adverse effects to fish and their designated critical habitats are within the range of effects considered in this opinion.

41. Temporary Safety Stabilization

a. Act as necessary to resolve the safety situation.

b. Without endangering human life or contributing to further loss of property or natural resources, apply all proposed design criteria from this opinion which are applicable to the stabilization to the maximum extent possible.

c. As soon as possible after the onset of the structural failure, contact NMFS to describe the nature and location of the site, review design criteria from this opinion that are applicable to the situation, and determine whether additional steps may be taken to further minimize the effects of the initial stabilization on listed species or their critical habitat.

   i. First try contacting the pertinent Branch Chief using the information on this webpage: http://www.westcoast.fisheries.noaa.gov/about_us/washington_oregon_coastal_area_office.html

   ii. For the Oregon Coast front desk call 541-957-3383

   iii. For the Willamette Basin front desk call 503-231-2202

   iv. For the Lower Columbia River front desk call 360-753-9597

d. If full implementation of the PDCs within this opinion are not possible during the temporary safety stabilization, during the next in-water work period bring the stabilization into conformance with all other applicable PDC in this opinion based on the existing conditions prior to the structural failure.

1.4 Action Area

“Action area” means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). All actions authorized by this programmatic opinion will occur within the jurisdiction of the Corps Portland District. The program action area consists of all the areas where the environmental effects of projects authorized, funded, or implemented by the action agencies under this opinion occur in Oregon and on the north bank of the Lower Columbia River in Washington. This includes all upland, riparian, and aquatic areas affected by implementation of projects. The program action area also includes estuaries and coastal waters where water quality effects of the projects may occur (small quantities of herbicides or other contaminants may move downstream of where they enter the water, eventually reaching the estuaries and coastal waters). There is overlap between the areas impacted by the proposed program and the range of ESA-listed salmon, steelhead, green sturgeon, eulachon, and their designated critical habitats. This includes the following recovery domains: Willamette River-Lower Columbia, Oregon Coast, and Southern Oregon/Northern California Coast.

The program action area is also designated as EFH for Pacific Coast salmon (PFMC 2014), Pacific groundfish (PFMC 2005), and coastal pelagic species (PFMC 1998) or is in an area where environmental effects of the proposed program may adversely affect designated EFH for those species.

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, Federal agencies must ensure that their 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 us and section 7(b)(3) requires that, at the conclusion of consultation, we provide an opinion stating how the agency's actions would affect listed species and their critical habitat. If incidental take is expected, section 7(b)(4) requires us to provide an ITS that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures and terms and conditions to minimize such impacts.

2.1 Analytical Approach

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

The adverse modification analysis considers the impacts of the Federal action on the conservation value of designated critical habitat. This 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 for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (81 FR 7214).

The designation of critical habitat uses the term primary constituent element (PCE) or essential features. The new critical habitat regulations (81 FR 7414) 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 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.

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

- Identify the range wide status of the species and critical habitat likely to be adversely affected by the proposed action.
- Describe the environmental baseline in the action area.
- Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.
- Describe any cumulative effects in the action area.
- Integrate and synthesize the above factors to assess the risk that the proposed action poses to species and critical habitat.
- Reach jeopardy and adverse modification conclusions.
- If necessary, define a reasonable and prudent alternative to the proposed action.

2.2 Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be adversely affected by the proposed program. 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% 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; Mote *et al*. 2014). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB 2007; Mote *et al*. 2014). Models consistently predict increases in the frequency of severe winter precipitation events (i.e., 20-year and 50-year events), in the western United States (Dominguez *et al*. 2012). The largest increases in winter flood frequency and magnitude are predicted in mixed rain-snow watersheds (Mote *et al*. 2014).

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

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

In addition to changes in freshwater conditions, predicted changes for coastal waters in the Pacific Northwest as a result of climate change include increasing surface water temperature, increasing but highly variable acidity, and increasing storm frequency and magnitude (Mote *et al*. 2014). Elevated ocean temperatures already documented for the Pacific Northwest are highly likely to continue during the next century, with sea surface temperature projected to increase by 1.0-3.7^{o}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 3, below, provides a summary of listing and recovery plan information, status summaries and limiting factors for the species addressed in this opinion. More information can be found in recovery plans and status reviews for these species. These documents are available on the NMFS West Coast Region website (http://www.westcoast.fisheries.noaa.gov/).

Table 3. 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 2013a	NWFSC 2015	This ESU comprises 32 independent populations. Twenty-seven populations are at very high risk, 2 populations are at high risk, one population is at moderate risk, and 2 populations are at very low risk Overall, there was little change since the last status review in the biological status of this ESU, although there are some positive trends. Increases in abundance were noted in about 70% of the fall-run populations and decreases in hatchery contribution were noted for several populations. Relative to baseline VSP levels identified in the recovery plan, there has been an overall improvement in the status of a number of fall-run populations, although most are still far from the recovery plan goals.	• Reduced access to spawning and rearing habitat • Hatchery-related effects • Harvest-related effects on fall Chinook salmon • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Contaminant
Upper Columbia River spring-run Chinook salmon	Endangered 6/28/05	Upper Columbia Salmon Recovery Board 2007	NWFSC 2015	This ESU comprises four independent populations. Three are at high risk and one is functionally extirpated. Current estimates of natural origin spawner abundance increased relative to the levels observed in the prior review for all three extant populations, and productivities were higher for the Wenatchee and Entiat populations and unchanged for the Methow population. However, abundance and productivity remained well below the viable thresholds called for in the Upper Columbia Recovery Plan for all three populations.	• Effects related to hydropower system in the mainstem Columbia River • Degraded freshwater habitat • Degraded estuarine and nearshore marine habitat • Hatchery-related effects • Persistence of non-native (exotic) fish species • Harvest in Columbia River fisheries
Snake River spring/summer-run Chinook salmon	Threatened 6/28/05	NMFS 2017a	NWFSC 2015	This ESU comprises 28 extant and four extirpated populations. All except 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 2011b	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
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.

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Columbia River chum salmon	Threatened 6/28/05	NMFS 2013a	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
Lower Columbia River coho salmon	Threatened 6/28/05	NMFS 2013a	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	• 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
				conditions suggest that population declines might occur in the upcoming return years	
Oregon Coast coho salmon	Threatened 6/20/11	NMFS 2016a	NWFSC 2015	This ESU comprises 56 populations including 21 independent and 35 dependent populations. The last status review indicated a moderate risk of extinction. Significant improvements in hatchery and harvest practices have been made for this ESU. Most recently, spatial structure conditions have improved in terms of spawner and juvenile distribution in watersheds; none of the geographic area or strata within the ESU appear to have considerably lower abundance or productivity. The ability of the ESU to survive another prolonged period of poor marine survival remains in question.	• Reduced amount and complexity of habitat including connected floodplain habitat • Degraded water quality • Blocked/impaired fish passage • Inadequate long-term habitat protection • Changes in ocean conditions
Southern Oregon/ Northern California Coast coho salmon	Threatened 6/28/05	NMFS 2014	NMFS 2016b	This ESU comprises 31 independent, 9 independent, and 5 ephemeral populations all grouped into 7 diversity strata. Of the 31 independent populations, 24 are at high risk of extinction and 6 are at moderate risk of extinction. The extinction risk of an ESU depends upon the extinction risk of its constituent independent populations; because the population abundance of most independent populations are below their depensation threshold, the SONCC coho salmon ESU is at high risk of extinction and is not viable	• Lack of floodplain and channel structure • Impaired water quality • Altered hydrologic function • Impaired estuary/mainstem function • Degraded riparian forest conditions • Altered sediment supply • Increased disease/predation/competition • Barriers to migration • Fishery-related effects • Hatchery-related effects
Snake River sockeye salmon	Endangered 6/28/05	NMFS 2015a	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

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Upper Columbia River steelhead	Threatened 1/5/06	Upper Columbia Salmon Recovery Board 2007	NWFSC 2015	This DPS comprises four independent populations. Three populations are at high risk of extinction while 1 population is at moderate risk. Upper Columbia River steelhead populations have increased relative to the low levels observed in the 1990s, but natural origin abundance and productivity remain well below viability thresholds for three out of the four populations. The status of the Wenatchee River steelhead population continued to improve based on the additional year's information available for the most recent review. The abundance and productivity viability rating for the Wenatchee River exceeds the minimum threshold for 5% 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
Lower Columbia River steelhead	Threatened 1/5/06	NMFS 2013a	NWFSC 2015	This DPS comprises 23 historical populations, 17 winter-run populations and six summer-run populations. Nine populations are at very high risk, 7 populations are at high risk, 6 populations are at moderate risk, and 1 population is at low risk. The majority of winter-run steelhead populations in this DPS continue to persist at low abundances. Hatchery interactions remain a concern in select basins, but the overall situation is somewhat improved compared to prior reviews. Summer-run steelhead populations were similarly stable, but at low abundance levels. The decline in the Wind River summer-run population is a source of concern, given that this population has been considered one of the healthiest of the summer-runs; however, the most recent abundance estimates suggest that the decline was a single year aberration. Passage programs in the Cowlitz and Lewis basins have the potential to provide considerable improvements in abundance and spatial structure, but have not produced self-sustaining populations to date. Even with modest improvements in the status of several winter-run DIPs, none of the populations appear to be at fully viable status, and similarly none of the MPGs meet the criteria for viability.	• Degraded estuarine and nearshore marine habitat • Degraded freshwater habitat • Reduced access to spawning and rearing habitat • Avian and marine mammal predation • Hatchery-related effects • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Upper Willamette River steelhead	Threatened 1/5/06	NMFS 2011b	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 2009c	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
Southern DPS of green sturgeon	Threatened 4/7/06	NMFS 2018a	NMFS 2015c	The Sacramento River contains the only known green sturgeon spawning population in this DPS. The current estimate of spawning adult abundance is between 824-1,872 individuals. Telemetry data and genetic analyses suggest that Southern DPS green sturgeon generally occur from Graves Harbor, Alaska to Monterey Bay, California and, within this range, most frequently occur in coastal waters of Washington, Oregon, and Vancouver Island and near San Francisco and Monterey bays. Within the nearshore marine environment, tagging and fisheries data indicate that Northern and Southern DPS green sturgeon prefer marine waters of less than a depth of 110 meters.	• Reduction of its spawning area to a single known population • Lack of water quantity • Poor water quality • Poaching
Southern DPS of eulachon	Threatened 3/18/10	NMFS 2017c	Gustafson et al. 2016	The Southern DPS of eulachon includes all naturally-spawned populations that occur in rivers south of the Nass River in British Columbia to the Mad River in California. Sub populations for this species include the Fraser River, Columbia River, British Columbia and the Klamath River. In the early 1990s, there was an abrupt decline in the abundance of eulachon returning to the Columbia River. Despite a brief period of improved returns in 2001-2003, the returns and associated commercial landings eventually declined to the low levels observed in the mid-1990s. Although eulachon abundance in monitored rivers has generally improved, especially in the 2013-2015 return years, recent poor ocean conditions and the likelihood that these conditions will persist into the near future suggest	• Changes in ocean conditions due to climate change, particularly in the southern portion of the species' range where ocean warming trends may be the most pronounced and may alter prey, spawning, and rearing success. • Climate-induced change to freshwater habitats • Bycatch of eulachon in commercial fisheries • Adverse effects related to dams and water diversions • Water quality, • Shoreline construction • Over harvest • Predation

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

2.2.2 Status of the Critical Habitat

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

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

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

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

A summary of the status of critical habitats, considered in this opinion, is provided in Table 4, below.

Table 4. 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.
Oregon Coast coho salmon	2/11/08 73 FR 7816	Critical habitat encompasses 13 subbasins in Oregon. The long-term decline in Oregon Coast coho salmon productivity reflects deteriorating conditions in freshwater habitat as well as extensive loss of access to habitats in estuaries and tidal freshwater. Many of the habitat changes resulting from land use practices over the last 150 years that contributed to the ESA-listing of Oregon Coast coho salmon continue to hinder recovery of the populations; changes in the watersheds due to land use practices have weakened natural watershed processes and functions, including loss of connectivity to historical floodplains, wetlands and side channels; reduced riparian area functions (stream temperature regulation, wood recruitment, sediment and nutrient retention); and altered flow and sediment regimes (NMFS 2016a). Several historical and ongoing land uses have reduced stream capacity and complexity in Oregon coastal streams and lakes through disturbance, road building, splash damming, stream cleaning, and other activities. Beaver removal, combined with loss of large wood in streams, has also led to degraded stream habitat conditions for coho salmon (Stout et al. 2012)
Southern Oregon/Northern California Coast coho salmon	5/5/99 64 FR 24049	Critical habitat includes all areas accessible to any life-stage up to long-standing, natural barriers and adjacent riparian zones. SONCC coho salmon critical habitat within this geographic area has been degraded from historical conditions by ongoing land management activities. Habitat impairments recognized as factors leading to decline of the species that were included in the original listing notice for SONCC coho salmon include: 1) Channel morphology changes; 2) substrate changes; 3) loss of in-stream roughness; 4) loss of estuarine habitat; 5) loss of wetlands; 6) loss/degradation of riparian areas; 7) declines in water quality; 8) altered stream flows; 9) fish passage impediments; and 10) elimination of habitat
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.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
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.
Southern DPS of green sturgeon	10/09/09 74 FR 52300	Critical habitat has been designated in coastal U.S. marine waters within 60 fathoms depth from Monterey Bay, California (including Monterey Bay), north to Cape Flattery, Washington, including the Strait of Juan de Fuca, Washington, to its United States boundary; the Sacramento River, lower Feather River, and lower Yuba River in California; the Sacramento-San Joaquin Delta and Suisun, San Pablo, and San Francisco bays in California; tidally influenced areas of the Columbia River estuary from the mouth upstream to river mile 46; and certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor), including, but not limited to, areas upstream to the head of tide in various streams that drain into the bays, as listed in Table 1 in USDC (2009). The CHRT identified several activities that threaten the PCEs in coastal bays and estuaries and necessitate the need for special management considerations or protection. The application of pesticides is likely to adversely affect prey resources and water quality within the bays and estuaries, as well as the growth and reproductive health of Southern DPS green sturgeon through bioaccumulation. Other activities of concern include those that disturb bottom substrates, adversely affect prey resources, or degrade water quality through re-suspension of contaminated sediments. Of particular concern are activities that affect prey resources. Prey resources are affected by: commercial shipping and activities generating point source pollution and non-point source pollution that discharge contaminants and result in bioaccumulation of contaminants in green sturgeon; disposal of dredged materials that bury prey resources; and bottom trawl fisheries that disturb the bottom (but result in beneficial or adverse effects on prey resources for green sturgeon).
Southern DPS of eulachon	10/20/11 76 FR 65324	Critical habitat for eulachon includes portions of 16 rivers and streams in California, Oregon, and Washington. All of these areas are designated as migration and spawning habitat for this species. In Oregon, we designated 24.2 miles of the lower Umpqua River, 12.4 miles of the lower Sandy River, and 0.2 miles of Tenmile Creek. We also designated the mainstem Columbia River from the mouth to the base of Bonneville Dam, a distance of 143.2 miles. Dams and water diversions are moderate threats to eulachon in the Columbia and Klamath rivers where hydropower generation and flood control are major activities. Degraded water quality is common in some areas occupied by southern DPS eulachon. In the Columbia and Klamath river basins, large-scale impoundment of water has increased winter water temperatures, potentially altering the water temperature during eulachon spawning periods. Numerous chemical

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
		contaminants are also present in spawning rivers, but the exact effect these compounds have on spawning and egg development is unknown. Dredging is a low to moderate threat to eulachon in the Columbia River. Dredging during eulachon spawning would be particularly detrimental.

2.3 Environmental Baseline

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the program action area, the anticipated impacts of all proposed Federal projects in the program action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

As described above in the Status of the Species and Critical Habitat sections, factors that limit the recovery of species considered in this opinion vary with the overall condition of aquatic habitats on surrounding lands. Within the program action area, many stream and riparian areas have been degraded by the effects of land and water use, including road construction, forest management, agriculture, mining, transportation, urbanization, and water development. Each of these economic activities has contributed to the myriad factors for the decline of species in the program action area. Among the most important of these are changes in stream channel morphology, degradation of spawning substrates, reduced instream roughness and cover, loss and degradation of estuarine rearing habitats, loss of wetlands, loss and degradation of riparian areas, water quality (*e.g.*, temperature, sediment, dissolved oxygen, contaminants) degradation, blocked fish passage, direct take, and loss of habitat refugia. Climate change is likely to play an increasingly important role in determining the abundance of ESA-listed species, and the conservation value of designated critical habitats, in the Pacific Northwest.

Stream habitats and riparian areas below the heads of tide in Oregon and lower Columbia River have been degraded by loss of mature riparian forests, increased sediment inputs, removal of large woody debris, urbanization, agriculture, alteration of floodplain and stream morphology, riparian vegetation disturbance, wetland draining and conversion, dredging, armoring of shorelines, marina and port development, and road construction. These activities have resulted in loss of available habitat, reduced habitat quality, altered forage species communities, reduced stream complexity, and altered stream flow and sediment load. Water quality has also been degraded from stormwater, municipal discharges, and agriculture and non-point source conveyances associated with the aforementioned activities. The negative impacts of these activities to aquatic habitat have contributed to the decline in abundance, productivity, diversity, and distribution and are limiting the recovery of the listed species.

Anadromous salmonids have been affected by the development and operation of dams. Dams and reservoirs have greatly altered the natural hydrograph of several rivers. Water impoundment and dam operations also affect downstream water quality characteristics, vital components to anadromous fish survival. In recent years, high quality fish passage has been restored where it did not previously exist, either through improvements to existing fish passage facilities or through dam removal.

The development of hydropower and water storage projects within the Columbia River basin have resulted in changes within the program action area such as loss of shallow-water rearing areas, altered water quality (reduced spring turbidity levels), water quantity (seasonal changes in flows and consumptive losses resulting from use of stored water for agricultural, industrial, or municipal purposes), water temperature (including generally warmer minimum winter temperatures and cooler maximum summer temperatures), water velocity (reduced spring flows and increased cross-sectional areas of the river channel), food (alteration of food webs, including the type and availability of prey species), and safe passage (increased mortality rates of migrating juveniles) (Ferguson *et al.* 2005; Williams *et al.* 2005).

Johnson *et al.* (2013) found polychlorinated biphenyls (PCBs) and dichlorodiphenyltrichloroethane (DDT) in juvenile salmon and salmon diet samples from the lower Columbia River and estuary at concentrations above estimated thresholds for effects on growth and survival. The Columbia River between Portland, Oregon, and Longview, Washington, appears to be an important source of contaminants for juvenile salmon and a region in which salmon were exposed to toxicants associated with urban development and industrial activity. Highest concentrations of PCBs were found in fall Chinook salmon stocks with subyearling life histories, including populations from the upper Columbia and Snake rivers, which feed and rear in the tidal freshwater and estuarine portions of the river for extended periods. Spring Chinook salmon stocks with yearling life histories that migrate more rapidly through the estuary generally had low PCB concentrations, but high concentrations of DDTs. Pesticides can be toxic to primary producers and macroinvertebrates, thereby limiting salmon population recovery through adverse, bottom-up impacts on aquatic food webs (Macneale *et al.* 2010).

Listed fish species considered in this opinion are exposed to high rates of predation during all life stages. Fish, birds, and marine mammals all prey on juvenile and adult salmon. The primary resident fish predators of salmonids in many areas of the State of Oregon inhabited by anadromous salmon are northern pikeminnow (native), smallmouth bass (introduced), and walleye (introduced). Other predatory resident fish include channel catfish (introduced), yellow perch (introduced), largemouth bass (introduced), and various rockfish (native). Increased predation by non-native predators has and continues to decrease population abundance and productivity.

In the Columbia River Basin, avian predation is another factor limiting salmonid recovery. Piscivorous birds congregate in the estuary near man-made islands and structures. Avian predation has been exacerbated by environmental changes associated with river developments. Water clarity caused by suspended sediments settling in impoundments increases the vulnerability of migrating smolts. Delay in project reservoirs, particularly immediately upstream from the dams, increases smolt exposure to avian predators, and juvenile bypass systems concentrate smolts, creating potential feeding stations for birds. Dredge spoil islands, associated with maintaining the Columbia River navigation channel, provide habitat for nesting Caspian terns and other piscivorous birds. Caspian terns, double-crested cormorants, glaucous-winged/western gull hybrids, California gulls, and ring-billed gulls are the principal avian predators in the basin. As with piscivorous predators, predation by birds has and continues to decrease population abundance and productivity.

Water quality throughout most of the program action area is degraded to various degrees because of contaminants that are harmful to species considered in this consultation. Aerial deposition, discharges of treated effluents, and stormwater runoff from residential, commercial, industrial, agricultural, recreational, and transportation land uses are all source of these contaminants. For example, 4.7 million pounds of toxic chemicals were discharged into surface waters of the Columbia River Basin and another 91.7 million pounds were discharged in the air and on land in 2011 (USEPA 2011). Though these volumes are reduced 39% from 2003, attributed, in part, to significant state, local and private efforts to modernize and strengthen tools available to treat and manage stormwater runoff (USEPA 2009; USEPA 2011).

In a typical year in the U.S., pesticides are applied at a rate of approximately five billion pounds of active ingredients per year (Kiely *et al.* 2004). Therefore, pesticide contamination in the nation's freshwater habitats is ubiquitous and pesticides usually occur in the environment as mixtures. The USGS National Water-Quality Assessment (NAWQA) Program conducted studies and monitoring to build on the baseline assessment established during the 1990s to assess trends of pesticides in basins across the Nation, including the Willamette River basin. More than 90 percent of the time, water from streams within agricultural, urban, or mixed-land-use watersheds had detections of 2 or more pesticides or degradates, and about 20 percent of the time they had detections of 10 or more. Fifty-seven percent of 83 agricultural streams had concentrations of at least one pesticide that exceeded one or more aquatic-life benchmarks at least one time during the year (68 percent of sites sampled during 1993–1994, 43 percent during 1995–1997, and 50 percent during 1998–2000) (Gilliom *et al.* 2006). In the Willamette Basin, 34 herbicides were detected. Forty-nine pesticides were detected in streams draining predominantly agricultural land (Rinella and Janet 1998). High-use herbicides such as glyphosate, triclopyr, 2,4-D, and metolachlor were frequently detected, particularly in the lower-basin tributaries (Carpenter *et al.* 2008).

The role of stormwater runoff in degrading water quality has been known for years but reducing that role has been notoriously difficult because the runoff is produced everywhere in the developed landscape, the production and delivery of runoff are episodic and difficult to attenuate, and runoff accumulates and transports much of the collective waste of the developed environment (NRC 2009). In most rivers in Oregon, the full spatial distribution and load of contaminants is not well understood. Hydrologically low-energy areas, where fine-grained sediment and associated contaminants settle, are more likely to have high water temperatures, concentrations of nitrogen and phosphorus that may promote algal blooms, and concentrations of aluminum, iron, copper, and lead that exceed ambient water quality criteria for chronic toxicity to aquatic life (Fuhrer *et al.* 1996). Even at extremely low levels, contaminants still make their way into salmon tissues at levels that are likely to have sublethal and synergistic effects on individual Pacific salmon, such as immune toxicity, reproductive toxicity, and growth inhibition (Baldwin *et al.* 2011; Carls and Meador 2009; Hicken *et al.* 2011; Johnson *et al.* 2013), that may be sufficient to reduce their survival and therefore the abundance and productivity of some populations (Baldwin *et al.* 2009; Spromberg and Meador 2006). The adverse effect of contaminants on aquatic life often increases with temperature because elevated temperatures accelerate metabolic processes and thus the penetration and harmful action of toxicants.

The full presence of contaminants throughout the program action area is poorly understood, but the concentration of many increase in downstream reaches (Fuhrer *et al.* 1996; Johnson *et al.* 2013; Johnson *et al.* 2005; Morace 2012). The fate and transport of contaminants varies by type, but are all determined by similar biogeochemical processes (Alpers *et al.* 2000b; Alpers *et al.* 2000a; Bricker 1999; Chadwick *et al.* 2004; Johnson *et al.* 2005). After deposition, each contaminant typically processes between aqueous and solid phases, sorption and deposition into active or deep sediments, diffusion through interstitial pore space, and re-suspension into the water column. Uptake by benthic organisms, plankton, fish, or other species may occur at any stage except deep sediment, although contaminants in deep sediments become available for biotic uptake when re-suspended by dredging or other disturbances.

Existing road systems contribute to the poor environmental baseline condition. Many miles of highway that parallel streams have degraded stream bank conditions by armoring the banks with rip rap, degraded floodplain connectivity by adding fill to floodplains, and discharge untreated or marginally treated highway runoff to streams. Culvert and bridge stream crossings have similar effects, and create additional problems for fish when they act as physical or hydraulic barriers that prevent fish access to spawning or rearing habitat, or contribute to adverse stream morphological changes upstream and downstream of the crossing itself.

The environmental baseline includes the anticipated impacts of all Federal actions in the program action area that have already undergone formal consultation. The Corps, Bonneville Power Administration (BPA), and Bureau of Reclamation have consulted on large water management actions, such as operation of the Federal Columbia River Power System, the Umatilla Basin Project, and the Deschutes Project. The U.S. Bureau of Indian Affairs (BIA), U.S. Bureau of Land Management (BLM), and the U.S. Forest Service (USFS) have consulted on Federal land management throughout Oregon, including restoration actions, forest management, livestock grazing, and special use permits. The Corps, BPA, NOAA Restoration Center, and U.S. Fish and Wildlife Service (FWS) have also consulted on large restoration programs that consist of actions designed to address species limiting factors or make contributions that would aid in species recovery. Restoration actions may have short-term adverse effects, but generally result in long-term improvements to habitat condition and population abundance, productivity, and spatial structure. After going through consultation, many ongoing actions, such as stormwater facilities, roads, culverts, bridges and utility lines, have less impact on listed salmon and steelhead.

As noted above, it is likely that the individual projects will take place at sites where habitat conditions have been previously disturbed. Specifically, NMFS made the following assumptions regarding the environmental baseline conditions in specific areas where projects occur:

1. Projects will occur at sites where the biological requirements of individual fish of ESA-listed species are not being fully met due, in part, to the presence of impaired fish passage, reduced water quality, streambank degradation, or degraded channel or riparian conditions.
2. Projects will occur at sites where the biological requirements of individual fish of ESA-listed species are not being met due to one or more impaired aquatic habitat functions related to any of the habitat factors limiting the recovery of the species in that area.

2.4 Effects of the Action on Species and Designated Critical Habitat

Under the ESA, “effects of the action” means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR

402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. To frame the analysis of the effects of the action, we first deconstruct the program in the following subsection to identify the individual categories of actions and examine the general environmental impacts of each of those actions. In the subsequent two sections, we analyze those effects for their combined impact on species and designated critical habitats.

For purposes of this analysis, the action agencies provided a maximum projected number of projects per year within each domain (Table 1). Although these are not targets, the projections provide a general expectation of the magnitude for us to analyze effects. The programmatic proposal provides sufficient information for us to meaningfully analyze the effects of the suite of projects that will occur under it. First, the PDCs are very specific such that they provide sideboards which can be meaningfully applied at the project scale. In addition, the proposed program includes projections about the aggregate numbers of projects, as well as, their geographic spread. Further, the proposed program has a built-in verification procedure that functions as a check on individual projects. These features function together to ensure that we are able to analyze the aggregate and synergistic effects of the numerous projects that will occur.

2.4.1 Analysis of the Environmental Effects

Programmatic consultation is a tool enabling the review of many; similar projects and works best when the outcomes of those projects can be readily anticipated and prescriptively addressed to ensure those outcomes meet the requirements of ESA section 7(a)(2). Therefore, when implementing the proposed program, the action agencies will ensure that: (a) The PDCs and the descriptions of categories of activities are applied to the projects; (b) the effects of the project are within the range considered in the opinion; and (c) the project can be carried out under the proposed program level monitoring and reporting requirements. These procedures are a central part of the programmatic opinion and function to ensure that individual projects covered by this opinion remain within the scope of effects considered here, and to ensure that the aggregate or program-level effects of those individual projects are also accounted for. Activities that fall within the proposed program, and otherwise comply with this opinion and ITS do not require further consultation. Activities that do not meet these criteria, including those that are expressly identified as exclusions, are not covered by this opinion, but can be the subject of individual consultations.

The discussion of the direct physical and chemical effects of the program on the environment will vary depending on the categories of activity being performed, but will be based on a common set of effects related to construction. The physical, chemical, and biotic effects of each individual project will vary according to the number and type of categories implemented, although each project will share a common set of effects related to pre-construction and construction (Darnell 1976; Spence *et al.* 1996), site restoration (Cramer *et al.* 2003; Cramer 2012), and operation and maintenance. We assume that every individual project will result in some of the effects described here in proportion to the project's complexity, footprint, and proximity to species and critical habitat. However, no project will have effects greater than the full range of effects described here, because every project is based on the same set of underlying construction activities or elements, and each category is limited by the same PDCs. The duration of construction required to complete most projects will normally be less than one year, although large projects may require additional in-water work or upland work to complete.

2.4.1.1. General Effects

Program Administration

The action agencies will ensure the appropriate PDCs are incorporated into all phases of design for each project, and that any unique situation or site constraint related to site suitability, right-of-way, special maintenance needs, or cost is resolved as the project is being designed. Additionally, the action agencies will obtain verification from NMFS for several activities and categories of activities. We will respond with verifications or denials within 30 days of receiving the Project Action Notification Sheet. Furthermore, the action agencies will coordinate with NMFS engineers early in the process on the most complex activity categories. Shortly (within 60 days) after all in-water work for a project is completed, the action agencies will submit the completion report portion of the implementation sheet, along with any pertinent information needed, to ensure that a completed project matches its proposed design.

As an additional check on the continuing effects of the program, the action agencies and NMFS will meet at least annually to review implementation of this opinion and opportunities to improve conservation, or make the program overall more effective or efficient. Application of consistent PDCs and engineering improvements to the maximum extent feasible in each recovery domain is likely to gradually reduce the total adverse impacts, improve ecosystem resilience, and contribute to management actions necessary for the recovery of ESA-listed species and critical habitats in Oregon and Lower Columbia River.

Pre-construction Activities

Pre-construction activities typically include work area isolation, surveying, mapping, placement of stakes and flagging guides, erosion and pollution control, creating temporary access roads, material staging areas, exploratory drilling, and boring. Project footprints that extend far into the active channel, such as the replacement of culverts and bridges, may require activities like work area isolation, fish capture, and relocation. Pre-construction activities are likely to have short-term adverse effects due to vegetation removal and the compaction of soil reducing permeability and infiltration due to site preparation for construction activities to occur in aquatic or riparian habitats. Short-term effects are minimized with the use of best management practices described within the PDCs including the use of erosion and pollution control measures.

Surveying, mapping, and the placement of stakes and flagging entail minor movements of machines and personnel over the project area with minimal direct effects but important indirect effects by establishing geographic boundaries that will limit the environmental impact of subsequent activities. The action agencies will ensure that work area limits are marked to preserve vegetation and reduce soil disturbance as a fundamental and effective management practice that will avoid and reduce the impact of all subsequent construction activities.

Erosion and pollution control measures will be applied to any project that involves soil disturbance. Those measures will constrain the use and disposal of all hazardous products, the disposal of construction debris, and secure the site against erosion and inundation during high flow events. During and after wet weather, runoff from disturbed areas is likely to suspend and transport more sediment to receiving waters. In-water work dislodges channel sediments, making them available for transporting downstream where it is eventually re-deposited.

Sediments in the water column can reduce light penetration, increase water temperature, and modify water chemistry. Because the action agencies propose to cease work when high flows may inundate the project area, except for efforts to avoid or minimize resource damage, significant erosion and contamination is unlikely.

Temporary access roads and staging areas require disturbance of vegetation and soils that support floodplain and riparian function, such as delivery of large wood and particulate organic matter, shade, development of root strength for slope and bank stability, and sediment filtering and nutrient absorption from runoff (Darnell 1976; Spence *et al.* 1996). The size of most temporary access roads and staging areas are small and their effects are likely to be short-term (weeks or months). The microclimate at each project site where vegetation is removed is likely to become drier and warmer, with a corresponding increase in wind speed, and soil and water temperature. Water tables and spring flow in the immediate area may be temporarily reduced. Loose soil will temporarily accumulate in the construction area. In dry weather, part of this soil is dispersed as dust and in wet weather; part is transported to streams by erosion and runoff, particularly in steep areas. Erosion and runoff increase the supply of sediment to lowland drainage areas and eventually to aquatic habitats, where they increase total suspended solids and sedimentation.

The effects of temporary roads and staging areas will be minimal because whenever reasonable, temporary access roads will not be built on steep slopes, where grade, soil, or other features suggest a likelihood of excessive erosion or failure; will use existing ways whenever possible; and will minimize soil disturbance and compaction within 150 feet of a stream, water body, or wetland. Furthermore, all temporary access roads will be obliterated when the project is completed, the soil will be stabilized and the site will be revegetated. Temporary roads in wet or flooded areas will be restored by the end of the applicable in-water work period.

Work area isolation, when necessary, proposed projects will use cofferdams to isolate work areas prior to construction. Dewatering of the isolated work areas will reduce the risk of exposure of streams to sediment and chemical contaminants resulting from construction. However, it requires fish capture and handling. Macro-invertebrates residing in the isolated work areas will die as the area dries out. Work isolations will also temporarily decrease available aquatic habitats.

Construction

Construction activities typically include the use of heavy equipment, pile driving and removal, water withdrawal, installation of rock and other hard structures, and non-native and invasive plant control. Each construction footprint that extends into a riparian or instream area is likely to have short-term adverse effects due to the physical and chemical consequences of altering those environments, and have potential for long-term adverse effects due to the impact of the built environment's encroachment on aquatic habitats. However, every project covered under this opinion will provide a long-term net benefit, such as improving floodplain connectivity, streambank function, water quality, and/or fish passage.

Use of heavy equipment can compact the soil, thus reducing permeability and infiltration. The action agencies will require heavy-duty equipment and vehicles for each project be selected with care and attention to features that minimize adverse environmental effects (*e.g.*, minimal size, temporary mats or plates within wet areas or sensitive soils), and use of staging areas at least 150 feet from surface waters. Also, as noted above, to reduce the likelihood that sediment or pollutants will be carried away from project construction sites, the action agencies will ensure that clearing areas are limited and that a suite of erosion and pollution control measures will be applied to any project that involves the likelihood of soil and vegetation disturbance that can increase runoff and erosion, including securing the site against erosion, inundation, or contamination by hazardous or toxic materials.

Use of heavy equipment, including stationary equipment like generators and cranes, also creates a risk that accidental spills of fuel, lubricants, hydraulic fluid, coolants, and other contaminants may occur. Petroleum-based contaminants (such as fuel, oil, and some hydraulic fluids) contain polycyclic aromatic hydrocarbons (PAHs), which are acutely toxic to listed fish species and other aquatic organisms at high levels of exposure and cause sublethal adverse effects on aquatic organisms at lower concentrations (Heintz *et al.* 2000; Heintz *et al.* 1999; Incardona *et al.* 2005; Incardona *et al.* 2004; Incardona *et al.* 2006). To minimize the risk of contamination from accidental spills that result from leaks and ruptured hydraulic hoses, equipment, vehicles, and power tools, operators will be leak free or operating with biodegradable products when working within wetlands or within 150 feet of a water body. The action agencies will require regular inspection and cleaning before operation to ensure that vehicles remain free of external oil, grease, mud, and other visible contaminants.

Work involving the presence of equipment or vehicles in the active channel has the potential to injure or kill fish and other aquatic life. The action agencies will avoid or reduce that risk by limiting the timing of in-water work to avoid the most vulnerable life stages (except for temporary safety stabilization). Further, when work in the active channel involves substantial excavation, backfilling, embankment construction, or similar work below OHW (riverine) or the HAT (estuarine) where adult or juvenile fish are reasonably certain to be present, the action agencies will require the work area be effectively isolated from the active channel. This reduces the likelihood of direct, mechanical interactions with fish.

Ground disturbance with heavy equipment will likely result in suspended sediment plumes, but they will be short-term events. Sediment is likely to be carried by surface runoff when the newly configured channel(s) are reactivated and erosion control structures are removed. Localized suspended sediment increases are likely to cause some fish to seek alternative habitat, which could contain suboptimal cover and forage and cause increases in behavioral stress (e.g., avoidance, displacement), and sub-lethal responses (e.g., increased respiration, reduced feeding success, reduced growth rates). Excessive sediment clogs the gills of fish, reduces prey availability, and reduces juvenile success in catching prey. However, implementation procedures and pollution and erosion control plans will be designed to minimize suspended sediment.

Pile driving and removal with a vibratory or impact hammer are likely to result in adverse effects to fish and aquatic life by temporarily increasing suspended sediment, and increasing underwater sound and sound pressures. Suspended sediment generated from pile driving or removal is temporary and confined to the area close to the operation. We expect that some fish may be harassed by turbidity plumes resulting from pile driving or removal. Injury or death can occur if juvenile fish are preyed on when leaving the work area to avoid temporary turbidity plumes. The proposed requirements for completing the work during the preferred in-water work window will minimize the effects of suspended sediment on listed species by scheduling the work when species presence is typically at its lowest levels of the year.

In the short-term, removal of creosote or other piles treated with oil-based preservatives can release toxic preservatives into the surrounding water, resulting in a temporary degradation of water quality (Weston Solutions 2006). In the long-term, removal of creosote piles will reduce water quality degradation.

Piles will be removed using a vibratory hammer, direct pull, clam shall grab, or cutting/breaking the pile below the mudline. Vibratory pile removal causes sediments to slough off at the mudline, resulting in some suspension of sediments and, possibly, contaminants. Old and brittle piles may break under the vibrations and require use of another method. The direct pull method involves placing a choker around the pile and pulling upward with a crane or other equipment. When the piling is pulled from the substrate, sediments clinging to the piling slough off as it is raised through the water column, producing a plume of turbidity, contaminants, or both. The use of a clamshell may suspend additional sediment if it penetrates the substrate while grabbing the pile. If a piling breaks the stub is often removed with a clam shell and crane. Sometimes pilings are cut, broken, or driven below the mudline, and the buried section left in place. This may suspend small amounts of sediment, providing the stub is left in place and little digging is required to reach the pile. Direct pull or use of a clamshell to remove broken piles is likely to suspend more sediment and contaminants.

Most often pile driving will occur in the dry above the ordinary high water line or in a dewatered isolation area primarily for use of construction of abutments for bridges. If an impact hammer is required for in-water work, the action agencies will require sound attenuation.

Pile driving often generates intense sound pressure waves that can injure or kill fish (Reyff 2003; Abbott and Bing-Sawyer 2002; Caltrans 2001; Longmuir and Lively 2001; Stotz and Colby 2001). The type and size of the pile, the firmness of the substrate into which the pile is being driven, the depth of water, and the type and size of the pile-driving hammer all influence the sounds produced during pile driving. Fishes with swim bladders (including salmon and steelhead) are sensitive to underwater impulsive sounds, *i.e.*, sounds with a sharp sound pressure peak occurring in a short interval of time, (Caltrans 2001). As the pressure wave passes through a fish, the swim bladder is rapidly squeezed due to the high pressure, and then rapidly expanded as the under pressure component of the wave passes through the fish. The pneumatic pounding may rupture capillaries in the internal organs as indicated by observed blood in the abdominal cavity, and maceration of the kidney tissues (Caltrans 2001). The injuries caused by such pressure waves are known as barotraumas, and include hemorrhage and rupture of internal organs, as described above, and damage to the auditory system. Death can be instantaneous, can occur within minutes after exposure, or can occur several days later.

Fish respond differently to sounds produced by impact hammers than to sounds produced by vibratory hammers. Fish consistently avoid sounds like those of a vibratory hammer (Enger *et al.* 1993; Dolat 1997; Knudsen *et al.* 1997; Sand *et al.* 2000) and appear not to habituate to these sounds, even after repeated exposure (Dolat, 1997; Knudsen *et al.* 1997). On the other hand, fish may respond to the first few strikes of an impact hammer with a startle response, but then the startle response wanes and some fish remain within the potentially harmful area (Dolat 1997). Compared to impact hammers, vibratory hammers make sounds that have a longer duration (minutes vs. milliseconds) and have more energy in the lower frequencies (15-26 Hertz vs. 100-800 Hertz) (Würsig, *et al.* 2000).

A multi-agency work group identified criteria to define sound pressure levels where 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 decibel $(dB)_{peak}$[18] 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}[19] 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}[20]) 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.

In water, vibratory hammers are known to produce lower sound levels than impact hammers; generally 10 to 20 dB lower. The general assumption here is that pile driving in the dry or in a dewatered isolation area would result in even lower sound levels than in the water. RMS sound levels below 150 dB could cause fish to avoid the area, thus hindering their free passage, but unlikely to injure the fish. Caltrans (2015) suggested that vibratory hammer use on a 12-inch steel pile produced sound values of 171 dB (peak) and 155 for both RMS and SEL. Using the practical spreading model for transmission loss and sound attenuation, we determined that during in-water vibratory pile driving RMS sound levels greater than 150 dB would extend to a distance of 72 feet laterally in all directions from the pile. However, this distance is likely less because transmission loss through soil or sediment is likely greater than through water resulting in higher

[18] 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).
[19] dB_{SEL} is referenced to 1 micropascal-squared·seconds (re: $1\mu Pa^2 \cdot sec$) throughout the rest of this document.
[20] dB_{RMS} is referenced to 1 micropascal (re: 1µPa) throughout the rest of this document.

level of sound attenuation. Impacts during vibratory driving will be short-term (up to 2.5 hours per day) and localized within the 200 feet of a bridge.

During in-water impact driving, the action agencies will require sound attenuation, most often a bubble curtain is used. The level of attenuation provided by a bubble curtain varies from project to project. Surrounding the pile with a bubble curtain can attenuate the peak SELs by approximately 28 dB and is equivalent to a 97% reduction in sound energy. Whether confined inside a sleeve made of metal or fabric or unconfined, these systems have been shown to reduce underwater sound pressure (Würsig *et al.* 2000; Longmuir and Lively 2001; Christopherson and Wilson 2002; Reyff and Donovan 2003). However, the sound attenuation achieved by bubble curtains varies greatly depending on design and location. Observed ranges have been between 0 and 30 dB (Caltrans 2015). Thus, a bubble curtain may not bring the peak and RMS SELs below the established thresholds, and take may still occur. Studies on pile driving and underwater explosions suggest that, besides attenuating peak pressure, bubble curtains also reduce the impulse energy and, therefore, the likelihood of injury (Keevin 1998). Because sound pressure attenuates more rapidly in shallow water (Rogers and Cox 1988), it may have fewer deleterious effects there.

Unconfined bubble curtains lower sound pressure by as much as 17 dB (85%) (Würsig *et al.* 2000; Longmuir and Lively 2001), while bubble curtains contained between two layers of fabric reduce sound pressure up to 22 dB (93%) (Christopherson and Wilson 2002). However, an unconfined bubble curtain can be disrupted and rendered ineffective by currents greater than 1.15 miles per hour (Christopherson and Wilson 2002). When using an unconfined air bubble system in areas of strong currents, it is essential that the pile be fully contained within the bubble curtain, and that the curtain have adequate air flow, and horizontal and vertical ring spacing around the pile. When currents are greater than 1.6 feet per second, the pile being driven will be surrounded with a confined bubble curtain.

The likelihood of effects from pile driving and removal will be minimized by completing the work during preferred in-water work windows, using a vibratory hammer where practical, and using sound attenuators when an impact hammer is necessary. Impact pile driving will result in sound increases greater than 150 dB that may alter fish behavior. Sound pressure levels generated from impact driving with a bubble curtain are expected to be below the instantaneous injury threshold of 206 dB_{peak}, thus there is little potential for an instantaneous injury from single strike peak pressure to nearby fish. Cumulative injury is possible above 187 dB_{SEL} for fish weighing greater than 2 grams, and above 183 dB_{SEL} for those weighing 2 grams or less. Thus a small number of fish may exhibit a behavioral response from pile driving that can lead to changes in feeding behavior or movement to a location where competition or predation levels are higher. For adult fishes, we expect varying levels of behavioral responses from no change, to mild awareness, or a startle response (Hastings and Popper 2005), but we do not believe this response will alter their fitness.

<u>Water withdrawal</u> is limited to minor amounts used in construction activities or off-channel livestock watering facilities. All water withdrawal will have a fish screen installed, operated, and maintained as described in NMFS (2011a). Diversions may not exceed 10 percent of the

available flow, and are short in duration as they are expected to last for only as long as it takes to fill a desired tank. Therefore, effects from water withdrawal will be very small.

Discharge water from construction activities, such as concrete washout, pumping for work area isolation, vehicle wash water, drilling fluids, or other construction work will be treated to remove debris, heat, nutrients, sediment, petroleum products, metals and any other pollutants likely to be present (*e.g.*, green concrete, contaminated water, silt, welding slag, sandblasting abrasive, grout cured less than 24 hours) to ensure that no pollutants are discharged from the construction site. Therefore, effects from discharge water will be negligible.

Treated wood piles may be used in or near water if they are wrapped or polyuria coated. Pile wraps and polyurea coating are described as barrier protection systems adhered or otherwise permanently affixed to the treated wood that includes boots, sleeves, wraps, and spray on coatings that meet minimum thickness standards (AWPA 2016). Pile wraps and polyurea coatings are effective at minimizing the rate of leaching from pressure-treated wood piles and are widely used (Brown 2011a; CCC 2012; Husain *et al.* 2004; Konkler and Morrell 2017; NMFS 2009a; Pendleton 1990; Poston 2001; Schottle and Prickett 2010; Stratus Consulting 2006a). A 2010 study concluded that the use of four different pile wraps were effective in minimizing short-term (≤ 1 month) metal leaching rates from ACZA pressure-treated pilings (ranging from 0.12±.02 to 61.1±9.4 mg/cm²/day) compared to unwrapped treated piles that did not exceed .01µg/cm²/day (Schottle and Prickett 2010). The Naval Civil Engineering Laboratory participated in two long-term studies determining the effectiveness of plastic barrier systems for treated wood piles (Pendleton 1990). They concluded that there was no visible marine borer damage, no polyurethane adhesion loss, and the wraps remained intact after five years of marine aquatic exposure (Pendleton 1990). Wraps can be prefabricated using outer plastic wraps such as PVC, HDPE, or fiber-glass reinforced plastic products with an epoxy fill, PST or an inner wrap of polyethylene in the void between the wrapping and pile to seal the preservative treated wood pile.

If the pile wrap becomes damaged, there is potential for a breach to occur, however unlikely, in-between the pile and the wrapping which would result in a sudden release of contaminants into the immediate environment (Schottle and Prickett 2010; Stratus Consulting 2006a, b). If a breach occurs, metals will leach at a higher rate than an unwrapped treated pile. However, the contaminants are expected to be localized and proportional to the area of the exposed wood, and anticipated to reduce to “minute levels” within a short time period (days to weeks) (Poston 2001). Pile wraps can also result in a sudden release of contaminants due to failed points along seams and fasteners from wood expansion and contraction over time (Brown 2011a). After being in-water for one month, Schottle and Prickett (2010) intentionally cut a small square from both the inner and outer wraps to determine the rate of leaching from ACZA-treated wood. Significant leaching occurred from the breach, especially a high short-increase in copper. Any failure points that are likely to occur is likely to be small and proximal to the area and will likely decrease over time. By installing wraps prior to installation and following an inspection and maintenance program, the likelihood of a breach occurring is minimal and we do not expect adverse effects to occur. Inspections will occur every 1-2 years beginning 3-5 years after installation and repairs will be made if damage has occurred to 25% or more to the barrier surface on an individual pile.

Repairs consist of adding additional coating or barrier material to mitigate for any future preservative loss.

Polyurea coatings have been used in numerous projects and are currently required in some California ports (Konkler and Morrell 2017). Seamed and sealed coatings are effective as long as they are "an impact-resistant, biologically inert coating that lasts or is maintained" (NMFS 2009a). Konkler and Morrell (2017) found metal levels within the water column, containing coated ACZA-treated wood, were below detection limits (0.05 milligram/kilogram (mg/kg) for each element) and remained low (<4 mg/kg of metal concentration) within the sediment in a synthetic salt water, non-circulating environment.

The NMFS expects the use of pile wraps and polyurea coating to minimize the rate of leaching from pressure-treated wood piles and an inspection and maintenance program will reduce the likelihood of a breach occurring and no more than minimal leaching of preservatives occur from the use of treated wood piles.

Non-native and Invasive Plant Control. Manual, mechanical, biological, and herbicidal treatments of invasive and non-native plants are often conducted as part of a project to restore native riparian vegetation. We have recently analyzed the effects of these activities using similar active ingredients and PDCs for proposed USDA Forest Service and USDI Bureau of Land Management invasive plant control programs (NMFS 2010; NMFS 2012). The types of plant control activities analyzed here are a conservative (*i.e.*, less aggressive) subset of the types of activities considered in those analyses, and the effects presented here are summarized from those analyses. Each type of treatment is likely to affect fish and aquatic macrophytes through a combination of pathways, including disturbance, chemical toxicity, dissolve oxygen and nutrients, water temperature, sediment, instream habitat structure, forage, and riparian and emergent vegetation (Table 5).

Table 5. Potential pathways of effects of invasive and non-native plan control.

	Pathways of Effects							
Treatment Methods	**Disturbance***	**Chemical toxicity**	**Dissolved oxygen and nutrients**	**Water temperature**	**Fine sediment and turbidity**	**Instream habitat structure**	**Forage**	**Riparian and emergent vegetation**
Manual	X					X	X	X
Mechanical	X			X	X		X	X
Biological				X	X			
Herbicides		X	X	X	X	X	X	X

*****Disturbing fish, interrupting fish feeding, or disturbing banks.

Short-term displacement or disturbance of threatened and endangered fish are likely to occur from activities in the area that disturb or displace fish that are feeding, resting or moving through the area. Due to proposed PDCs, mechanical and herbicidal treatments of invasive plant species in riparian areas are not likely to substantially decrease shading of streams in most cases. Significant shade loss is likely to be rare, occurring primarily from treating streamside knotweed, canarygrass, and blackberry monocultures. The loss of shade would persist until native vegetation reaches and surpasses the height of the invasive plants that were removed. Shade recovery may take one to several years, depending on the success of invasive plant treatment, stream size and location, topography, growing conditions for the replacement plants, and the density and height of the invasive plants when treated. The short-term shade reduction could slightly affect stream temperatures or dissolved oxygen levels, which could cause stress to rearing juveniles but other life stages will not be present or will not reside in the area for a duration adequate to cause a response. Effects pathways are described in detail below.

Manual and mechanical treatments are likely to result in mild ground disturbance. Hand pulling of emergent vegetation is likely to result in a localized mobilization of suspended sediments. Treatment of streamside invasive species with heavy machinery is likely to result in short-term releases of suspended sediment when treatment of locally extensive streamside monocultures occurs. Thus, these treatments are likely to affect a broad area and produce at least minor damage to riparian soil and vegetation. In some cases, this will decrease stream shade, increase suspended sediment and temperature in the water column, reduce organic inputs (*e.g*., insects, leaves, woody material), and alter streambanks and the composition of stream substrates. However, these circumstances are likely to occur only in rare cases, such as treatment of an expansive invasive plant monoculture that encompasses a small stream channel. Effects will vary depending on site aspect, elevation, and amount of topographic shading, but are likely to decrease over time as native vegetation is reestablished.

Biological controls work slowly, typically over several years, and are designed to work only on the target species. Thus, biological controls produce a smaller reduction of riparian and instream vegetation over a smaller area than manual and mechanical treatments and are unlikely to lead to bare ground and surface erosion that would release suspended sediment to streams. As treated invasive plants die, native plants are likely to become reestablished at each site; root systems will restore soil and streambank stability and vegetation will provide shade. Therefore, any adverse effects due to biological treatments, by themselves, are likely to be very mild. Over time, successful biological control agents will reduce the size and vigor of host noxious weeds with minimal or no impact to other plant species.

We identified three scenarios for delivery of herbicide to the aquatic environment: (1) Spray and vapor drift; (2) direct application to water bodies; and (3) groundwater contamination.

Spray and vapor drift are important pathways for herbicide entry into aquatic habitats. Several factors influence herbicide drift, including spray droplet size, wind and air stability, humidity and temperature, physical properties of herbicides and their formulations, and method of application. For example, the amount of herbicide lost from the target area and the distance the herbicide moves both increase as wind velocity increases. Under inversion conditions, when cool air is near the surface under a layer of warm air, little vertical mixing of air occurs. Spray drift is most severe under these conditions, since small spray droplets will fall slowly and move to adjoining areas even with very little wind. Low relative humidity and high temperature cause more rapid evaporation of spray droplets between sprayer and target. This reduces droplet size, resulting in increased potential for spray drift. Vapor drift can occur when herbicide volatilizes. The formulation and volatility of the compound will determine its vapor drift potential. The potential for vapor drift is greatest under high air temperatures and low humidity and with ester formulations. For example, ester formulations of triclopyr are very susceptible to vapor drift, particularly at temperatures above 80°F (DiTomaso *et al.* 2006). Triclopyr, is detected frequently in freshwater habitats within the four western states where listed Pacific salmonids are distributed (NMFS 2011c).

Several proposed PDCs reduce the risk of herbicide drift. Ground equipment reduces the risk of drift, and hand equipment nearly eliminates it. Relatively calm conditions, preferably when humidity is high and temperatures are relatively low, and low sprayer nozzle height will reduce the distance that herbicide droplets will fall before reaching weeds or soil. Less distance means less travel time and less drift. Wind velocity is often greater as height above ground increases, so droplets from nozzles close to the ground would be exposed to lower wind speeds. The higher that an application is made above the ground, the more likely it is to be carried by faster wind speeds, result in long distance drift.

Direct application to water bodies can occur when herbicides are applied intentionally or accidentally into ditches, irrigation channels or other bodies of water, or when soil-applied herbicides are carried away in runoff to surface waters. Direct application into water sources is generally used for control of aquatic species. Accidental contamination of surface waters can occur when irrigation ditches are sprayed with herbicides or when buffer zones around water sources are not wide enough. In these situations, use of hand application methods will greatly reduce the risk of surface water contamination.

The contribution from runoff will vary depending on site and application variables, although the highest pollutant concentrations generally occur early in the storm runoff period when the greatest amount of herbicide is available for dissolution (Stenstrom and Kayhanian 2005; Wood 2001). Lower exposures are likely when herbicide is applied to smaller areas, when intermittent stream channel or ditches are not completely treated, or when rainfall occurs more than 24 hours after application. Under the proposed program, some formulas of herbicide can be applied within the bankfull elevation of streams, in some cases up to the water's edge. Any juvenile fish in the margins of those streams are more likely to be exposed to herbicides as a result of overspray, inundation of treatment sites, percolation, surface runoff, or a combination of these factors. Overspray and inundation will be minimized through the use of dyes or colorants.

Groundwater contamination typically occurs by "point sources," such as spills or leaks at storage and handling facilities, improperly discarded containers, and rinses of equipment in loading and handling areas, often into adjacent drainage ditches (DiTomaso 1997). Point sources are discrete, identifiable locations that discharge relatively high local concentrations. In soil and water, herbicides persist or are decomposed by sunlight, microorganisms, hydrolysis, and other factors. 2,4-D and triclopyr are detected frequently in freshwater habitats within the four western states where listed Pacific salmonids are distributed (NMFS 2011c). Proposed PDCs minimize these concerns by ensuing proper calibration, mixing, and cleaning of equipment. Groundwater contamination can also occur from non-point source use of herbicides, usually when a mobile herbicide is applied in areas with a shallow water table. Proposed PDCs minimize this danger by restricting the formulas used, and the time, place and manner of their application to minimize offsite movement.

Herbicides included in the proposed program were selected due to their low to moderate aquatic toxicity to listed salmonids. The risk of adverse effects from the toxicity of herbicides and other compounds present in formulations to listed aquatic species is mitigated by reducing stream delivery potential by restricting application methods. Near wet stream channels, only aquatic labeled herbicides are to be applied. Aquatic glyphosate, aquatic imazapyr, and aquatic triclopyr-TEA can be applied up to the waterline, but only using hand selective techniques. A 15-foot buffer is required to use aquatic imazapyr and aquatic triclopyr-TEA by spot spraying. On dry streams, ditches, and wetlands, no buffers are required when using the aquatic herbicides for spot spraying or hand selective application. The associated application methods were selected for their low risk of contaminating soils and subsequently introducing herbicides to streams. However, some unintended exposure and toxicity risks are inherent when applying herbicides.

Generally, herbicide active ingredients have been tested on only a limited number of species and mostly under laboratory conditions. While laboratory experiments can be used to determine acute toxicity and effects to reproduction, cancer rates, birth defect rates, and other effects to fish and wildlife, laboratory experiments do not typically account for species in their natural environments and little data is available from studies focused specifically on the listed species in this opinion. Environmental stressors increase the adverse effects of contaminants, but the degree to which these effects are likely to occur for various herbicides is largely unknown. This leads to uncertainty in risk assessment analyses.

Data on toxicity to wild fish under natural conditions are limited and most studies are conducted on lab specimens. Adverse effects could be observed in stressed populations of fish, and it is less likely that effects will be noted in otherwise healthy populations of fish. Chronic studies or even long-term studies on fish egg-and-fry are seldom conducted. Risk characterizations for both terrestrial and aquatic species are limited by the relatively few animal and plant species on which data are available, compared to the large number of species that could potentially be exposed. This limitation and consequent uncertainty is common to most if not all ecological risk assessments. Additionally, in laboratory studies, test animals are exposed to only a single chemical. In the environment, humans and wildlife may be exposed to multiple toxicants simultaneously, which can lead to additive or synergistic effects.

The effects of herbicide application to various representative groups of species have been evaluated for each proposed herbicide. The effects of herbicide applications using spot spray, hand/select, and broadcast spray methods were evaluated under several exposure scenarios: (1) runoff from riparian application along streams and wetlands, (2) runoff from treated ditches and dry intermittent streams, and (3) application within perennial streams (dry areas within channel and emergent plants). The potential for herbicide movement from broadcast drift was also evaluated.

Adverse effect threshold values for each species group were defined as either 1/20th of the LC50[21] value for listed salmonids, 1/10th of the LC50 value for non-listed aquatic species, or the lowest acute or chronic "no observable effect concentration," whichever was lower, found in Syracuse Environmental Research Associates, Inc. (SERA) risk assessments that were completed for the USFS; *i.e.*, sethoxydim (SERA 2001), sulfometuron-methyl (SERA 2004a), imazapic (SERA 2004b), chlorsulfuron (SERA 2004c), imazapyr (SERA 2011a), glyphosate (SERA 2011b), triclopyr (SERA 2011c), and picloram (SERA 2011d). These assessments form the basis of the analysis in this opinion. Generally, effect threshold values for listed salmonids were lower than values for other fish species groups, so values for salmonids were also used to evaluate potential effects to other listed fish. In the case of sulfometuron-methyl, threshold values for fathead minnow were lower than salmonid values, so threshold values for minnow were used to evaluate effects to listed fish.

The effects of herbicides on salmonids are fully described by NMFS in other recent opinions with FEMA, EPA, USFS, BPA, and Corps (NMFS 2018b; NMFS 2010; NMFS 2011d; NMFS 2012; NMFS 2013b; NMFS 2013c; NMFS 2013d) and in SERA reports. For the 2008 Aquatic Restoration Biological Opinion (ARBO), the USFS, BLM, and BIA evaluated the risk of adverse effects to listed salmonids and their habitat in terms of hazard quotient (HQ) values (NMFS 2008).

HQ evaluations form the 2008 ARBO (NMFS 2008) are summarized below for the herbicides (chlorsulfuron, clopyralid, glyphosate, imazapyr, metsulfuron methyl, sethoxydim, and sulfometuron methyl). HQs were calculated by dividing the expected environmental concentration by the effects threshold concentration. Adverse effect threshold concentrations are 1/20th (for ESA listed aquatic species) or 1/10th (all other species) of LC50 values, or "no observable adverse effect" concentrations, whichever concentration was lower. The water contamination rate (WCR) values are categorized by herbicide, annual rainfall level, and soil type. Variation of herbicide delivery to streams among soil types (clay, loam, and sand) is displayed as low and high WCR values. All WCR values are from risk assessments conducted by SERA. When there are HQ values greater than 1, adverse effects are likely to occur. Hazard quotient values were calculated for fish, aquatic invertebrates, algae, and aquatic macrophytes.

Chlorsulfuron. No chlorsulfuron HQ exceedences occur for fish or aquatic invertebrates. HQ exceedences occur for algae at rainfall rates of 50 and 150 inches per year, and for aquatic macrophytes at rainfall rates of 15, 50, and 150 inches per year.

The HQ values predicted for algae at 50 inches per year ranged from 0.002 to 2.8, and the HQ exceedence occurred at the maximum application rate on clay soils. The HQ values predicted for algae at 150 inches per year ranged from 0.02 to 5.0, and HQ exceedences occurred at both the typical (HQ of 1.1) and maximum (HQ of 5.0) application rates on clay soils. Application of chlorsulfuron adjacent to stream channels at the typical and maximum application rates, in rainfall regimes of 50 to 150 inches per year, is likely to adversely affect algal production when occurring on soils with poor infiltration.

[21] LC50 is the lethal concentration required to kill 50% of exposed animals.

The HQ values predicted for aquatic macrophytes at 15 inches per year ranged from 0 to 64, and HQ exceedences occurred at both the typical and maximum application rates on clay soils. The HQ values for aquatic macrophytes at 50 inches per year ranged from 0.5 to 585, and ranged from 4.8 to 1,064 at 150 inches per year. The HQ exceedences at 50 and 150 inches per year occurred at both typical and maximum application rates, with lower HQ values occurring on loam soils, and the highest values on clay soils. Given the wide range of HQ values observed among soil types at a given rainfall rate, soil type is clearly a major driver of exposure risk for chlorsulfuron, with low permeability soils markedly increasing exposure levels. Application of chlorsulfuron adjacent to stream channels at the typical and maximum application rates, in rainfall regimes of 15 to 150 inches per year, is likely to adversely affect aquatic macrophytes. Application on soils with low infiltration rates will have a substantially higher risk of resulting in adverse effects.

Clopyralid. Application of clopyralid under the modeled scenario did not result in any HQ exceedences for any of the species groups. Clopyralid applications are unlikely to result in adverse effects to the aquatic environment because HQ values are less than 1.

Glyphosate. Glyphosate HQ exceedences occurred for fish and algae at a rainfall rate of 150 inches per year, and no HQ exceedences occurred for aquatic invertebrates or aquatic macrophytes. The HQ exceedences occurred at the maximum application rates only. The HQ values for fish at 150 inches per year ranged from 1.5 to 3.6, and occurred within a narrow range on all soil types. The HQ values for algae at 150 inches per year ranged from 0.8 to 2.0 in sand. Application of glyphosate adjacent to stream channels at application rates approaching the maximum, in rainfall regimes approaching 150 inches per year, on all soil types is likely to result in adverse effects to fish. When glyphosate is applied adjacent to stream channels at rates approaching the maximum on sandy soils, in rainfall regimes approaching 150 inches per year, adverse effects to algal production will occur.

Imazapic. Aquatic animals appear to be relatively insensitive to imazapic exposures, with LC50 values of greater than 100 milligrams per liter for both acute toxicity and reproductive effects. Aquatic macrophytes may be much more sensitive, with an acute EC50 of 6.1 micrograms per liter in duck weed (*Lemna gibba*). Aquatic algae appear to be much less sensitive, with EC50 values of greater than 45 micrograms per liter. No toxicity studies have been located on the effects of imazapic on amphibians or microorganisms (SERA 2004a).

Imazapyr. No HQ exceedences occurred for imazapyr for fish or aquatic invertebrates. HQ exceedences occurred for algae and aquatic macrophytes at a rainfall rate of 150 inches per year.

The HQ values for algae at 150 inches per year ranged from 0 to 1.3. The HQ exceedence at 150 inches per year occurred only at the maximum application rate on clay soils. The HQ values for aquatic macrophytes at 150 inches per year ranged from 0 to 2.0. The HQ exceedence at 150 inches per year occurred only at the maximum application rate on clay soils. Given the range of HQ values observed for imazapyr at a rainfall rate of 150 inches per year, soil type is an important factor in determining exposure risk, with low permeability soils markedly increasing exposure levels. Application of imazapyr adjacent to stream channels at application rates approaching the maximum on soils with low permeability, in rainfall regimes approaching 150 inches per year, is likely to adversely affect algal production and aquatic macrophytes.

Metsulfuron methyl. No HQ exceedences occurred for metsulfuron for fish, aquatic invertebrates, or algae. The HQ exceedences for aquatic macrophytes occurred at the maximum application rate on clay soils at rainfall rates of 50 and 150 inches per year. The HQ values ranged from 0.009 to 1.0 at 50 inches, and from 0.02 to 1.9 at 150 inches per year.

Given the range of HQ values observed for metsulfuron at each rainfall level, soil type is an important factor in determining exposure risk, with low permeability soils markedly increasing exposure levels. In areas with rainfall rates between 50 and 150 inches per year, application of metsulfuron adjacent to stream channels on soils with low permeability at application rates approaching the maximum is likely to adversely affect aquatic macrophytes. A slight decrease in invertebrate availability as food will result from adverse effects to aquatic macrophytes.

Picloram. Based on expected concentrations of picloram in surface water, all central estimates of the HQs are below the level of concern for fish, aquatic invertebrates, and aquatic plants. No risk characterization for aquatic-phase amphibians can be developed because no directly useful data are available. Upper bound HQs exceed the level of concern for longer-term exposures in sensitive species of fish (HQ=3) and peak exposures in sensitive species of algae (HQ=8). It does not seem likely that either of these HQs would be associated with overt or readily observable effects in either fish or algal populations for typical applications. In the event of an accidental spill, substantial mortality of fish and algae will be likely (SERA 2011b).

Sethoxydim. No HQ exceedences occurred for sethoxydim for aquatic invertebrates, algae, or aquatic macrophytes. The HQ exceedences for fish occurred at rainfall rates of 50 and 150 inches per year, and ranged from 0.3 to 1.0, and from 1.1 to 3.0, respectively. The HQ exceedence at 50 inches per year occurred only at the maximum application rate on loam soils. The HQ exceedences at 150 inches per year occurred at the typical application rate on sand, and at the maximum application rate on loam soil.

The HQ values for sethoxydim were calculated using the toxicity data for the Poast formulation, and incorporates the toxicity of naphtha solvent. The toxicity of sethoxydim alone for fish and aquatic invertebrates is much less than that of the formulated product (about 30 times less toxic for invertebrates, and about 100 times less toxic for fish). Since the naphtha solvent tends to volatilize or adsorb to sediments, using Poast formulation data to predict indirect aquatic effects from runoff leaching is likely to overestimate adverse effects (SERA 2001). The PDCs sharply reduce the risk of naptha solvent presence in percolation runoff reaching streams. When PDC to reduce naptha solvent exposure are employed, application of sethoxydim adjacent to stream channels will not result in adverse effects to fish or their habitats.

Sulfometuron-methyl. No HQ exceedences occurred for sulfometuron-methyl for fish, aquatic invertebrates, or algae. The HQ exceedence for aquatic macrophytes occurred at a rainfall rate of 150 inches per year on clay soils, and HQ values ranged from 0.007 to 3.8. Considering the range of HQ values observed for sulfometuron at each rainfall level, soil type is an important factor in determining exposure risk, with low permeability soils markedly increasing exposure levels. In areas with a rainfall rate approaching 150 inches per year, application of metsulfuron adjacent to stream channels on soils with low permeability at application rates approaching the maximum is likely to inhibit aquatic macrophytes. A slight decrease in forage availability for juvenile salmonids will result from adverse effects to aquatic macrophytes.

Triclopyr. With the exception of aquatic plants, substantial risks to non-target species (including humans) associated with the contamination of surface water are low, relative to risks associated with contaminated vegetation. Stehr *et al.*(2009) observed no developmental effects at nominal concentrations of 10 milligrams per liter or less for purified triclopyr alone or for the TEA formulations Garlon 3A and Renovate.

Herbicides are likely to reduce the food base of fish. Algae and macrophytes provide food for aquatic macroinvertebrates, particularly those in the scraper feeding guild (Williams and Feltmate 1992). These macroinvertebrates in turn provide food for rearing juveniles. Consequently, adverse effects on algae and aquatic macrophyte production may cause a reduction in availability of forage for fish. Over time, juveniles that receive less food have lower body condition and smaller size. However, the small amounts and extents of herbicides expected to reach the water are unlikely to result in effects this severe.

The proposed PDCs include limitations on the herbicides, adjuvants, carriers, handling procedures, application methods, drift minimization measures, and riparian buffers. The PDCs also specify a maximum herbicide treatment area, specifically, limiting treatment to a maximum of 1.0% of the acres of riparian habitat within a 6^{th-}field HUC with herbicides per year. This is a limiting threshold that, together with the other limitations, will greatly reduce the likelihood that significant amounts of herbicide will be transported to aquatic habitats. Some herbicides are still likely to enter streams through aerial drift, in association with eroded sediment in runoff, and dissolved in runoff. The indirect effects or long-term consequences of invasive, non-native plant control on riparian condition will depend on the long-term progression of climatic factors and the success of follow-up management actions to exclude undesirable species from the project area.

In summary, the application of manual, mechanical, biological, or chemical plant controls will reduce vegetative cover, disturb soil, and degrade water quality, which will cause adverse effects to fish in the form of sublethal adverse physiological effects. These include increased respiration, reduced feeding success, and subtle behavioral changes that can result in increased predation and adverse impacts on aquatic macrophytes and aquatic invertebrates. However, the PDCs limiting these activities will minimize the occurrence of negative effects and restrict affected area to be very small and localized.

Post-Construction

Post-construction activities typically include stormwater management, site restoration and revegetation, and flexible uplift implementation. Post-construction activities are likely to have short-term adverse effects by altering the physical characteristics of the aquatic environment and are also likely to have long-term positive effects by restoring and revegetating project sites after the work has been completed.

Stormwater Management. During precipitation events, runoff picks up and carries natural and anthropogenic pollutants, depositing them into lakes, rivers, wetlands, coastal waters and ground waters (USEPA 2016). Pollutants in post-construction stormwater runoff typically include (Buckler and Granato 1999; Colman *et al.* 2001; Driscoll *et al.* 1990; Kayhanian *et al.* 2003; Van Metre *et al.* 2006):

- Excess fertilizers, herbicides, insecticides and sediment from landscaping areas
- Oil, grease, PAHs and other toxic chemicals from roads and parking areas used by motor vehicles
- Bacteria and nutrients from pet wastes and faulty septic systems
- Metals (arsenic, copper, chromium, lead, mercury, and nickel) and other pollutants from the decay of building and other infrastructure
- Atmospheric deposition from surrounding land uses
- Erosion of sediment and attached pollutant due to hydromodification

These ubiquitous pollutants are a source of potent adverse effects to aquatic life, even at ambient levels (Hecht *et al.* 2007; Johnson *et al*. 2007; Loge *et al*. 2006; Sandahl *et al.* 2007; Spromberg and Meador 2006). Although stormwater discharge from most proposed projects will be small in comparison to the flow of the nearby waterways, it will have an incremental impact on pollutant levels. Stormwater runoff from the proposed projects will contribute to the total incremental effect on the environment caused by all development activities within the watersheds and basins each project occurs. At this scale, the additive effect of persistent pollutants contributed by many small, unrelated land developments has a greater impact on natural processes than the input from larger, individual projects, and the impacts of many small and large projects are all compounded together (NRC 2009; Vestal and Rieser 1995).

The following brief summaries from toxicological profiles (ATSDR 1995; ATSDR 2004a; ATSDR 2004b; ATSDR 2005; ATSDR 2007) show how the environmental fate of each contaminant and the subsequent exposure of listed species and critical habitats varies widely, depending on the transport and partitioning mechanisms affecting that contaminant, and the impossibility of linking a particular discharge to specific water body impairment (NRC 2009):

- DDT and its metabolites, dichlorodiphenyldichloroethylene and dichlorodiphenyltrichloroethane (all collectively referred to as DDx) may be transported from one medium to another by the processes of solubilization, adsorption, remobilization, bioaccumulation, and volatilization. In addition, DDx can be transported within a medium by currents, wind, and diffusion. These chemicals are only slightly soluble in water, therefore loss of these compounds in runoff is primarily due to transport of particulate matter to which these compounds are bound. For example, DDx have been found to fractionate and concentrate on the organic material that is transported with the clay fraction of the wash load in runoff. Sediment is the sink for DDx released into water where it is can remain available for ingestion by organisms, such as bottom feeders, for many years.
- The environmental fate of each type of PAH depends on its molecular weight. In surface water, PAHs can volatilize, photolyze, oxidize, biodegrade, bind to suspended particles or sediments, or accumulate in aquatic organisms, with bioconcentration factors often in the

10-10,000 range. In sediments, PAHs can biodegrade or accumulate in aquatic organisms or non-living organic matter. Some evaporate into the air from the surface but most do not easily dissolve in water, some evaporate into the air from surface waters, but most stick to solid particles and settle into sediments. Changes in pH and hardness may increase or decrease the toxicity of PAHs, and the variables of organic decay further complicate their environmental pathway (Santore *et al.* 2001).

- PCBs are globally transported and present in all media. Atmospheric transport is the most important mechanism for global dispersion of PCBs. PCBs are physically removed from the atmosphere by wet deposition (*i.e.*, rain and snow scavenging of vapors and aerosols); by dry deposition of aerosols; and by vapor adsorption at the air-water, air-soil, and air-plant interfaces. The dominant source of PCBs to surface waters is atmospheric deposition; however, redissolution of sediment-bound PCBs also accounts for water concentrations. PCBs in water are transported by diffusion and currents. PCBs are removed from the water column by sorption to suspended solids and sediments as well as from volatilization from water surfaces. Higher chlorinated congeners are more likely to sorb, while lower chlorinated congeners are more likely to volatilize. PCBs also leave the water column by concentrating in biota. PCBs accumulate more in higher trophic levels through the consumption of contaminated food.
- Due to analytical limitations, investigators rarely identify the form of a metal present in the environment. Nonetheless, much of the copper discharged into waterways is in particulate matter that settles out. In the water column and in sediments, copper adsorbs to organic matter, hydrous iron and manganese oxides, and clay. In the water column, a significant fraction of the copper is adsorbed within the first hour of introduction, and in most cases, equilibrium is obtained within 24 hours.
- For zinc, sorption onto hydrous iron and manganese oxides, clay minerals, and organic material is the dominant reaction, resulting in the enrichment of zinc in suspended and bed sediments. The efficiency of these materials in removing zinc from solution varies according to their concentrations, pH, redox potential, salinity, nature and concentrations of complexing ligands, cation exchange capacity, and the concentration of zinc. Precipitation of soluble zinc compounds appears to be significant only under reducing conditions in highly polluted water.
- A significant fraction of lead carried by river water occurs in an undissolved form, which can consist of colloidal particles or larger undissolved particles of lead carbonate, lead oxide, lead hydroxide, or other lead compounds incorporated in other components of surface particulate matters from runoff. Lead may occur either as sorbed ions or surface coatings on sediment mineral particles, or it may be carried as a part of suspended living or nonliving organic matter in water. The ratio of lead in suspended solids to lead in dissolved form has been found to vary from 4:1 in rural streams to 27:1 in urban streams. Sorption of lead to polar particulate matter in freshwater and estuarine environments is an important process for the removal of lead from these surface waters.

Pollutants travel long distances in rivers either in solution, adsorbed to suspended particles, or they are retained in sediments, particularly clay and silt, which can only be deposited in areas of reduced water velocity, such as behind dams or backwater and off-channel areas, until they are mobilized and transported by future sediment moving flows (Alpers *et al.* 2000a; Alpers *et al.* 2000b; Anderson *et al.* 1996). Santore *et al.* (2001) indicates that the presence of natural organic matter and changes in pH and hardness affect the potential for toxicity (both increase and decrease). Additionally, organics (living and dead) can adsorb and absorb other pollutants such as PAHs. The variables of organic decay further complicate the path and cycle of pollutants. The persistence and speciation of these pollutants also cause effects to extend from the point where runoff discharges into a stream to the downstream terminus.

Runoff from impervious surfaces within each project area being treated at or near the point at which rainfall occurs using low impact development, bioretention, filter subsoils, and other practices that have been identified as excellent treatments to reduce or eliminate contaminants for runoff (Barrett *et al.* 1993; Center for Watershed Protection and Maryland Department of the Environment 2000 (revised 2009); Feist *et al*. 2017; Herrera Environmental Consultants 2006; Hirschman *et al.* 2008; National Cooperative Highway Research Program 2006).[22] The treatment protocols proposed by the action agencies are based on a design storm (50% of the 2-year, 24 hour storm) that will generally result in more than 95% of the runoff from all impervious surfaces within the construction area being treated. Stormwater treatment practices, such as bioretention, bioslopes, and infiltration ponds, supplemented with appropriate soil amendments as needed,[23] are excellent treatments to reduce or eliminate contaminants from runoff (Barrett *et al.* 1993; Center for Watershed Protection and Maryland Department of the Environment 2000 (revised 2009); Hirschman *et al.* 2008; National Cooperative Highway Research Program 2006; Washington State Department of Ecology 2004; Washington State Department of Ecology 2014). The proposed design criterion for stormwater management will treat stormwater flows associated with more than 95% of the annual average rainfall.

Although the proposed program will capture, manage, and treat runoff, no treatment is 100% effective and stormwater contaminants will still be delivered to waterbodies. Thus, adverse effects of post-construction stormwater runoff will persist for impervious surfaces treated by projects of the program. However, because most impervious surfaces affected by the projects of the proposed program are likely currently untreated, the amount of stormwater contaminants delivered to waterbodies will be less than the pre-project state. Furthermore, most projects covered in this program will not include impervious surfaces. While FHWA projects almost always will include impervious surfaces, the Corps projects almost never will. FEMA projects may or may not.

<u>Site restoration & revegetation.</u> After each project is complete, the action agencies will require any significant disturbance of riparian vegetation, soils, streambanks, or stream channel caused by the construction to be cleaned up and restored. Site restoration will typically include replacement of natural materials or other geomorphic characteristics altered or degraded, so that ecosystem processes that form and maintain productive fish habitats are replaced and can function.

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[22] See also Memos from Ronan Igloria, HDR (Henningson, Durham, and Richardson, Inc.), to Jennifer Sellers and William Fletcher, Oregon Department of Transportation, dated December 28, 2007 (Stormwater Treatment Strategy Development – Water Quality Design Storm Performance Standard), February 28, 2008 (Stormwater Treatment Strategy Development – Water Quantity Design Storm Performance Standard - Final), and April 15, 2008 (Stormwater Treatment Strategy Development – BMP Selection Tool).

[23] See also Memos from Ronan Igloria, HDR (Henningson, Durham, and Richardson, Inc.), to Jennifer Sellers and William Fletcher, Oregon Department of Transportation (Igloira 2007; Igloira 2008a; Igloria 2008b).

The direct physical and chemical effects of site clean-up after construction is complete are essentially the reverse of the construction activities that go before it. Bare earth will be protected by various methods, including seeding, planting woody shrubs and trees, and mulching. This will immediately dissipate erosive energy associated with precipitation and increase soil infiltration. It also will accelerate vegetative succession necessary to restore root strength necessary for slope and bank stability, leaf and other particulate organic matter input, sediment filtering and nutrient absorption from runoff, and shade. Microclimate will become cooler and moister, and wind speed will decrease.

Proposed projects will likely occur in areas where productive habitat functions and recovery mechanisms are absent or degraded. Therefore, the time necessary for recovery to baseline conditions of riparian vegetation will be quick (*i.e*., months to years). Full recovery to functional habitat attributes sufficient to support species recovery will vary by the potential capacity of each habitat attribute. Recovery mechanisms such as soil stability, sediment filtering and nutrient absorption, and vegetation succession may recover quickly (months). Recovery of functions related to large wood recruitment and microclimate may require decades or longer. Functions related to shading of the riparian area and stream, root strength for bank stabilization, and organic matter input may require intermediate lengths of time.

Flexible Uplift. Any project that does not fully meet all applicable PDCs may incorporate flexible uplift to fulfill the requirement to provide long-term benefit to the listed species and critical habitat. Activities completed as flexible uplift are most likely to be covered in one of the twelve proposed categories included in this opinion. As such, the effects of implementing flexible uplift activities will be the same as the activity category implemented. Other activities that may occur under flexible uplift include riprap removal and over-water structure removal. Because the in-water work to implement these activities is the same as required for the twelve proposed categories, the effects of implementing them will be the same.

2.4.1.2 Activity Category-Specific Effects

All of the activities are designed to have long-term beneficial effects to habitat and listed species. However, the long-term effectiveness of habitat restoration, in general, has not been well documented. In part, this is because they often concentrate on instream habitat without addressing the processes that led to the loss of the habitat (Cederholm *et al.* 1997; Doyle and Shields 2012; Fox 1992; Roper *et al.* 1997; Simenstad and Thom 1996; Zedler 1996). Nevertheless, the proposed projects are reasonably certain to lead to some degree of ecological recovery within each project area, including the establishment or restoration of environmental conditions associated with functional habitat and high conservation value. Projects that improve fish passage to streams and floodplains, in particular, are likely to have long-term beneficial effects at the watershed or designation-wide scale (Roni *et al.* 2002).

Tide/Flood Gate Removal, Replacement, or Retrofit

Historically, tide and flood gates were constructed of cast iron or wood. Plastic, fiberglass and aluminum gates are also available and are preferred because the lighter gates open more easily for better fish passage and for drainage. Today's designs include float-operated gates, such as self-regulating tide gates, automatic electric- or hydraulically-powered gates, and other mechanical systems that allow a specific and variable operating range of upstream water surface elevation. This class is collectively called automated gates as opposed to passive gates that simply rely on the direction of flow to either close or open (Barnard 2011; Giannico and Souder 2005; Greene *et al*. 2012).

When tide/flood gates are partially or completely closed they are barriers to fish migration, blocking upstream habitat. Most are also a barrier to migration when they are open because they don't open far enough or frequently enough, or the water velocity is too high. The velocity and depth in the barrel of the culvert may exceed the swimming ability of the fish that make it past the gate. There is often an increase in velocity at the inlet of the culvert as flow contracts into the smaller culvert. Head loss in excess of 0.5 feet (greater than 5 feet per second) is likely to be a barrier to juvenile and weak swimming fish. In addition to salmonid species, forage fish species such as surf smelt and sand lance could potentially immigrate into the lower reaches of watercourses (Western Washington Agricultural Association *et al*. 2007).

Tide/flood gates reduce the quality and quantity of fish habitat above them (Greene *et al*. 2017). Water quality parameters negatively affected by tide/flood gates include salinity, dissolved oxygen, sediment, and temperature (Greene *et al*. 2017). High tide water surface elevations above tide gates were reduced by 50% to 65%, compared to downstream sites (Greene *et al*. 2012). Many studies have documented the importance of tidal wetlands to growth and life history diversity of salmonids (e.g. *Craig et al*. 2014). Nickelson (2011) estimated the number of coho salmon smolts produced by restored tidal wetlands is between 180 and 270 per acre per year.

Removal of Tide and Flood Gates. Removal of dikes and their tide/flood gates, regardless of how fish friendly their design and operation, will improve fish movement and positively alter the quality of their habitats. Even "fish friendly" automated gates on tidal sloughs, which remain open for part of the flood tide, negatively affect the abundance and movement of juvenile salmon when compared to similar but un-gated sloughs.

NOAA Fisheries Science Center and the Skagit River Systems Cooperative (Barnard 2011; Greene *et al*. 2012) found the following preliminary findings:

- Juvenile Chinook salmon are present in lower numbers upstream of automated gated sloughs than in un-gated sloughs
- These fish tended to spend less time behind the tide gate
- Tagged fish were shown to move less frequently across the gate and, in the case of larger fish released above the gate, to move only once downstream and out of the slough
- Indications are that the muted tidal cycle created by the automated gate results in reduced habitat quality which may be reflected in lower abundance with fewer repeated visits by juvenile Chinook salmon
- Tide gates alter the salinity, temperature, dissolved oxygen, total suspended solids, etc. of the habitat upstream

Removal of tide/flood gates is likely to result in restoration of estuarine functions related to regulation of temperature, tidal currents, and salinity; increased habitat abundance from distributary channels, that increase in size after tidal flows are allowed to inundate and scour on a twice daily basis; reduction of fine sediment in-channel and downstream; reduced estuary filling due to increased availability of low-energy, overbank storage areas for fine sediment; restoration of fish access into tributaries, off- and side-channel ponds and wetlands; restoration of saline-dependent plant species; increased primary productivity; increased estuarine food production; and restoration of an estuarine transition zone for fish and other species migrating through the tidal zone (Cramer 2012; Giannico and Souder 2004; Giannico and Souder 2005).

Replacement or Retrofit of Tide and Flood Gates. Replacement of tidegates is necessary when upstream land and infrastructure is not compatible with full tidal exchange. Replacement usually involves installing new tubes and gates to extend the life of the facility or to restore impaired function. Tubes and gates typically collapse over time due to corrosion. A recent study by the NOAA Northwest Fisheries Science Center and the Skagit River System Cooperative (Greene *et al.* 2012) on "fish friendly" tide gates concluded:

- The similarity of automated to flap- or side-hinged gates, or reference sites, depends upon which metrics are measured.
- Automated gates limit habitat availability above the gates relative to natural channels, but perform slightly better than passive side hinged or flap gates.
- Flap or side hinged gates blocked open for observation periods were consistently higher in cumulative Chinook salmon density than purely passively operated gates.
- Automated gate designs still limit tidal processes, habitat availability and passage compared to non-gated systems.
- Automated gate designs and operation standards that maximize connectivity, and site selection criteria that focus on reconnection of large amounts of habitat, may overcome some of the limitations of reduced habitat use associated with tide gate installation.

In one instance, a passive side hinged gate was removed and replaced with an automated gate -- the result was a nearly 10-fold decline in cumulative density of juvenile Chinook salmon. It was observed that previous gate operations, which stipulated the former gate be manually held open during key migration periods for juvenile Chinook salmon, were not duplicated in the operation of the newly installed automated gate. The unintended biological effects of the change in gate operation suggest: (1) Tide gates designed to better accommodate fish passage still have some negative impacts; (2) proper gate operation is an essential component in meeting project goals regardless of the gate design; (3) hydraulic modeling is an essential part of establishing both the feasibility and sustainability of project goals; and (4) continued monitoring and adaptive management is essential in meeting project goals.

Removal and replacement/retrofit of tide/flood gates using the proposed PDCs are likely to have most of the construction-related effects as described above. Though many activities will be timed with low tidal cycles to avoid impacts of work area isolation, fish capture, and release.

Every replaced or retrofitted tide/flood gate structure will result in improvements to baseline conditions by not only meeting fish passage criteria, but either improving fish passage or benefitting habitat quality (or both). Although the proposed program will improve passage and/or habitat quality, some adverse effects will continue since full natural flushing is not allowed.

As described in the environmental baseline section of this opinion, coastal marsh lands have been extensively altered by the installation of dikes, levees, and tide/flood gates to protect developments or to create pasturelands or land for development. In addition to the loss of these wetlands, fish passage into waterways has been adversely affected. While not a substitution for complete removal, replacing or retrofitting old tide gates with structures that are designed to increase the hydraulic connections between waterways will improve water quality, habitat conditions, and fish passage into coastal marsh habitat.

Set-back or Removal of Existing Dikes and Levees

Channelization of estuaries and streams through dike and levee construction eliminates the floodplain benefits during floods, producing many of the same changes to living communities and ecosystems as those resulting from dams. Dikes and levees are commonly found along mid- to large-sized rivers for flood control or infrastructure protection and can severely disrupt ecosystem function (Gergel *et al.* 2002) and fish community structure (Freyer and Healey 2003).

Salmonids and other fishes benefit from restoring the processes that maintain floodplain complexity (Bellmore *et al.* 2013). Set-back or removal of existing dikes and levees increases habitat diversity and complexity, moderates flow disturbances, and provides refuge for fish during high flows. Floodplain heterogeneity is associated with the occurrence of a mosaic of food webs, all of which are utilized by anadromous salmonids and other estuarine fishes, and all of which may be important to their recovery and persistence. Other restored ecological functions include overland flow during flood events, dissipation of flood energy, increased water storage to augment low flows, sediment and debris deposition, growth of riparian vegetation, nutrient cycling, and development of side channels and alcoves.

Short-term effects of dike and levee removal include most of the construction-related effects as described above. For constructability, many activities will be timed with low tidal cycles which also minimizes short-term effects including sediment generation. Because of their locations and elevations, work area isolation is not needed for most dike and levee removals. Thus, they do not result in fish capture and handling.

Long-term effects will be beneficial to habitat diversity and complexity (Cramer 2012), including increased overbank flow and greater potential for groundwater recharge in the floodplain; attenuation of sediment transport downstream due to increased sediment storage; greater channel complexity or increased shoreline length; increased floodplain functionality; reduction of chronic streambank erosion and channel instability due to sediment deposition; and increased width of riparian corridors. Increased floodplain connection is likely to moderate water temperatures and microclimate; increase abundance and retention of wood; increase organic material supply; improve water quality; filter sediment and nutrient inputs; improve nutrient cycling; and restore flood-flow refuge for fish (Cramer 2012). Tidal wetlands are also cost-effective tools to sequester carbon to mitigate the effect of greenhouse gas emissions (Bernal and Mitsch 2013).

Large Wood and Engineered Log Jams

Land management actions such as logging, road building, stream clearing, and splash damming carried out over the last 150 years have greatly reduced the amount of LW in streams (McIntosh *et al.* 1994; Murphy 1995). Addition of LW is a common and effective restoration technique used throughout the Pacific Northwest (Roni *et al.* 2002). Roni and Quinn (2001a) found that LW placement can lead to higher densities of juvenile coho salmon during summer and winter and higher densities of steelhead and cutthroat trout in the winter. These authors also found addition of LW to streams with low levels of wood can lead to greater fish growth and less frequent and shorter fish movements (Roni and Quinn 2001b).

ELJs, which are engineered to create an interlocking composite structure, are an effective tool for restoring physical and biological conditions critical to salmon recovery in large alluvial rivers. Placement of a single log can provide benefits in certain situations but a log jam typically provides more habitat value. The mass of the structures and pilings are designed to provide the needed resistance to the expected forces of the river. These diverse bio-structures provide the base for different aquatic life to find food, shelter, and space to thrive. A log jam also changes water velocity and direction to sort gravels and create pool and riffle habitat.

On the Elwha River, ELJs have proved to be stable with little significant change in position or surface area noted despite frequent inundation from floods including two peak floods that rank within the top 10% of floods recorded for over 100 years of record. The ELJs have also helped maximize habitat area by partially balancing flows between two major channels. During flood flows, ELJs have increased exchange of water with floodplain surfaces, primarily through backwatering. This has resulted in the expansion of side-channel habitats, including groundwater fed channels that provide critical habitats for multiple salmonid species. The ELJs developed scour pools, stored gravel, and reduced bed substrate grain size in the vicinity of several ELJs, with the mean particle size changing from large cobble to gravel. ELJs also had a measurable and significant positive effect on primary productivity, secondary productivity and juvenile fish populations (McHenry *et al.* 2007).

ELJs also retard streambank erosion as flow redirection structures that mimic stable log jams or bedrock outcrops that create “hard points” that form pools and cover, and increase overall channel complexity. Flow redirection structures are an effective means to control erosion and restore the quantity and quality of aquatic habitat by increasing channel length, pool frequency, and the amount of cover. With properly spaced flow ELJs, sediment storage can be encouraged in between the structures to establish and sustain riparian buffers (Entrix 2009).

Installation of LW and ELJ structures is likely to require entry of personnel and equipment into the riparian area and channel, and will result in unavoidable short-term construction related effects, as described above. In the long-term, we expect benefits to habitat functions. Numerous authors have highlighted the importance of LW to lotic ecosystems (Bilby 1984; Keller *et al.* 1985; Lassettre and Harris 2001; Spence *et al.* 1996). LW influences channel morphology, traps and retains gravels, and provides food for aquatic invertebrates that in turn provide food for juvenile salmonids. LW, boulders, and other structures provide hydraulic complexity and pool habitats that serve as resting and feeding stations for salmonids as they rear or migrate upstream to spawn (Spence *et al.* 1996).

Dam and Legacy Structure Removal

The diversity of water control structures distributed on the landscape combined with the relative scarcity of knowledge about the environmental response to their removal makes it difficult to generalize about the ecological harm or benefits of their removal. However, many small water control structures are nearing the end of their useful life due to sediment accumulation and general deterioration. They are likely to be either intentionally removed by parties concerned about liability that may arise from failure, or fail due to lack of maintenance. Thus, it is likely in some cases, the greatest benefit from removing a legacy structure will be minimizing adverse effects of an unplanned failure. Benefits may include reducing the size of a contaminated sediment release, preventing an unplanned sediment pulse, controlling undesirable species, or ensuring fish passage around any remnant of the structure.

This activity category requires instream construction with equipment such as excavators, bull dozers, dump trucks, front-end loaders, etc. These cause short-term construction-related effects as described earlier. Over the long-term, this activity category results in beneficial effects by reconnecting stream corridors, floodplains, and estuaries, reestablishing wetlands, improving aquatic organism passage, and restoring more natural channel and flow conditions. Removal of legacy structures, such as a small dams, earthen embankments, subsurface drainage features, and gabions is likely to have significant local and landscape-level beneficial effects to processes related to sediment transport, energy flow, stream flow, and temperature (Poff and Hart 2002).

Channel Reconstruction/Relocation

Channel straightening and dredging were extensively used in the 20th century to enhance agricultural drainage and facilitate crop maintenance and harvest. Channels were also straightened in response to flood events. Channelized streams have increased flow velocities and potential to erode their bed and banks. As bed elevations decreased, streambank heights increased such that greater water depth and discharge is required for the stream to spread onto the floodplain. The increase in streambank heights and bankfull discharge, which results in increased bank erosion, and may be responsible for a significant portion of sediment loads in streams.

Channel Reconstruction/Relocation will be implemented to improve aquatic and riparian habitat diversity and complexity, reconnect them to floodplains, reduce bed and bank erosion, increase hyporheic exchange, provide long-term nutrient storage, provide substrate for macroinvertebrates, moderate flow disturbance, increase retention of organic material, and provide refuge for fish and other aquatic species.

Typically stream channel reconstruction/relocation projects are conducted in phases that will end with the full return of river flows to the historical channel and the filling of the old shortened channel. Significant mechanical manipulation and grading may be required to recover floodplain width and elevations. Short-term risks associated with this construction exist. Channel reconstruction/ relocation projects using the proposed PDC are likely to have significant local and landscape-level effects to processes related to sediment transport, energy flow, stream flow, temperature, and biotic fragmentation, including:

- Incision or aggradation within the project reach or in upstream, downstream or tributary reaches
- Bank erosion due to changes in hydraulic forces or bank stability
- Mid-channel bar formation and widening
- Channel avulsion (sudden shift in channel location across the intervening floodplain)
- Flanking of in-stream structures
- Increased sediment delivered to downstream reaches due to post-project channel adjustments
- Decreased sediment delivered to downstream reaches due to reduction of bank erosion rates to below natural levels
- Altered patterns of flooding
- Creation of fish-stranding hazards
- Shifts in composition and distribution of riparian plant and fish species, including establishment of non-native species (Cramer 2012).

Stream channel reconstruction/relocation using the proposed PDCs will have most of the construction-related effects as described above. Most of these activities require work area isolation, and thus fish capture and release. Disturbances associated with restoration have the potential to increase non-native plant abundance in the project area through influx of non-native species on equipment and by providing bare soil conditions. However, PDC for revegetation of native species and active removal/treatment of invasive plants will help to establish native species and reduce the overall presence of non-native plants.

Post-construction, this activity category will result in short and long-term environmental benefits by restoring hydrologic function of stream channels to more natural conditions. Functional floodplains will promote riparian vegetation and stable banks. The restored corridor will provide an adequate riparian buffer zone. Aquatic habitat will be greatly improved by making streams more self-sustaining and resilient to external perturbation will lead to improved aquatic habitat, which will help improve aquatic population abundance and productivity.

Off- and Side-Channel Habitat Restoration

Many historical off- and side-channels have been blocked from main stream channels for flood control or by other land management activities, or have ceased functioning due to other in-stream sediment imbalances. Restoration of off and side-channel habitat removes fill material to reconnect existing stream channels to historical off- and side-channels. The construction-related effects of this project category will include short-term effects, as discussed above. However, because they occur in areas currently blocked off, work area isolation is not needed for most. Thus, they do not result in fish capture and handling.

This activity category will increase habitat diversity and complexity, improve flow heterogeneity, provide long-term nutrient storage and substrate for aquatic macroinvertebrates, moderate flow disturbances, increase retention of leaf litter, and provide refuge for fish during high flows. Side channel wetlands and ponds provide important benefits such as have high value as summer and winter rearing habitat for coho salmon (Cramer 2012). Long-term benefits will include intense beneficial effects to habitat diversity and complexity (Cramer 2012), including increased overbank flow and greater potential for groundwater recharge in the floodplain; attenuation of sediment transport downstream due to increased sediment storage; greater channel complexity or increased shoreline length; increased floodplain functionality; reduction of chronic streambank erosion and channel instability due to sediment deposition; and increased width of riparian corridors. Increased riparian functions are likely to include increased shade and hence moderated water temperatures and microclimate; increased abundance and retention of wood; increased organic material supply; water quality improvement; filtering of sediment and nutrient inputs; more efficient nutrient cycling; and restoration of flood-flow refuge for ESA-listed fish (Cramer 2012). Wetlands, such as those created by off- and side-channel restoration are also cost-effective tools to sequester carbon to mitigate the effect of greenhouse gas emissions (Bernal and Mitsch 2013).

Streambank Restoration

Eroded streambanks exist throughout the recovery domains. Streambank erosion happens slowly naturally, but is often accelerated but anthropogenic changes at the site and/or watershed levels. Causes include stream channel straightening or hardening, livestock grazing, and increases in flood flows due to impervious surfaces. Eroding streambanks provide excessive fine sediments and decreased vegetation for stream complexity, flow heterogeneity, and shade.

The primary proposed streambank restoration is bank reshaping and use of bioengineering such as large wood and vegetation to increase bank strength and resistance to erosion in an ecological approach to engineering (Mitsch 1996; WDFW *et al.* 2003). This approach protects banks by using natural materials to increase erosion resistance and bank roughness to disrupt stream energy. Bioengineered bank treatments develop root systems that are flexible and regenerative, and respond more favorably to hydraulic disturbance than conventional hard alternatives.

This activity category requires instream construction with equipment such as excavators, bull dozers, dump trucks, front-end loaders, etc. These cause short-term construction-related effects as described earlier. Over the long-term, these activities result in beneficial effects by reconnecting stream corridors, floodplains, and estuaries, reestablishing wetlands, improving aquatic organism passage, and restoring more natural channel and flow conditions. Streambank restoration immediately dissipates erosive energy associated with precipitation and increases soil infiltration. It also accelerates establishment of vegetation necessary to restore the delivery of root strength necessary for slope and bank stability, leaf and other particulate organic matter input, sediment filtering and nutrient absorption from runoff, shade, and eventually large wood to the riparian area and stream. Microclimate will become cooler and moister, and wind speed will decrease. Eliminating a sediment source will help to increase the diversity and densities of aquatic macroinvertebrates, which are used as a food source by fish.

Livestock Fencing, Stream Crossings and Off-Channel Livestock Watering Facilities.

Livestock grazing routinely causes loss of riparian vegetation along stream channels, which can lead to loss of streambank integrity, increased bank erosion, and even bank sloughing (Kauffman and Krueger 1984). These processes increase sedimentation to the stream and reduce stream complexity, flow heterogeneity, and shade. This proposed activity category promotes a balanced approach to livestock use in riparian areas, reducing livestock impacts to riparian soils and vegetation, streambanks, channel substrates, and water quality.

Livestock fencing and installing off-channel watering facilities have little to no adverse short-term effects as they occur outside of the stream channel. Because they occur within the channel, stream crossings will result in the short-term construction-related effects identified above.

Over the long-term, these activities are significantly beneficial, including reducing the likelihood that livestock, particularly cattle, will have unrestricted access to a riparian area or stream channel for shade, forage, drinking water, or to cross the stream. This, in turn, is likely to reduce the likelihood that livestock will disturb streambeds or erode streambanks, and will improve water quality by increasing riparian vegetation and reducing sediment and nutrient loading to streams. Stream crossings will not allow the channel to recover to pre-European man conditions, but because they occur in areas where productive habitat functions and recovery mechanisms are absent or degraded, reach level functions and values will certainly improve over the environmental baseline.

Piling and other Structure Removal

This category includes the removal of untreated and chemically treated wood pilings, piers, and boat docks as well as similar structures comprised of plastic, concrete and other material. Piling and other structure removal from waterways will improve water quality by eliminating chronic sources of toxic contamination and associated impacts to riparian dependent species. The most likely structures removed under this activity category are piles and posts associated with tidegates. These are typically treated with toxic oil-based preservatives (creosote).

In the short-term, removal of piles will re-suspend sediments that are inevitably pulled up with, or attached to, the piles. If sediment in the vicinity of a pile is contaminated, or if the pile is creosote treated, those contaminants will be included with the re-suspended sediments, especially if a creosote-treated pile is damaged during removal. The long-term effects of structure removal will be wholly beneficial, and include reduction of resting areas for piscivorous birds, hiding habitat for aquatic predators, and, in the case of preservative-treated piles, a chronic source of contamination.

Beaver Habitat Restoration

Beaver exploitation for the fur trade left them nearly extinct by 1900 (Naiman *et al*. 1988; Bouwes *et al*. 2016), though some researchers believe beaver populations in Oregon Coast streams were impacted more by early 1900s forestry and agricultural practices (ODFW 2005). Their numbers have increased since, but remain at approximately 3-10% of historic levels

(Pollock *et al*. 2003). Loss of beavers results in the eventual loss of their ponds as the dams fail without maintenance. Because beaver ponds provide high value fish habitat (Leidholt-Bruner *et al*. 1992; Nickelson *et al*. 1992), their loss constitutes a significant degradation of environmental conditions.

Because this work is typically completed by hand, installation of BDAs and riparian vegetation will only result in very minor and short-term adverse effects, most notably fine sediment delivery to streams. Work area isolation is not required, thus no salvage and handling of fish.

The long-term effects of this category are restoration of linear, entrenched, simplified channels to their previously sinuous, structurally complex channels that were connected to their floodplains. This will result in a substantial expansion of riparian vegetation and improved instream habitat. Beaver dams substantially alter the hydrology, geomorphology, and sediment transport within the riparian corridor by: Entraining substrate, aggrading the bottom, and reconnecting the stream to the floodplain; raising water tables; increasing the extent of riparian vegetation; increasing pool frequency and depth; increasing stream sinuosity and sediment sorting; and lowering water temperatures (Pollock *et al.* 2007; Pollock *et al.* 2012).

Wetland Restoration.

Oregon, Washington and northern California have lost approximately 70% of their estuarine wetlands, including 73% of those in Coos Bay, 76% of those in the Columbia River, and 95% of those in the Coquille River (Brophy *et al*. 2017). This loss has obvious impacts on life stages of the fish species that rely on estuaries, such as those covered in this opinion.

Wetland restoration projects will use heavy equipment to remove fill and shape the floodplain and have the potential for most of the short-term construction-related adverse effects discussed above. However, most of these activities take place outside of stream channels and/or above the current water elevation. Therefore, occurrences of adverse effects (such as suspended sediment or accidental spills) are unlikely, and there is no need for work area isolation.

The long-term effects of wetland restoration are wholly beneficial. Some of the benefits are restoring a more natural floodplain and flood flow conditions, improving aquatic organism passage, increasing soil infiltration and ground water recharge, sediment filtering, and nutrient absorption from runoff.

Temporary Safety Stabilization

A temporary safety stabilization will implement short-term activities to stabilize a structure with a recent or imminent failure. Such failures are likely to include a significant amount of structural debris plus disturbance and erosion of riparian vegetation and soils, dikes/levees, stream banks, and stream substrates. Stabilization techniques are likely to include other categories within this program, but may also consist of placing large rock, sheet piles, or rebuilding levees and dikes. During the next in-water work period, the action agency will implement a permanent solution which meets one of the 11 categories above.

The short-term effects of temporary safety stabilization will include the short-term construction-related ones detailed above. However, these effects will likely be more severe than discussed for other categories because they will occur outside of the preferred work windows, potentially when more susceptible life stages of fish are present, and use hard structures like rock and sheet pile. These hardened stabilization techniques come with adverse effects not discussed above, such as increase water velocity, increased erosion in downstream areas, loss of cover, and impaired channel evolution. However, these effects will persist only until the permanent fix is implemented, likely a few months.

The long-term effects of temporary safety stabilization will be identical to the 11 categories discussed above, because the permanent project will implement one or more of them.

2.4.2 Effects of the Action on ESA-Listed Salmonids

As noted above, each individual project will be completed as proposed with full application of PDCs. Each project is likely to have the following effects on individual fish at the site and reach scale. The nature of these effects will be similar between projects because each project is based on a similar set of underlying construction activities that are limited by the same PDCs and the individual salmon and steelhead ESUs or DPSs have relatively similar life history requirements and behaviors regardless of species.

The intensity of the effects, in terms of changes in the condition of individual fish and the number of individuals affected, and severity of these effects will also vary somewhat between projects because of differences at each site in the scope of work area isolation and construction, the particular life history stages present, the baseline condition of each fish present, and factors responsible for those conditions. However, no project will have effects on fish that are beyond the full range of effects described here.

The proximity of juvenile and adult salmon and steelhead species to the effects of activities that could injure or kill them will be limited by the PDCs that require completion in accordance with the Oregon and Washington guidelines for timing of in-water work to protect fish and wildlife resources. These guidelines are primarily based on the average run timing of salmon and steelhead populations, the actual timing of each run varies from year to year according to environmental conditions. Moreover, because populations of salmon and steelhead have evolved different run timings, work timing becomes less effective as a measure to reduce adverse effects on species when two or more populations occur in a particular area.

Work area isolation

Most direct, lethal effects of authorizing and carrying out the proposed program are likely caused by the isolation of in-water work areas, though lethal and sublethal effects would be greater without isolation. Any individual fish present in the work isolation area will be captured and released. Fish that are transferred to holding tanks can experience trauma if care is not taken in the transfer process, and fish can experience stress and injury from overcrowding in traps, if the traps are not emptied on a regular basis. Stress and death from handling occur because of differences in water temperature and dissolved oxygen between the river and transfer buckets, as well as physical trauma and the amount of time that fish are held out of the water. Stress on salmon and steelhead increases rapidly from handling if the water temperature exceeds 64ºF, or if dissolved oxygen is below saturation. Design criteria related to the capture and release of fish during work area isolation will avoid most of these consequences, and ensure that most of the resulting stress is short-lived (NMFS 2002).

Juvenile salmon and steelhead are likely to be captured and handled during work area isolation. Adult salmon and steelhead are unlikely to be present when in-water work area is isolated, and they will likely leave by their own volition. To estimate the maximum number of juvenile salmon and steelhead captured and handled, we used data from the FWS and NOAA Restoration Center on the average number of juveniles per isolation event and extrapolated it by the number of isolation events per year. At the same time, we converted the number of juveniles to adult equivalents to assess the population-level effect. The resulting formula was: A = n(pct), where:

A = number of adult equivalents "killed" each year
n = number of isolation events likely to occur in a recovery domain each year[24]
p = 66, *i.e.*, number of juveniles expected to be captured per isolation event[25]
c = 0.05, *i.e.*, rate of juvenile injury or death caused by electrofishing during capture and release, primarily steelhead and coho salmon. Consistent with observations by Cannon (2008, 2012) and data reported in McMichael *et al*. (1998).
t = 0.02, *i.e.*, an estimated average smolt to adult survival ratio, see Smoker *et al*. (2004) and Scheuerell and Williams (2005). This is likely conservative because many juveniles are likely to be captured prior to smoltification and juveniles have a survival rate to adulthood smaller than do smolts.

The effects of work area isolation on the abundance of adult salmon or steelhead in any population is likely to be small, because no more than 3.6 adult-equivalents will be killed in the entirety of any recovery domain per year (Table 6). The OC and SONCC salmon recovery domains contain only one listed ESU, accordingly we assume all the losses will occur to those coho salmon ESUs even though the estimated capture numbers include Chinook salmon and steelhead. Within the Willamette/Lower Columbia (WLC) domain individuals of 13 ESA-listed ESUs are present. We do not assume the losses will be spread evenly, but it is unlikely that any ESU will experience a loss greater than 0.5 adult equivalents.

[24] The average number of isolation events per proposed action is estimated to be 1. This considers that most actions will not require work area isolation, but some will require multiple.

[25] From 2010 to 2012, USFWS and NOAA Restoration Center tracked the number of salmon and steelhead caught in work area isolation events of 35 aquatic habitat restoration actions and found an average of 132 juveniles. Because most of those occurred in freshwater environments where densities of rearing salmon and steelhead are much higher than tidally influenced areas, we assume approximately half the number of juveniles (66) will be captured.

Table 6. Number of salmon and steelhead affected, per year, by recovery domain.

Recovery Domain	Estimated Total Number of Isolation Events (per year) (n)	Estimated Maximum Number of Juveniles Captured (per year)(n*p)	Estimated Maximum Number of Juveniles Injured or Killed (per year)(n*p*c)	Estimated Maximum Number of Adult Equivalents "Killed" (per year)(n*p*c*t)
WLC	45	2,970	149	3.0
OC	55	3,630	182	3.6
SONCC	30	1,980	99	2.0

Construction-related effects

The construction-related adverse effects of project implementation are short-term. For example, suspended sediment plumes and sound pressures will last hours, where site disturbance may last months to a few years. The long-term effects are beneficial (years to decades, or the life of the project).

Impacts to stream margins are likely to be most important to fish because those areas often provide shallow, low-flow conditions, may have a slow mixing rate with mainstem waters, and may also be the site at which subsurface runoff is introduced. Juvenile salmon and steelhead often use low-flow areas along stream margins. Wild Chinook salmon rear near stream margins until they reach about 60 mm in length (Bottom *et al.* 2005; Fresh *et al.* 2005). As juveniles grow, they migrate away from stream margins and occupy habitats with progressively higher flow velocities. Nonetheless, stream margins continue to be used by larger salmon and steelhead for a variety of reasons, including nocturnal resting, summer and winter thermal refuge, predator avoidance, and flow refuge.

Disturbances caused by construction are likely to cause a physiological stress response that will change the behavior of salmon and steelhead (Moberg 2000; Shreck 2000). For example, the addition of fine sediment to channels and increased sound pressures are likely to lead to displacement from or avoidance of preferred rearing areas. Which, in turn, may increase losses to competition, disease, predation, or, for juvenile fish, reduce the ability to obtain food necessary for growth and maintenance (Moberg 2000; Newcombe and Jensen 1996; Sprague and Drury 1969). The ultimate effect of these changes in behavior, and on the distribution and productivity of salmon and steelhead, will vary with life stage, the duration and severity of the stressor, the frequency of stressful situations, the number and temporal separation between exposures, and the number of contemporaneous stressors experienced (Newcombe and Jensen 1996; Shreck 2000). Because the adverse effects are short-term, responses in salmonids will also be short-term such that some injuries are likely, but significant deaths are unlikely.

Application of herbicides may degrade water quality, which will cause adverse effects to salmonids in the form of sublethal adverse physiological effects. Stormwater contaminants delivered to waterbodies from impervious surfaces will have similar effects. However, due to PDCs to treat stormwater, the amount of stormwater contaminants delivered to waterbodies will be reduced compared to the pre-project state. Removal of treated piles may temporarily increase contaminants, with a long-term reduction.

Over the long-term, every project will result in improvement in the function and conservation value at each site. Many of the activity categories improve movement of fish upstream, downstream, and onto the floodplain. Even more of the categories improve the health of riparian and floodplain ecosystems. Each proposed project will increase the amount of habitat available and promote the development of more natural riparian and stream channel conditions to improve aquatic functions and become more productive. This will allow more complete expression of essential biological behaviors related to reproduction, feeding, rearing, and migration. The long-term effects of access to larger or more productive habitat will increase juvenile survival and adult reproductive success.

Scaling up effects on salmonids

Population level responses to habitat alterations can be thought of as the integrated response of individual organisms to environmental change. Thus, instantaneous measures of population characteristics, such as population abundance, population spatial structure and population diversity, are the sum of individual characteristics within a particular area, while measures of population change, such as population growth rate, are measured as the productivity of individuals over the entire life cycle (McElhany *et al.* 2000).

The greatest adverse effects occur from work area isolation, a measure put in place to minimize the overall adverse effects of each individual project. The ESU with the greatest losses from work area isolation is OC coho salmon, where the losses equate to 3.6 adult fish per year. Even if all the losses occurred with one population, this is too few fish to affect abundance or productivity of the entire population. Within the WLC domain, up to three adult equivalents may be killed, but those losses will occur across 13 ESUs. We do not assume the losses will be spread evenly, but it is unlikely that any ESU will experience a loss greater than 0.5 adult equivalents.

All other adverse effects from construction activities will be too minor and short-term to kill more than a small number of juvenile fish at a particular site. The program would have to kill many times more than that to affect the abundance or productivity of an entire population. Thus, the proposed program will simply kill too few fish of any one population to meaningfully affect the primary viable salmonid population (VSP) attributes of abundance or productivity for that population.

Allowing continued presence of tide/flood gates and impervious surfaces will have adverse effects, but required PDCs ensure significant improvements from baseline conditions. The proposed program will meaningfully improve habitat function and value at each project site for the long-term. Many studies have documented the importance of tidal wetlands to growth and life history diversity of salmonids (e.g. Craig *et al.* 2014). Nickelson (2011) estimated the number of coho salmon smolts produced by restored tidal wetlands is between 180 and 270 per acre per year. Therefore, each individual project will result in substantial increases in juvenile fitness and survival and adult reproductive success. These long-term improvements to fitness and survival far outweigh the short-term losses.

At the species level, biological effects are synonymous with those at the population level or, more likely, are the integrated demographic response of one or more subpopulations (McElhany *et al.* 2000). Because the likely adverse effects of any project authorized, funded or implemented under this opinion will not adversely affect the VSP characteristics of any salmon or steelhead population, and the long-term effects will improve VSP characteristics, the proposed program will not have any measurable negative effect on species-level abundance, productivity, or ability to recover, and will likely improve those characteristics.

2.4.3 Effects on ESA-Listed Green Sturgeon and Eulachon

Green sturgeon

Green sturgeon use the program action area for subadult and adult growth, development, and migration. Green sturgeon congregate in coastal waters and estuaries, including non-natal estuaries. Beamis and Kynard (1997) suggested that green sturgeon move into estuaries of non-natal rivers to feed. Data from Washington studies indicate that green sturgeon will only be present in estuaries from June until October (Moser and Lindley 2007). Recent fieldwork indicates that green sturgeon generally inhabit specific areas of coastal estuaries near or within deep channels or holes, moving into the upper reaches of the estuary, but rarely into freshwater (WDFW and ODFW 2012). Green sturgeon in these estuaries may move into tidal flats, particularly at night, to feed (Dumbauld *et al*. 2008). When they are not feeding in the shallows, green sturgeon likely will be holding in the deepest habitat available (WDFW and ODFW 2012).

Some individual green sturgeon are likely to be adversely affected by the proposed program. However, impacts from construction to green sturgeon will be less than those described above for salmonids, because of their size and location in the estuary. There should be few green sturgeon in the vicinity of most of the projects. Individuals near project activities are highly unlikely to be where work area isolation occurs. Adult and subadult green sturgeons are likely to be far less sensitive to suspended solids than salmonids. It is also reasonably certain that elevated suspended sediment concentrations will result in little to no behavioral and physical response due to the higher tolerance of green sturgeon, which usually inhabit much more turbid environments than do salmonids. Pile driving is the most likely activity to affect individuals. Though PDCs for pile driving will minimize those impacts.

The impacts from these activities are not expected to result in a change at the population level. For that reason and because effects are unrelated to the principal factor for the decline of this species (the reduction of its spawning area in the Sacramento River), the proposed program will not result in a negative effect at the species level. The long-term effects will benefit green sturgeon growth, development, and migration.

Eulachon

Eulachon inhabit several riverine and estuarine systems along the west coast and population sizes vary between these systems. Eulachon have been observed in the program action area (Gustafson *et al.* 2010), but are described as rare by Monaco *et al*. (1990 as cited in Gustafson *et al.* 2010). Eulachon spawners have returned in the Columbia River as early as mid-December to as late as mid-February, with an average of mid-January (Gustafson *et al.* 2010). Based on the available information for eulachon run-timing, small numbers of spawners, and frequency of occurrence, adult eulachon will probably migrate through the program action area from mid-January through May.

Because their migration timings are similar to salmonids, the Oregon and Washington guidelines for timing of in-water work are also protective of eulachon, making their capture extremely unlikely. Other impacts on eulachon will be similar to those described for salmon and steelhead listed above with a few individuals likely to be adversely affected by construction-related effects of the proposed program. However, the number of individuals killed will also be far too few to change any population characteristics. Since the likely adverse effects of any project authorized, funded, or implemented under this opinion will not adversely affect population viability, the proposed program will not have any measurable effect on species-level abundance, productivity, or ability to recover.

2.4.4 Effects of the Action on Critical Habitat

Each individual project is likely to have the following effects on critical habitat PBFs. The intensity of each effect, in terms of change in the PBF from baseline condition, and severity of each effect, measured as recovery time, will vary somewhat between projects because of differences in the scope of the work. However, no individual project is likely to have any effect on PBFs that is greater than the full range of effects summarized here.

Effects of the action on salmon and steelhead critical habitat PBFs:

1. Freshwater spawning sites – These PBFs do not occur in the action area.
2. Freshwater rearing sites – These PBFs do not occur in the action area.
3. Estuarine areas
    a. Free passage – Short-term decrease due to water quality impairment and in-water work isolation; long-term increase due improved floodplain connectivity, water quality, riparian conditions, and streambank conditions. Replaced or retrofitted tide/flood gates will meet fish passage criteria, but will not pass fish as well as open channels.
    b. Water quality – Short-term increase in suspended sediment due to riparian and channel disturbance and contaminants due to heavy equipment and herbicide use. Long-term improvement due to improved channel and floodplain functions. Stormwater contaminants will still be delivered to streams by impervious surfaces (when present), but treatment requirements will reduce their concentrations from baseline conditions.
    c. Water quantity – Brief and minor reductions in flow (less than 10 percent of the available flow for only as long as it takes to fill a desired tank) due to construction needs and livestock watering facilities.
    d. Salinity – Improved flow through tide/flood gates will improve salinity concentrations.
    e. Natural cover – Short-term decrease due to riparian and channel disturbance; long-term increase due to restored functions of channels, streambanks, and floodplains.

f. Forage – Short-term decrease due to riparian and channel disturbance. Long-term increase due to improved riparian conditions and restored functions of channels, streambanks, and floodplains.

4. Nearshore marine areas – These PBFs do not occur in the action area.
5. Offshore marine areas – These PBFs do not occur in the action area.

Effects of the action on green sturgeon critical habitat physical and biological features:

1. Freshwater riverine areas – These PBFs do not occur in the action area.
2. Estuarine areas
    a. Food – Short-term decrease due to riparian and channel disturbance. Long-term increase due to improved tidal wetlands and floodplains.
    b. Migratory corridor – Short-term decrease due to water quality impairment and in-water work isolation; long-term increase due improved tidal wetland and floodplain connectivity. Replaced or retrofitted tide/flood gates will meet fish passage criteria, but will not pass fish as well as open channels.
    c. Sediment quality – Short-term decrease due to stream and river-bottom disturbance.
    d. Depth – Depth will not be measurably affected
    e. Water quality – Short-term increase in suspended sediment due to riparian and channel disturbance and contaminants due to heavy equipment use and herbicides. Long-term improvement due to improved channel and floodplain functions. Stormwater contaminants will still be delivered to streams by impervious surfaces (when present), but treatment requirements will reduce their concentrations from baseline conditions.
2. Coastal marine areas – These PBFs do not occur in the action area.

Effects of the action on eulachon critical habitat physical and biological features:

1. Freshwater spawning sites and incubation – These PBFs do not occur in the action area.
2. Freshwater and estuarine migration corridors
    a. Migratory Corridor – Short-term decrease due to water quality impairment and in-water work isolation; long-term increase due improved tidal wetland and floodplain connectivity. Replaced or retrofitted tide/flood gates will meet fish passage criteria, but will not pass fish as well as open channels.
    b. Flow – Replaced or retrofitted tide/flood gates will improve flow in tidal channels over baseline conditions, but will not pass flow as well as open channels.
    c. Water quality – Short-term increase in suspended sediment due to riparian and channel disturbance and contaminants due to heavy equipment use and herbicides. Long-term improvement due to improved channel and floodplain functions. Stormwater contaminants will still be delivered to streams by impervious surfaces (when present), but treatment requirements will reduce their concentrations from baseline conditions.
    d. Water temperature – Improved flow into tidal channels will improve temperatures within them. Improved floodplain and wetland connectivity will improve temperatures in those areas.

e. Food – No effect as adult and larval eulachon do not eat in the action area.

3. Nearshore and offshore marine foraging areas – These PBFs do not occur in the action area.

Summary of effects to critical habitat for all listed species.

Activities of the proposed program, both individually and collectively, are likely to have some short-term impacts, but none of those impacts will be severe enough to affect the function of PBFs at the watershed scale. Nor will the negative effects impact the conservation value of the critical habitat unit. Furthermore, the proposed program will lead to significant ecological recovery at each site, including the establishment or restoration of environmental conditions associated with functional habitat and high conservation value. These benefits are likely to improve the conservation value of the critical habitat units where they occur.

2.5 Cumulative Effects

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

The contribution of non-Federal activities to the current condition of ESA-listed species and designated critical habitats within the program action area was described in the Status of the Species and Critical Habitats and Environmental Baseline sections, above. Among those activities were agriculture, forest management, mining, road construction, urbanization, water development, and river restoration. Those actions were driven by a combination of economic conditions that characterized traditional natural resource-based industries, general resource demands associated with settlement of local and regional population centers, and the efforts of social groups dedicated to river restoration and use of natural amenities, such as cultural inspiration and recreational experiences.

Resource-based industries caused many long-lasting environmental changes that harmed ESA-listed species and their critical habitats, such as state-wide loss or degradation of stream channel morphology, spawning substrates, instream roughness and cover, estuarine rearing habitats, wetlands, riparian areas, water quality (*e.g.*, temperature, sediment, dissolved oxygen, contaminants), fish passage, and habitat refugia. Those changes reduced the ability of populations of ESA-listed species to sustain themselves in the natural environment by altering or interfering with their behavior in ways that reduce their survival throughout their life cycle. The environmental changes also reduced the quality and function of critical habitat PBFs that are necessary for successful spawning, production of offspring, and migratory access necessary for adult fish to swim upstream to reach spawning areas and for juvenile fish to proceed downstream and reach the ocean. Without those features, the species cannot successfully spawn and produce offspring. However, the declining level of resource-based industrial activity and rapidly rising industry standards for resource protection are likely to reduce the intensity and severity of those impacts into the future.

The economic and environmental significance of the natural resource-based economy is currently declining in absolute terms and relative to a newer economy based on mixed manufacturing and marketing with an emphasis on high technology (Brown 2011b). Nonetheless, resource-based industries are likely to continue to have an influence on environmental conditions within the program action area for the indefinite future.

While natural resource extraction within the Pacific Northwest may be declining, general resource demands are increasing with growth in the size and standard of living of the local and regional human population (Metro 2010; Metro 2011). Population growth is a good proxy for multiple, dispersed activities and provides the best estimate of general resource demands because as local human populations grow, so does the overall consumption of local and regional natural resources. Between 2000 and 2010, the population of Oregon grew 12.0 percent (U.S. Census Bureau 2012). Between 2010 and 2020, the population of Oregon is projected to grow another 12.4 percent (Oregon Office of Economic Analysis 2017).

Areas of faster growing population, such as Portland and the Willamette Valley, are likely to experience greater resource demands, and therefore produce adverse environmental effects to the program action area. However, land use laws and progressive policies related to long-range planning will help to limit those impacts by ensuring that concern for a healthy economy that generates jobs and business opportunities is balanced by concern for protection of farms, forests, rivers, streams and natural areas (Metro 2000; Metro 2008; Metro 2011). In addition to land use planning to minimize adverse environmental impacts, larger population centers may also partly offset the adverse effects of their growing resource demands with more river restoration projects designed to provide ecosystem-based cultural amenities, although the geographic distribution of those actions, and therefore any benefits to ESA-listed species or critical habitats, may occur far from the centers of human populations.

Similarly, demand for cultural and aesthetic amenities continues to grow with human population, and is reflected in decades of concentrated effort by Tribes, states, and local communities to restore an environment that supports flourishing wildlife populations, including populations of species that are now ESA-listed (CRITFC 1995; OWEB 2017). Reduced economic dependence on traditional resource-based industries has been associated with growing public appreciation for the economic benefits of river restoration, and growing demand for the cultural amenities that river restoration provides. Thus, many non-Federal actions have become responsive to the recovery needs of ESA-listed species. Those actions included efforts to ensure that resource-based industries adopt improved practices to avoid, minimize, or offset their adverse impacts. Many actions are focused on completion of river restoration projects specifically designed to broadly reverse the major factors now limiting the survival of ESA-listed species at all stages of their life cycle. Those actions have improved the availability and quality of estuarine habitats, floodplain connectivity, channel structure and complexity, riparian areas and LW recruitment, stream substrates, stream flow, water quality, and fish passage. In this way, the goal of ESA-listed species recovery has become institutionalized as a common and accepted part of the economic and environmental culture. We expect this trend to continue into the future as awareness of environmental and at-risk species issues increases among the general public.

It is not possible to predict the future intensity of specific non-Federal actions due to uncertainties about the economy, funding levels for restoration actions, and individual investment decisions. However, the adverse effects of resource-based industries in the program action area are likely to continue in the future, although their net adverse effect is likely to decline slowly as beneficial effects spread from the adoption of industry-wide standards for more protective management practices. These effects, both negative and positive, will be expressed most strongly in rural areas where these industries occur, and therefore somewhat in contrast to human population density.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the rangewide status of the species and critical habitat (Section 2.2) and environmental baseline (Section 2.3).

In summary, resource-based activities such as timber harvest, agriculture, mining, shipping, and energy development are likely to continue to exert an influence on the quality of habitat in the action area. The intensity of this influence is difficult to predict and is dependent on many social and economic factors. However, the adoption of industry-wide standards to reduce environmental impacts and the shift away from resource extraction to a mixed manufacturing and technology based economy should result in a gradual decrease in influence over time. In contrast, the population of Oregon is expected to increase in the next several decades with a corresponding increase in natural resource consumption. Additional residential and commercial development and a general increase in human activities are expected to cause localized degradation of freshwater and estuarine habitat. Interest in restoration activities is also increasing as is environmental awareness among the public. When these influences are considered collectively, we expect trends in habitat quality to remain flat or improve gradually over time. This will, at best, have positive influence on population abundance and productivity for the species affected by this consultation. In a worst cases scenario, we expect cumulative effects will have a relatively neutral effect on population abundance trends. Similarly, we expect the quality and function of critical habitat PBFs to express a slightly positive to neutral trend over time as a result of the cumulative effects.

2.6 Integration and Synthesis

The Integration and Synthesis section is the final step of NMFS's assessment of the risk posed to species and critical habitat because of implementing the proposed program. In this section, we add the effects of the action (Section 2.4) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5) to formulate the agency's biological opinion as to whether the proposed program is likely to: (1) Result in appreciable reductions in the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the status of the species and critical habitat (Section 2.2).

2.6.1 Synthesis of the Analysis of Listed Species

The status of each salmonid and steelhead species addressed by this consultation varies considerably from very high risk (SR sockeye salmon) to moderate risk (*e.g.*, OC coho salmon, MCR steelhead). Similarly, the hundreds of individual populations affected by the proposed program vary considerably in their biological status. The species addressed in this opinion have declined due to numerous factors. The one factor for decline all these species share is degradation of freshwater and estuarine habitat. Human development has caused significant negative changes to stream and estuary habitat across the range of these species.

Eulachon population abundance has declined significantly since the early 1990s. Although NMFS considers variation in ocean productivity to be the most important natural phenomenon affecting the productivity of these species, NMFS identified many other factors associated with the freshwater phase of their life cycle that are also limiting the recovery of these species. These factors include, but are not limited to, elevated water temperatures; excessive sediment; reduced access to spawning and rearing areas; reductions in habitat complexity, instream wood, and channel stability; degraded floodplain structure and function, and reduced flow.

Green sturgeon generally migrate in coastal waters of Oregon, entering estuaries of the program action area to feed and grow. Limiting factors of green sturgeon within the action area include the lack of water quantity, poor water quality and poaching.

The environmental baseline has been degraded by the effects of past land and water use, road construction, forest management, agriculture, mining, transportation, urbanization, and water development. The severity of disturbance varies across the action area. Climate change is likely to exacerbate several of the ongoing habitat issues, in particular, increased summer temperatures, decreased summer flows in the freshwater environment, ocean acidification, and sea level rise in the estuarine environment.

The programmatic nature of the proposed action prevents a precise analysis of each project eventually authorized, funded, or implemented under this opinion. Though, each project must be carried out using carefully designed PDCs that ensure environmental outcomes of each activity can be readily predicted in a manner that enables a comprehensive synthesis of the effects of carrying out the program.

As described in the analysis of the effects of the action (Section 2.4), the proposed activities will cause short-term, localized, and minor adverse effects while providing significant improvement of habitat function and value for the long-term. The adverse effects will likely kill or injure juvenile salmon and steelhead, mostly from isolation of in-water work areas. The resulting reduction of adult equivalents is far too few to change population-level VSP characteristics. Over the long-term, projects carried out under the program will contribute to a lessening of many of the factors limiting the recovery of these species, particularly those factors related to fish passage, degraded floodplain connectivity, and improvement of ecological conditions over the currently-degraded environmental baseline. The number of additional adults produced every ensuing year from restored habitats will exceed those lost during the construction year.

These conclusions also hold true for eulachon and green sturgeon. However, they are less likely to be caught in work area isolation events and green sturgeon are likely to be far less sensitive to suspended solids than salmonids.

Because the likely adverse effects of any project authorized, funded, or implemented under this opinion will not adversely affect the viable population characteristics of any salmonid, eulachon, or green population, the proposed program will not have any measurable effect on population-level abundance, productivity, or ability to recover.

Cumulative effects described in Section 2.5 are likely to have a neutral to slightly positive effect over time effects on salmon, steelhead, eulachon, and green sturgeon population abundance, productivity, and spatial structure. Resource-based activities will continue to adversely affect species, but industry-wide standards and shifts away from resource extraction will gradual decrease their effects over time. Human population of Oregon is expected to continue to increase causing localized degradation. Restoration activities and the public's growing environmental awareness will reduce the effects.

At the ESU or species scale, the status of individual populations determines the ability of the species to sustain itself or persist well into the future, thus impacts to the populations are important to the survival and recovery of the species. Because the adverse effects are small and mostly temporary and the proposed activities provide significant improvement of habitat function and value for the long-term, when we add them to the current population status, environmental baseline, and consider cumulative effects and climate change, we find the proposed program will not appreciably reduce the likelihood of the survival or recovery of any species at the population scale for any one of the populations. Given our conclusion that the populations will not be impeded in recovery as a result of the proposed program, it will also not appreciably reduce the likelihood of the survival or recovery of any species at the ESU level.

2.6.2 Synthesis of the Analysis of Critical Habitat

Tidal areas in the program action area are designated as critical habitat for ESA-listed salmon, steelhead. CHART teams determined that most designated critical habitat for ESA-listed species has a high conservation value, based largely on its restoration potential. Some estuaries are also designated critical habitat for eulachon and/or green sturgeon.

Baseline conditions for PBFs vary widely, from poor to excellent. Climate change and human development have and continue to adversely impact critical habitat creating limiting factors and threats to the recovery of the ESA listed species. Climate change will likely result in a generally negative trend for stream flow and temperature. Information in Section 2.3 described the environmental baseline in the action area. The NMFS determined the environmental baseline is degraded due to one or more impaired aquatic habitat functions related to factors limiting the recovery of the species.

In the analysis of the effects of the action on critical habitat PBFs, we found the proposed activities will cause short-term, localized, and minor adverse effects while providing significant improvement of habitat function and value for the long-term. Therefore, the proposed program will contribute to lessening of the factors limiting the recovery of these species. By contributing to improve the critical habitat PBFs, this proposed program will, over the long-term, improve PBF site conditions that support various life history events.

As described in Section 2.5, the cumulative effects are likely to have a neutral to slightly positive influence on critical habitat PBFs. Resource-based activities will continue to adversely affect species, but industry-wide standards and shifts away from resource extraction will gradual decrease their effects over time. Human population of Oregon is expected to continue to increase causing localized degradation. Restoration activities and the public's growing environmental awareness will reduce the effects.

Based on the above analysis, when considered in light of the status of the critical habitat, the effects of the proposed action, when added to the effects of the environmental baseline, and anticipated cumulative effects and climate change, the proposed program will not appreciably diminish the value of critical habitat for the conservation of the species at the critical habitat unit scale. Consequently, since the proposed program will not appreciably diminish the value of critical habitat for the conservation of the species at the critical habitat unit scale, it will not diminish the value of the critical habitat at the designation level and will retain its current ability to play the intended conservation role.

2.7 Conclusion

After reviewing the current status of the listed species, the environmental baseline within the action area, the effects of the proposed action, and cumulative effects, it is NMFS's biological opinion that the proposed program is not likely to jeopardize the continued existence of LCR Chinook salmon, UWR spring-run Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, CR chum salmon, LCR coho salmon, OC coho salmon, SONCC coho salmon, SR sockeye salmon, LCR steelhead, UWR steelhead, MCR steelhead, UCR steelhead, SRB steelhead, green sturgeon, or eulachon, or result in the destruction or adverse modification of critical habitat that has been designated for these species.

2.8 Incidental Take Statement

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

2.8.1 Amount or Extent of Take

Work necessary for construction of projects authorized, funded, or implemented under the Tidal Area Restoration Programmatic will take place within and adjacent to aquatic habitats reasonably certain to be occupied by ESA-listed species. Juvenile life stages of salmon and steelhead are most likely to be affected, although adult salmon and steelhead, as well as eulachon and green sturgeon will sometimes also be present. The proposed program is reasonably certain to cause incidental take of one or more of those species as: Capture during work area isolation; and harm from impairing habitat with construction-related activities, tidegate operation, herbicide application, and stormwater runoff. This take will typically occur within an area that includes the channel network and wetland footprint of each project, and downstream for pathways that are caused by diminished water quality.

Capture of juvenile fish during work area isolation

The NMFS does not anticipate that any adult salmon or steelhead, green sturgeon or eulachon will be captured as a result of work necessary to isolate in-water construction areas. As described in Section 2.4.2, the number of juvenile salmon and steelhead captured per year will be up to 2,970 in the WLC domain, 3,630 in the OC salmon domain, and 1,980 in the SONCC salmon domain (Table 6). This capture results in take even though the vast majority of the fish will be released uninjured. In the WLC domain, several ESUs of steelhead, coho salmon, and Chinook salmon mix together. Because individuals from different ESUs of the same salmonid type are not easily distinguishable, it is not possible to assign take to individual ESUs. In addition, it is not possible to monitor the exact number of fish that die as a result of handling because much of it happens after release (but there is a relationship between the number of fish handled and the number that die). Therefore, the amount of take exempted under this ITS for each action agency is the capture and handling of juvenile salmonids specified in Table 7.

Table 7. Number of salmon and steelhead captured and handled by action agency in each recovery domain, per year.

Action Agency	Recovery Domain/Species		
	WLC/All	OC coho salmon	SONCC coho salmon
Corps	2,310	2,310	1,320
FWHA	264	924	264
FEMA	396	396	396

Harm from impairing habitat

Take caused by the habitat-related effects of this program cannot be accurately quantified as a number of fish because the distribution and abundance of fish that occur within an project area are affected by habitat quality, competition, predation, and the interaction of processes that influence genetic, population, and environmental characteristics. These biotic and environmental processes interact in ways that may be random or directional, and may operate across far broader temporal and spatial scales than are affected by projects that will be completed under the proposed program. Thus, the distribution and abundance of fish within the program action area cannot be attributed entirely to habitat conditions, nor can we precisely predict the number of fish that are reasonably certain to be injured or killed if their habitat is modified or degraded by projects that will be completed under the proposed program. Additionally, there is no practical way to count the number of fish exposed to the adverse effects of the proposed program without causing additional stress and injury. In such circumstances, we use the causal link established between the activity and the likely changes in habitat conditions affecting the listed species to describe the extent of take as a numerical level of habitat disturbance.

Construction-related disturbance of stream and wetland areas. The best available indicator for the extent of take caused due to construction-related disturbance of stream and wetland areas is the distance of visible suspended sediment increase. This variable is proportional to the short-term habitat impairment individual projects will cause, including other water quality parameters and effects from riparian and channel disturbance. It has a causal link to the amount of harm because the distance of visible increased suspended sediment is proportional to the size of the disturbance which in turn reflects the number of fish that will be injured or killed.

The extent of take will be exceeded if the turbidity plume generated by construction activities is visible above background levels, about a 10% increase in natural stream turbidity, downstream from the project area source as follows: A visible increase in suspended sediment 300 feet from the discharge point or nonpoint source.

Tide/flood gate operation. When tide/flood gates are partially or completely closed they can be barriers to fish migration, even when the structure is designed to meet fish passage criteria. Tide/flood gates reduce the quality and quantity of fish habitat above them (Greene *et al*. 2017). Water quality parameters negatively affected by tide/flood gates include salinity, dissolved oxygen, sediment, and temperature (Greene *et al*. 2017). High tide water surface elevations above tide gates were reduced by 50% to 65%, compared to downstream sites (Greene *et al*. 2012). We cannot quantify the amount of incidental take from tide/flood gate operation for the reasons outlined above.

The best available indicator for the extent of take caused due to tide/flood gate operation is the number of tide/flood gates installed or retrofitted. We expect many projects covered under this program will include multiple tide/flood gate replacements and retrofits. To account for this we assume an average of three tide/flood gates per project. Therefore, the amount of take exempted under this ITS for each action agency is the number of tide/flood gates replaced or retrofitted as specified in Table 8.

Table 7. Number of tide/flood gates installed or retrofitted by action agency in each recovery domain, per year.

Recovery Domain	Corps	FWHA	FEMA
WLC	105	12	18
OC	105	42	18
SONCC	60	12	18

The number tide/flood gates installed or retrofitted has a causal link to the amount of harm because of the direct correlation between it and the amount of fish passage blockage and habitat reduction.

Application of herbicides to control invasive and non-native plant species. Application of manual, mechanical, biological or chemical plant controls will result in short-term reduction of vegetative cover, soil disturbance, and degradation of water quality, which is reasonably certain to cause injury to fish in the form of sublethal adverse physiological effects. This is particularly true for herbicide applications in riparian areas or in ditches that may deliver herbicides to streams occupied by listed salmonids. These sublethal effects, described in the effects analysis for this opinion, will include increased respiration, reduced feeding success, and subtle behavioral changes that can result in predation. We cannot quantify the amount of incidental take from tide/flood gate operation for the reasons outlined above.

Direct measurement of herbicide transport using the most commonly accepted method of residue analysis, *e.g.*, liquid chromatography–mass spectrometry (Pico *et al.* 2004) is impracticable for the type and scale of herbicide applications proposed. Thus, use of those measurements in this take statement as an extent of take indicator is likely to outweigh any benefits of using herbicide as a simple and economical restoration tool, and act as an insurmountable disincentive to their use for noxious plant control. Further, the use of simpler, indirect methods, such as olfactometric tests, do not correlate well with measured levels of the airborne pesticides, and may raise ethical questions (Brown *et al.* 2000) that cannot be resolved in consultation.

Therefore, the best available indicator for the extent of take due to the proposed invasive plant control is the annual limitation on the extent of treated areas, *i.e.*, less than, or equal to, 1% of the acres of riparian habitat within a 6^{th-}field HUC per year (PDC 23d). The area over which herbicides will be applied has a causal link to the amount of take expected given the design criteria and best management practices for herbicide application. This is because as the amount of area treated increases, the area of disturbance increases and the amount of chemical applied generally increases, raising the chance that some of that chemical will reach water occupied by listed species. This take indicator functions as an effective reinitiation trigger because it is calculated and monitored on an annual basis, and thus will serve as a check on the proposed program on a regular basis.

Stormwater runoff. Stormwater runoff from impervious surfaces will result in delivering a wide variety of pollutants to aquatic ecosystems, such as nutrients, metals, petroleum-related compounds, and sediment washed off the road surface. Stormwater contaminant inputs are reasonably certain to cause injury to fish by causing a variety of lethal and sublethal effects, including disrupted behavior, reduced olfactory function, immune suppression, reduced growth, disrupted smoltification, hormone disruption, disrupted reproduction, cellular damage, and physical and developmental abnormalities (Fresh *et al.* 2005; Hecht *et al.* 2007; Lower Columbia River Estuary Partnership 2007). We cannot quantify the amount of incidental take from tide/flood gate operation for the reasons outlined above.

In the context of this programmatic consultation, the best available take indicator reflects the stormwater management requirements and practices we assumed in analyzing the stormwater effects of the proposed program. The extent of take surrogate for stormwater effects is as follows:

A. For each project that requires post-construction stormwater management, the responsible action agency shall ensure completion of a stormwater management plan that is reviewed by NMFS to verify it is adequate in minimizing adverse effects from stormwater runoff.
B. For each project that requires post-construction stormwater management, the responsible action agency shall submit the Stormwater Information Worksheet in Appendix A of this opinion along with the stormwater management plan before authorizing, funding, or implementing the project.
C. The responsible party for monitoring and maintenance shall inspect and maintain stormwater facilities to assure that the stormwater treatment system continues to reduce the concentration of pollutants in stormwater runoff as designed.

There is a causal link between the three parts of this surrogate and the extent of take because they correlate with the level of stormwater treatment assumed in the opinion; any non-compliance with the stormwater plan requirements will result in take at levels that was not analyzed in the opinion. Although plan completion and verification are somewhat coextensive with the proposed action, they nevertheless function as meaningful reinitiation triggers because the action agencies and NMFS can track them in real time and it will be obvious if and when these indicators are exceeded.

2.8.2 Effect of the Take

In Section 2.7, we determined that the level of anticipated take, coupled with other effects of the proposed program, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.8.3 Reasonable and Prudent Measures

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

The action agencies shall:

1. Minimize incidental take by ensuring that all projects use the PDCs described in the proposed action and analyzed in this opinion, as appropriate.
2. Ensure completion of a comprehensive monitoring and reporting program regarding all projects authorized, funded or implemented.

2.8.4 Terms and Conditions

The terms and conditions described below are non-discretionary. The action agencies, or any other party affected by these terms and conditions, must comply with them to implement the reasonable and prudent measures (50 CFR 402.14). The action agencies have a continuing duty to monitor the impacts of incidental take and must report the progress of the program and its impact on the species as specified in this incidental take statement (50 CFR 402.14). If the following terms and conditions are not complied with, the protective coverage of section 7(o)(2) will likely lapse.

1. To implement reasonable and prudent measure #1 (implementation of PDCs), the action agencies shall ensure that:
   a. Every project authorized, funded, or implemented under this opinion will be administered consistent with conservation measures 1 through 7.
   b. For each project involving construction, add conservation measures 8 through 29, as appropriate, as conditions on authorization or funding. For projects implemented by the action agency, ensure conservation measures 8 through 29, as appropriate, are implemented.
   c. For each category of activity, the action agencies apply criteria 30 through 41, as appropriate.

2. To implement reasonable and prudent measure #2 (monitoring and reporting), the action agencies shall ensure that:
   a. The following notifications and reports (Appendix A) are submitted to NMFS for each project to be completed under this opinion. All notifications and reports are to be submitted electronically to NMFS at tarp.wcr@noaa.gov.
      i. Project notification at least 30-days before start of construction (Part 1). Early coordination is required for some complex activity categories.
      ii. Project completion within 90-days of end of construction (Part 1 with Part 2 completed).
      iii. Fish salvage within 90-days of work area isolation with fish capture (Part 1 with Part 3 completed).
   b. The action agencies will each submit a monitoring report to NMFS by March 15 each year that describes their implementation of the proposed program. The report will include an assessment of overall program activity, a map showing the location and category of each project authorized, funded or implemented under this opinion, and any other data or analyses the agency deems necessary or helpful to assess habitat trends as a result of projects authorized under this opinion.
   c. The action agencies will each attend an annual coordination meeting with NMFS by May 15 each year to discuss the annual monitoring reports and any projects that will improve conservation under this opinion, or make the program more efficient or more accountable.
   d. For all projects that require post-construction stormwater management, the action agencies submit the Stormwater Information Worksheet in Appendix A of this opinion along with the stormwater management plan before any authorization, funding, or implementing of that project.
   e. For all projects that require water quality observations to ensure that any increases in suspended sediment do not exceed background levels, the action agencies will ensure:
      i. Turbidity sampling using an appropriately and regularly calibrated turbidimeter, or a visual turbidity observation, every four hours when work is being completed, or more often as necessary to ensure that the in-

water work area is not contributing visible sediment to water, at a relatively undisturbed area approximately 100 feet upstream from the project area. Record the observation, location, and time before monitoring at the downstream point.

ii. Take a second visual observation, immediately after each upstream observation, approximately 300 feet downstream from the discharge point or nonpoint source. Record the downstream observation, location, and time.

iii. Compare the upstream and downstream observations. If more turbidity or pollutants are visible downstream than upstream, the activity must be modified to reduce pollution. Continue to monitor every four hours.

iv. If the exceedance continues after the second monitoring interval (after 8 hours), the activity must stop until turbidity returns to background levels.

f. Failure to provide timely reporting may constitute a modification having an effect to listed species or critical habitat not considered in the biological opinion and thus may require reinitiation of this consultation.

2.9 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02). The following conservation recommendation is a discretionary measure that we believes is consistent with this obligation and therefore should be carried out by the action agencies:

- The effectiveness of some stream restoration activities are not well documented, partly because decisions about which restoration activity deserve support do not always address the underlying processes that led to habitat loss. We recommend the action agencies use species' recovery plans to help ensure that their projects will address the underlying processes that limit fish recovery. Most of these plans are currently available in final or draft form at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/Draft-Plans.cfm.

Please notify us if the action agency carries out this recommendations so we will be kept informed of actions that minimize or avoid adverse effects and those that benefit the listed species or their designated critical habitats.

2.10 Reinitiation of Consultation

This concludes formal consultation for the Tidal Area Restoration Programmatic.

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

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

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 descriptions of EFH for Pacific Coast groundfish (PFMC 2005), coastal pelagic species (PFMC 1998), and Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC) and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

The proposed program and action area for this consultation are described in the Introduction to this document. The program action area includes areas designated as EFH for various life-history stages of groundfish, coastal pelagic species, and Pacific Coast salmon (Chinook, chum, and coho salmon). In addition, estuaries are defined as habitat areas of particular concern (HAPCs).

3.2 Adverse Effects on Essential Fish Habitat

See Section 2.4 of the biological opinion for a description of the adverse effects on eulachon, Green sturgeon, and Pacific salmon. The effects of the action on Pacific Coast Salmon EFH are similar to those described above in the ESA portion of this document. Based on information provided by the action agencies and the analysis of effects presented in the ESA portion of this document, we conclude that the proposed action will have the following adverse effects on EFH designated for Pacific Coast salmon, groundfish, and coastal pelagic species in tidal areas, including estuarine areas designated as HAPCs.

1. Free passage – Short-term decrease due to water quality impairment and in-water work isolation; long-term increase due improved floodplain connectivity, water quality,

riparian conditions, and streambank conditions. Replaced or retrofitted tide/flood gates will meet fish passage criteria, but will not pass fish as well as open channels.

2. Water quality – Short-term increase in suspended sediment due to riparian and channel disturbance and contaminants due to heavy equipment and herbicide use. Long-term improvement due to improved channel and floodplain functions. Stormwater contaminants will still be delivered to streams by impervious surfaces (when present), but treatment requirements will reduce their concentrations from baseline conditions.
3. Water quantity – Brief and minor reductions in flow (less than 10 percent of the available flow for only as long as it takes to fill a desired tank) due to construction needs and livestock watering facilities.
4. Natural cover – Short-term decrease due to riparian and channel disturbance; long-term increase due to restored functions of channels, streambanks, and floodplains.
5. Forage – Short-term decrease due to riparian and channel disturbance. Long-term increase due to improved riparian conditions and restored functions of channels, streambanks, and floodplains.
6. Sediment quality – Short-term decrease due to stream and river-bottom disturbance.

3.3 Essential Fish Habitat Conservation Recommendations

The following conservation recommendations are necessary to avoid, mitigate, or offset the impact of the proposed action on EFH:

1. Ensure completion of a monitoring and reporting program as described in term and condition numbers 1 and 2 in the accompanying opinion to verify the project is meeting its objective of minimizing habitat modification from funded activities.
2. As appropriate to each project authorized, funded, or implemented under this opinion, include the PDCs for general construction and categories of activities (*i.e.*, 8 through 41) as conditions of the project, except 22 (fish capture and release).

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the action agencies 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 verification of the action if the response is inconsistent with any of NMFS's 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, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

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

3.5 Supplemental Consultation

The action agencies 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 document is helpful, serviceable, and beneficial to the intended users. The intended users are the Federal action agencies (the Corps, FHWA, and FEMA). Other interested users could include applicants, State of Oregon, citizens of affected areas, and others interested in conservation of the affected species and restoration of their habitats. Individual copies of this opinion were provided to the Corps, FHWA, and FEMA. The format and naming adheres to conventional standards for style.

4.2 Integrity

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

4.3 Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

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Appendix A: Guidelines and Implementation Sheets

EMAIL GUIDELINES

The programmatic e-mail box (tarp.wcr@noaa.gov) is to be used for projects submitted to the National Marine Fisheries Service (NMFS) for inclusion in **the Tidal Area Restoration Programmatic opinion.**

The action agencies must ensure to avoid multiple submittals and withdrawals. In rare occurrences, a withdrawal may be necessary and unavoidable. In this situation, please specify in the e-mail subject line that the project is being withdrawn. There is no implementation sheet for a withdrawal, simply state the reason for the withdrawal and submit to the e-mail box, following the email titling conventions. If a previously withdrawn notification is resubmitted later, this resubmittal will be regarded as a new action notification.

An automatic reply will be sent upon receipt, but no other communication will be sent from the programmatic e-mail box; this box is used for **Incoming Mail Only**. All other pre-decisional communication should be conducted **outside** the use of the tarp.wcr@noaa.gov e-mail.

The action agencies will send only **one** project per e-mail submittal, and will attach all related documents. These documents will include the following:

1. Action Notification, Action Completion, and Fish Salvage and Stormwater Information (if fish salvage and/or stormwater treatment are conducted).
2. Map(s) and project design drawings.
3. Final project plan.
4. The joint-permit application if a corps permit is associated with the project.

The action agencies shall ensure that NMFS receives a Fish Salvage report (if fish salvage is conducted) and Action Completion Report, within 90 days after in-water work completion.

E-mail Titling Conventions

In the subject line of the email (see below for requirements), clearly identify the programmatic you are submitting under (**TARP**), the specific submittal type (pre-notification coordination, 30-day verification, no verification, project completion, withdrawal, or salvage report), the action agency, project number, project names, 6th field HUC, county, and state.

Use caution when entering the necessary information in the subject line. **If these titling conventions are not used, the e-mail will not be accepted.** Ensure that you clearly identify:

1. Which programmatic you are submitting under (**TARP).**
2. The specific submittal category (pre-notification coordination, 30-day verification, no verification, action completion, withdrawal, or salvage report);
3. Action agency
4. Project number;
5. Project name;
6. 6th field HUC;
7. County; and
8. State.

Examples:

> <u>*Pre-Notification Coordination*</u>
>
> > *TARP-Pre-Notification Coordination, Corps of Engineers, NWP-2018-999, Winchester Creek Tidegate Replacement, 171003040306 (South Slough) Coos County, Oregon*
>
> <u>*Action Notification - Verification*</u>
>
> > *TARP-30 Day Notification - Verification, FEMA, DR-9999-OR, Winchester Creek Tidegate Replacement, 171003040306 (South Slough) Coos County, Oregon*
>
> <u>*Action Notification – No Verification*</u>
>
> > *TARP-30 Day Notification – No Verification, FHWA, Key Number 99999, Winchester Creek Tidegate Replacement, 171003040306 (South Slough) Coos County, Oregon*
>
> <u>*Project Completion*</u>
> > *TARP-Completion Report, FHWA, Key Number 99999, Winchester Creek Tidegate Replacement, 171003040306 (South Slough) Coos County, Oregon*
>
> <u>*Salvage Report*</u>
> > *TARP-Salvage Report, Corps of Engineers, NWP-2018-999, Winchester Creek Tidegate Replacement, 171003040306 (South Slough) Coos County, Oregon*
>
> <u>*Withdrawal*</u>
> > *TARP-Withdrawal, FEMA, DR-9999-OR, Winchester Creek Tidegate Replacement, 171003040306 (South Slough) Coos County, Oregon*

Project Description

Please provide enough information for NMFS to be able to determine the effects of the action and whether the project fits the **TARP** criteria. Attach additional sheets if necessary. The project description should include information such as (but not limited to):

- Proposed in-water work including timing and duration
- Work area isolation and salvage plan including pumping, screening, electroshocking, fish handling, *etc*.
- Discussion of alternatives considered including rationale for why it was not selected.

Action Notification Instructions

<u>NMFS Review and Verification</u>. The action agency project manager shall submit the below implementation sheet for every project submitted along with the stormwater information worksheet (if applicable), with the Action Notification portion completed, to NMFS at *tarp.wcr@noaa.gov* for notification or verification.

<u>The Following Actions Require Pre-Notification Coordination with NMFS.</u> The action agency will ensure adequate time (at least 30 days) for coordination with NMFS on any project with any of the following categories or activities prior to submission of the notification form to NMFS:.

a. Tide/flood gate removal, replacement or retrofit projects
b. Channel reconstruction/relocation
c. Dam removal
d. Off- and side-channel habitat restoration
e. LW or ELJs that occupy >25% of the bankfull area
f. Alluvium placement projects that occupy more than 25% of the channel bed or more than 25% of the bankfull cross sectional area
g. Livestock stream crossing using a bridge or culvert
h. Fish screen for pump intake(s) to dewater at a rate >3 cfs
i. Any project that uses "flexible uplift"
j. Precedent or policy setting activities, such as the application of new technology

<u>The Following Actions Require Verification from NMFS.</u> NMFS will notify FEMA within 30 calendar days if the actions are verified or disqualified.

a. Tide/flood gate replacement or retrofit projects
b. Channel reconstruction/relocation
c. Off- and side-channel habitat restoration
d. Installation of pilings
e. Dam and legacy structure removal
f. "Flexible uplift"
g. LW and ELJs that occupy >25% of the bankfull area
h. Alluvium placement projects that occupy more than 25% of the channel bed or more than 25% of the bankfull cross sectional area
i. Livestock stream crossing without using a bridge or culvert (ford)
j. Piling installation
k. Beaver dam analogs
l. Temporary safety stabilization
m. Any earthwork at an U.S. Environmental Protection Agency (EPA)-designated Superfund Site, a state-designated clean-up area, or in the likely impact zone of a significant contaminant source, as identified by historical information or best professional judgment

Attach the following information to e-mail message if required or relevant to NMFS's review:

- Erosion and pollution control plan
- Engineering designs

- Site assessment for contaminants to identify the type, quantity, and extent of any potential contamination
- Stormwater management plan

The Following Actions Do Not Require Verification from NMFS. For the following categories of activities, when the project does not include any of the verification-required activities above, the action agency will submit an Action Notification Form, but is not required to wait for NMFS verification:

a. Tide/flood gate removal
b. Set-back or removal of dikes and levees
c. LW and ELJs that occupy <25% of the bankfull area
d. Streambank restoration
e. Livestock fencing and off-channel livestock watering facilities
f. Piling and other structure removal
g. Beaver habitat restoration without beaver dam analogs
h. Wetland restoration

Project Reporting. The Action Agency project manager shall submit the following reports as necessary:

> **Action Completion Reporting.** It is the action agency project manager's responsibility to submit this form within 90 days of completing all work to NMFS at *tarp.wcr@noaa.gov*.
>
> **Fish Salvage Reporting.** It is the action agency project manager's responsibility to submit this form within 90 days of completing a salvage to NMFS at *tarp.wcr@noaa.gov*.

TARP Action Notification Form

DATE OR REQUEST:		**NMFS TRACKING #: WCR-2018-8958**	
TYPE OF REQUEST:	☐ PRE-NOTIFICATION COORDINATION ☐ ACTION NOTIFICATION (VERIFICATION REQUIRED) ☐ ACTION NOTIFICATION (NO VERIFICATION)		
Statutory Authority:	☐ ESA ONLY	☐ EFH ONLY ☐ ESA & EFH COMBINED	
Lead Action Agency:		Action Agency ID #:	Corps Permit #:
Action Agency Contact:			
Applicant:		DSL Permit #:	
Project Name:			
Latitude & Longitude: (Degrees Decimal)			
6th-Field HUC & Name:			
Proposed Construction Period:	***Start Date:***		***End Date:***
Does action include a tide/flood gate? (Y/N) If so, are water management and maintenance plans included? (Y/N):			
Proposed area of herbicide application (acres):			
Is stormwater treatment required? (Y/N) If so, is a stormwater plan included? (Y/N):			

Project Description:

Type of Action:
Identify the type of action proposed.

Actions Not Requiring **Verification** from NMFS:

☐ Tide/flood gate removal
☐ Set-back or removal of dikes and levees
☐ LW and ELJs occupying <25% of bankfull
☐ Streambank restoration
☐ Beaver habitat restoration without BDAs
☐ Piling and other structure removal
☐ Wetland Restoration
☐ Livestock fencing and off-channel livestock watering facilities
☐ Livestock stream crossing without using a bridge or culvert (ford)

Actions Requiring **Verification** from NMFS:

☐ *Tide/flood gate replacement or retrofit
☐ *Channel reconstruction/relocation
☐ *Off- and side-channel habitat restoration
☐ Pile installation
☐ *Dam and legacy structure removal
☐ *"Flexible uplift"
☐ *LW placement that occupies >25% of the bankfull cross section area
☐ Alluvium placement projects that occupy more than 25% of the channel bed or more than 25% of the bankfull cross sectional area
☐ *Livestock stream crossing using a bridge or culvert
☐ Beaver dam analogs
☐ Temporary safety stabilization
☐ Any earthwork at an U.S. Environmental Protection Agency (EPA)-designated Superfund Site, a state-designated clean-up area, or in the likely impact zone of a significant contaminant Source.

* These activities require 30-day pre-notification coordination with NMFS

NMFS Species/Critical Habitat Present in Action Area:
Identify the species or designated critical habitat found in the action area:

ESA Species

☐ LCR Chinook	☐ LCR coho	☐ LCR steelhead
☐ UWR spring-run Chinook	☐ OC coho	☐ UWR steelhead
☐ UCR spring-run Chinook	☐ SONCC coho	☐ MCR steelhead
☐ SR spring/summer run Chinook	☐ SR sockeye	☐ UCR steelhead
☐ SR fall-run Chinook	☐ Green sturgeon	☐ SR steelhead
☐ Columbia River chum	☐ Eulachon	

EFH

☐ Pacific Coast Salmon
☐ Coastal Pelagic Species
☐ Pacific Coast groundfish

Project Design Criteria:

Check the Project Design Criteria from the biological opinion that apply to this proposed action. Please attach all appropriate plan(s) for this proposed action including, but not limited to: design plans, any revegetation or "flexible uplift" plans, water management plans, and any related stormwater treatment design plans. In general, a minimum of at least 30% completed design plan(s) plans are required for projects that do not involve any in-water work, and a minimum of at 50% completed design plan(s) is typically required for any projects that include in-water work. Some projects that involve complex designs or extensive disturbance may require near 100% design. When in doubt of what is required we recommend contacting NMFS staff for direction.

General Construction Measures ☐ Site assessment for contaminants ☐ Site layout and flagging ☐ Staging, storage, and stockpile areas ☐ Erosion control ☐ Hazardous material spill prevention and control ☐ Equipment, vehicles, power tools ☐ Temporary access roads and paths ☐ Dust abatement ☐ Temporary stream crossings ☐ Surface water withdrawal ☐ Construction discharge water ☐ Fish passage ☐ Timing of in-water work ☐ Work area isolation ☐ Fish screens ☐ Fish capture and release ☐ Invasive and non-native plant control ☐ Pile installation ☐ Pesticide and preservative-treated wood ☐ Broken or intractable pile ☐ Post-construction stormwater management ☐ Site restoration ☐ Revegetation ☐ "Flexible uplift" ☐ Pollution and erosion control	30. Tide/Flood Gate Removal, Replacement, or Retrofit ☐ Fish passage review ☐ Baseline conditions ☐ Benefit summary ☐ Full tidal exchange ☐ Water management plan ☐ Maintenance plan 31. Set-Back or Removal of Existing Dikes, or Levees ☐ Floodplain and freshwater delta criteria ☐ Estuary criteria 32. Large Wood and Engineered Logjams ☐ Large wood design criteria ☐ Engineered logjam criteria 33. Dam and Legacy Structure Removal ☐ Dam removal design criteria ☐ Legacy structure criteria 34. Channel Reconstruction/ Relocation ☐ Fish passage review ☐ Design criteria ☐ Monitoring 35. Off- and side-channel restoration ☐ Fish passage review ☐ Data requirements ☐ Allowable excavation ☐ Excavation depth ☐ Material disposal	36. Streambank Restoration ☐ Natural slope ☐ Include large wood ☐ Stabilization methods ☐ Use of rock ☐ Alluvium placement ☐ Roughened toe 37. Livestock Fencing, Stream Crossings and Off-Channel Livestock Watering Facilities ☐ Livestock fencing criteria ☐ Livestock stream crossing criteria ☐ Off-channel watering facility criteria 38. Piling and other Structure Removal ☐ Piling removal criteria ☐ Broken pile criteria 39. Beaver Habitat Restoration ☐ Restoration action design ☐ Consistency with Beaver Restoration Guidebook ☐ Beaver dam analog criteria ☐ Other beaver habitat restoration 40. Wetland Restoration ☐ General construction measures 41. Temporary safety stabilization ☐ Act as necessary ☐ Apply PDCs as practicable ☐ NMFS review ☐ Bring into conformance

Stormwater Information Worksheet

Tidal Area Restoration Programmatic

If you are submitting a project that includes a stormwater plan for review, please fill out the following cover sheet **to be included with** any stormwater management plan and any other supporting materials. Submit this form with the Action Notification Form to NMFS at ***tarp.wcr@noaa.gov***.

Also include a drawing of the stormwater treatment area including drainage areas, direction of flow, BMP locations and types, contributing areas, other drainage features, receiving water/location, etc.

Project Information	**NMFS Project Tracking #:** WCR-2018-8958
County, State:	Agency Project #:
Name of Project:	
Have you contacted anyone at NMFS? ☐ Yes ☐ No If Yes, Who:	
Nearest receiving water potentially occupied by ESA-listed species or designated critical habitat:	
Distance from nearest receiving water potentially occupied by ESA-listed species or designated critical habitat:	
Lat/Long (DDD.dddd) of Project Location:	
Stormwater Design Manual Used and Year/Version: (example: City of Portland 2016 Stormwater Management Manual) Describe which elements of your stormwater plan came from this manual:	
Applicant/Consultant Contact Information	
Name: Email: Phone:	
Stormwater Designer and/or Engineer Contact Information	
Name: Phone: Email:	
Site Characteristics	
Is the site contaminated? If yes, provide investigation results to NMFS. ☐ Yes ☐ No	

Design Storms	
2-year 24-hour Design Storm: (from: NOAA Precipitation Atlas: http://nws.noaa.gov/ohd/hdsc/noaaatlas2.htm)	Inches (box 1)
Water Quality Design Storm (50% of 2-year, 24-hour storm)(box 1 divided by 2):	Inches (box 2)
Water Quantity Design Storm (10-year, 24-hour storm): (from: NOAA Precipitation Atlas: http://www.wrcc.dri.edu/pcpnfreq/or10y24.gif)	Inches (box 3)

Post-Construction Runoff	
Existing Contributing Impervious Area (CIA)[26] including all contiguous surfaces (e.g. roads, driveways, parking lots, sidewalks, roofs, compacted gravel, and similar surfaces): List the type(s) of existing impervious area:	Ft^2 (box 4)
Proposed new impervious area (negative numbers if impervious will be removed): List the type(s) of new impervious area:	Ft^2 (box 5)
Total Contributing Impervious Area (box 4 plus box 5):	Ft^2 (box 6)
Water Quality Volume for Treatment (box 2 divided by 12, multiplied by box 6):	Ft^3 (box 7)
Water Quantity Discharge Rate for Treatment- 50% of 2-year, 24-hour storm (box 2 divided by 86,400, multiplied by box 6): 10-year, 24 hour storm (box 3 divided by 86,400, multiplied by box 6):	 cfs (box 8) cfs (box 9)

Water Quality Information		
Does the project treat 50% of the 2-year 24-hour design storm (box 7)? If no, project may not meet the Project Design Criteria. Please provide justification or proposed "flexible uplift" to offset the deficiency in the stormwater management plan (e.g. discrepancy due to modeling method)	☐ Yes	☐ No
Low Impact Development methods incorporated?	☐ Yes	☐ No
How much of total stormwater is treated using LID:		%

Specific Lid Water Quality Treatment Elements Incorporated

SITE DESIGN ELEMENTS
- ☐ SITE LAYOUT
- ☐ CLUSTERED DEVELOPMENT
- ☐ DE-PAVE EXISTING PAVEMENT
- ☐ CONSERVE SOILS W/ BEST DRAINAGE
- ☐ TREE PROTECTION
- ☐ CONSTRUCTION SEQUENCING
- ☐ REFORESTATION/TREE PLANTING
- ☐ RESTORED SOILS
- ☐ POROUS PAVEMENT

TREATMENT METHODS
- ☐ VEGETATED ROOF
- ☐ INFILTRATION RAIN GARDEN / LID SWALE
- ☐ INFILTRATION STORMWATER PLANTERS
- ☐ SOAKAGE TRENCH
- ☐ DRYWELL
- ☐ WATER QUALITY SWALE
- ☐ VEGETATED FILTER STRIPS
- ☐ LINED RAIN GARDEN/LID SWALE
- ☐ LINED STORMWATER PLANTER

OTHER LID WATER QUALITY TREATMENT METHODS (LIST NAME & SOURCE):

[26] Contributing Impervious Area (CIA) consists of all impervious surfaces within the strict project limits, plus impervious surface owned or operated by the grantee outside the project limits that drain to the project via direct flow or discrete conveyance.

Treatment train, including pretreatment and LID BMPs used to treat water quality: Why this treatment train was chosen for the project site: Page in stormwater plan where more details can be found:

Water Quantity Information		
Does the project discharge directly into a major water body? (if yes, skip this section) (Large waterbody= ocean, estuary, Columbia River, Willamette River) ☐ Yes ☐ No		
Methods used to treat water quantity: Page in stormwater plan where more details can be found:		
Water Quantity Runoff Rates	50% of 2-yr, 24-hour storm:	10-yr storm, 24-hour:
Pre-development rate (boxes 2 and 3 divided by 86,400, multiplied by box 4):	cfs	cfs
Post-development rate (boxes 8 and 9 minus water quantity treatment methods)	cfs	cfs
Are the post-development runoff rates less than or equal to pre-development runoff rates? ☐ Yes ☐ No If no, project may not meet the Project Design Criteria. Please provide justification or proposed "flexible uplift" to offset the deficiency in the stormwater management plan (e.g. discrepancy due to modeling method)		
Specific LID Water Quantity Reduction Elements Incorporated		
MANAGEMENT ELEMENTS ☐ POROUS PAVEMENT ☐ INFILTRATION RAIN GARDEN/LID SWALE ☐ INFILTRATION STORMWATER PLANTERS ☐ SOAKAGE TRENCH ☐ DRYWELL ☐ DOWNSPOUT DISCONNECTION OTHER LID WATER QUALITY TREATMENT METHODS (LIST NAME & SOURCE):		

Maintenance and Inspection Plan	
Have you included a stormwater maintenance plan with a description of the onsite stormwater system, inspection schedule and process, maintenance activities, legal and financial responsibility, and inspection and maintenance logs? Page in stormwater plan where maintenance and inspection description can be found: *Projects cannot be submitted for review without a maintenance and inspection plan.	☐ Yes ☐ No
Contact information for the party/parties that will be legally responsible for performing the inspections and maintenance or the stormwater facilities: Name: ____________________ Phone number: ____________________ Email: ____________________ Name: ____________________ Phone number: ____________________ Email: ____________________ Name: ____________________ Phone number: ____________________ Email: ____________________ Page in stormwater plan where more details can be found:	

ACTION COMPLETION REPORT

The action agency shall submit this form to NMFS at *tarp.wcr@noaa.gov*within 90 days of completing all work below ordinary high water (OHW) for riverine systems or below the highest astronomical tide (HAT) for marine systems.

Agency Action ID #		
Actual Start and End Dates of In-water Work:	*Start*:	*End*:
Were There Fish Salvage Attempts?	☐ Yes (fill in extent of take table and complete salvage form)	☐ No
Was Turbidity Monitoring/Sampling Completed?	☐ Yes (answer #7 below and fill in extent of take table)	☐ No
Were Tide/Flood Gates Replaced or Retrofit?	☐ Yes (answer #8-10 below and fill in extent of take table)	☐ No
Was There Application of Herbicides?	☐ Yes (answer #11 below and fill in extent of take table)	☐ No
Was Stormwater Treatment Required?	☐ Yes (answer #12-13 below and fill in extent of take table)	☐ No

Please include the following:

1. Attach any modification(s) that occurred during construction and provide justification for each modification.
2. Attach photos of habitat conditions before, during, and after action completion.
3. Describe compliance with fish screen criteria for any pump used.
4. Summarize results of pollution and erosion control inspections, including any erosion control failure, contaminant release, and correction effort.
5. Describe site restoration.
6. Attach any “flexible uplift”plan.
7. Describe turbidity monitoring (visual or by turbidimeter) including dates, times and location of monitoring and any exceedances and steps taken to reduce turbidity observed.
8. How many tide/flood gates were replaced or retrofit?
9. For each tide/flood gate replaced or retrofit attach the water management plan.
10. For each tide/flood gate replaced or retrofit attach the inspection and maintenance plan plan.
11. Describe application of herbicides including locations of applications and which chemicals were used.
12. Attached stormwater management plan
13. Attach stormwater facility inspection, maintenance, and recording plan
14. If the project was a temporary safety stabilization, include the following:

a. Nature of structural failure.
b. NMFS staff contacted, with date and time of contact.
c. Description of the actions taken in stabilization.
d. List of the design criteria followed and not followed.
e. Remedial actions necessary to bring the initial stabilization into compliance with design criteria in this opinion.

15. Fill out the Extent of Take Table:

EXTENT OF TAKE TABLE

Recovery domain:	
Number of ESA- listed fish captured	
Were there any suspended sediment (turbidity) exceedences?	
Was each tide/flood gate reviewed by NMFS fish engineers?	
Did each tide/flood gate have a water management plan (if required)?	
Did each tide/flood gate have an inspection and maintenance plan?	
Were herbicide treated areas less than, or equal to, 1% of the acres of riparian habitat within a 6th-field HUC per year?	
Was the stormwater management plan completed and reviewed by NMFS (if required)?	
Was the stormwater information worksheet completed and submitted to NMFS (if required)?	
Is the responsible party for stormwater inspection and maintenance identified?	

FISH SALVAGE REPORT

If applicable: The action agency shall submit a completed Fish Salvage Report and Fish Salvage Data Table (see below) within 90 days of completing a capture and release as part of any action completed under this opinion to NMFS at *tarp.wcr@noaa.gov*.

Agency Action ID #: ______________________

Date(s) of Fish Salvage Operation(s): ______________________

Supervisory Fish Biologist: ______________________

Address: ______________________

Telephone Number: ______________________

<u>Fish Salvage Data</u>

Water Temperature:

Air Temperature:

Time of Day:

ESA-Listed Salmonid Species per Recovery Domain	Number Handled		Number Injured		Number Killed	
	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult
Willamette/Lower Columbia River Domain						
Interior Columbia River Domain						
Oregon Coast Domain						
Southern Oregon/Northern California Coast Domain						
Total						

Describe methods that were used to isolate the work area and remove fish: