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.:
NWR-2013-10411

March 14, 2014

Shawn H. Zinszer, Chief
Regulatory Branch
U.S. Army Corps of Engineers, Portland District
P.O. Box 2946
Portland, Oregon 97208-2946

Joyce Casey, Chief
Environmental Resources Branch
Planning, Programs and Project Management Division
U.S. Army Corps of Engineers, Portland District
P.O. Box 2946
Portland, Oregon 97208-2946

Re: Reinitiation of the Endangered Species Act Section 7 Programmatic Conference and Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Revisions to Standard Local Operating Procedures for Endangered Species to Administer Maintenance or Improvement of Stormwater, Transportation or Utility Actions Authorized or Carried Out by the U.S. Army Corps of Engineers in Oregon (SLOPES for Stormwater, Transportation or Utilities).

Dear Mr. Zinszer and Ms. Casey:

The enclosed document contains a programmatic conference and 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 implementing a proposed revised set of standard local operating procedures used by the U.S. Army Corps of Engineers, Portland District (Corps), to authorize or carry out actions to install, maintain or improve stormwater facilities, or to maintain or improve roads, culverts, bridges or utility lines in Oregon (SLOPES for Stormwater, Transportation or Utilities). This action is in accordance with the Corps' regulatory and civil works authorities under section 10 of the Rivers and Harbors Act of 1899, section 404 of the Clean Water Act of 1972, and sections 1135, 206, and 536 of the Water Resources Development Acts of 1986, 1996, and 2000, respectively. Actions covered in this opinion are modified from those analyzed in the biological opinion issued on August 13, 2008, as summarized in the consultation history section of the opinion.

During this consultation, NMFS concluded that the proposed action is not likely to adversely affect southern resident killer whales *(Orcinus orca)* and their designated critical habitat. Southern resident killer whales do not have critical habitat designated in the program action area. NMFS also concluded that the proposed program is 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 salmon
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 Coasts (SONCC) coho salmon
10. SR sockeye salmon (*O. nerka*)
11. LCR steelhead (*O. mykiss*)
12. UWR steelhead
13. MCR steelhead
14. UCR steelhead
15. Snake River Basin (SRB) steelhead
16. Southern distinct population segment (DPS) green sturgeon *(Acipenser medirostris)*
17. Southern DPS eulachon (*Thaleichthys pacificus*).

As required by section 7 of the ESA, NMFS is 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 agency 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 program's likely effects on essential fish habitat (EFH) pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes three 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 Corps 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, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we request that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

If you have any questions regarding this consultation, please contact Marc Liverman of my staff at 503-231-2336, in the Washington/Oregon Coastal Area Office.

Sincerely,

William W. Stelle, Jr.
Regional Administrator

cc: Natural Resources Conservation Service
Oregon Department of Fish and Wildlife
Oregon Department of Parks and Recreation
Oregon Department of State Lands
Oregon Watershed Enhancement Board

Endangered Species Act – Section 7 Programmatic Consultation Conference and Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation

for

Revised Standard Local Operating Procedures for Endangered Species to Administer Maintenance or Improvement of Stormwater, Transportation, and Utility Actions Authorized or Carried Out by the U.S. Army Corps of Engineers in Oregon (SLOPES for Stormwater, Transportation or Utilities)

NMFS Consultation No.: NWR-2013-10411

Action Agency: U.S. Army Corps of Engineers
Portland District, Operations and Regulatory Branches

Affected Species and Determinations:

ESA-Listed Species	ESA Status	Is the action likely to adversely affect this species or its critical habitat?	Is the action likely to jeopardize this species?	Is the action likely to 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 coasts 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
Southern green sturgeon	T	Yes	No	No
Eulachon	T	Yes	No	No
Southern resident killer whale	T	No	No	N/A

*Critical habitat has been proposed for LCR coho salmon.

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

Consultation
Conducted By: National Marine Fisheries Service
West Coast Region

Issued by:

/for William W. Stelle, Jr.
Regional Administrator

Date Issued: March 14, 2014

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LIST OF ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
CFR	Code of Federal Regulations
CHART	Critical Habitat Analytical Review Team
Corps	U.S. Army Corps of Engineers
CWA	Clean Water Act
DPS	distinct population segment
DQA	Data Quality Act
EFH	essential fish habitat
ELJ	engineered log jam
ESA	Endangered Species Act
FHWA	Federal Highways Administration
FR	Federal Register
HUC_5	fifth-field hydrologic unit code
HQ	hazard quotient
IC	interior Columbia
LCR	lower Columbia River
LW	large wood
MCR	mid Columbia River
MSA	Magnuson – Stevens Act
NMFS	National Marine Fisheries Service
NWP	nationwide permit
OC	Oregon Coast
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OHW	ordinary high water
OTIA	Oregon Transportation Improvement Act
PAH	polycyclic aromatic hydrocarbon
PCE	primary constituent element
PDC	project design criteria
RHA	Rivers and Harbors Act
SLOPES	standard local operating procedures for endangered species
SONCC	Southern Oregon/Northern California Coasts
SR	Snake River
SRB	Snake River Basin
TRT	technical recovery team
UCR	upper Columbia River
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWR	upper Willamette River
VSP	viable salmonid population
WLC	Willamette/lower Columbia
WRDA	Water Resources Development Act

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 conference and biological opinion (opinion) and incidental take statement portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531, *et seq.*), and implementing regulations at 50 CFR 402.

We also completed an essential fish habitat (EFH) consultation, 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.

The opinion, incidental take statement, and EFH conservation recommendations are each in compliance with Data Quality Act (44 U.S.C. 3504(d)(1) *et seq.*) and they underwent pre-dissemination review.

On August 12, 2013, the U.S. Army Corps of Engineers, Portland District (Corps), requested to reinitiate consultation on the Standard Local Operating Procedures for Endangered Species (SLOPES) for the maintenance or improvement of stormwater, transportation or utility actions in Oregon. "SLOPES" refers to the process and criteria that the Corps uses to guide the administration of 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.

Section 1135 of the Water Resources Development Act (WRDA) authorizes the Corps to modify the structure or operation of a Corps project to restore or improve environmental quality and ecosystem functions impaired by that project, provided that the modification does not conflict with the authorized project purposes. Section 206 of WRDA expands this authority to cover construction of projects for the restoration and protection of aquatic ecosystems unrelated to an existing Corps facility. Section 536 of WRDA authorizes studies and ecosystem restoration actions in the Lower Columbia River and Tillamook Bay. The Corps has environmental restoration programs in place, in Oregon, that are authorized by these authorities and are intended to restore habitat for ESA-listed salmon and steelhead.

Nearly all anadromous fish-bearing streams within the Corps' jurisdiction are occupied by ESA-listed salmon and steelhead and designated as EFH for Chinook salmon and coho salmon. Individual ESA and EFH consultation for permits within these streams results in a substantial workload for both the Corps and NMFS, often with little additional benefit to the species. Many of these activities are minor and repetitive in nature, and consultation on them has resulted in the imposition of similar conditions for regulatory approval. Thus, SLOPES provides a mechanism to describe such activities and the conditions under which they will be conducted, in order to provide a basis for an efficient and effective programmatic ESA consultation.

Applications for actions that fall within the parameters of the current SLOPES procedures, and the effects of which fall within the range of effects considered in the associated biological opinion, are issued a permit with corresponding conditions; applications that do not fall within SLOPES or are not found to be within the range of effects, are not covered by the SLOPES biological opinion but can be submitted by the Corps to NMFS for individual, site-specific ESA and EFH consultation.

1.2 Consultation History

Since March 21, 2001, the Portland District has used SLOPES, as described in a series of programmatic biological opinions,[1][2][3][4][5] to guide its review of individual permit requests under

[1] Programmatic Biological Opinion. 15 Categories of Activities Requiring Department of the Army Permits. (refer to:OSB2001-0016) (March 21, 2001); Programmatic Biological Opinion and Magnuson-Stevens Act Essential Fish Habitat Consultation for Standard Local Operating Procedures for Endangered Species (SLOPES) for Certain Activities Requiring Department of Army Permits in Oregon and the North Shore of the Columbia River (refer to OHB2001-0016-PEC) (June 14, 2002).

[2] Letter from D. Robert Lohn, NOAA Fisheries, to Lawrence Evans and Thomas Mueller, U.S. Army Corps of Engineers (August 14, 2002) (Amending Terms and Conditions for SLOPES, issued June 14, 2002).

[3] Programmatic Biological Opinion and Magnuson-Stevens Act Essential Fish Habitat Consultation for Standard Local Operating Procedures for Endangered Species (SLOPES II) for Certain Regulatory and Operations Activities Carried Out by the Department of Army Permits in Oregon and the North Shore of the Columbia River (refer to: NWR-2003-850) (July 8, 2003).

[4] Programmatic Biological Opinion and Conference Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Revised Standard Local Operating Procedures for Endangered Species (SLOPES III) to Administer Certain Activities Authorized or Carried Out by the Department of

section 10 of the RHA and section 404 of the CWA, including requests for authorization of activities which are similar to those that may be regulated under the following 2007 Corps nationwide permits (NWPs): NWP-3 Maintenance; NWP-6 Survey Activities; NWP-7 Outfall and Associated Intake Structures; NWP-12 Utility Line Activities; NWP-14 Linear Transportation Projects; and NWP-25 Structural Discharge.

Under SLOPES, the Corps is required to provide an annual monitoring report. The report is intended to be a summary of action data and a description of program participation, the quality of supporting analyses, monitoring information, compensatory mitigation provided by applicants, and recommendations to improve the effectiveness of the program. Between 2001 and 2012, the Corps used SLOPES to issue 580 permits for maintenance or improvement of roads, culverts, bridges and utility lines, mostly in the Willamette/Lower Columbia and coastal areas (Table 1).

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the Army in the State of Oregon and on the North Shore of the Columbia River (refer to: NWR-2004-1043) (November 30, 2004).

[5] Programmatic Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Revisions to Standard Local Operating Procedures for Endangered Species to Administer Maintenance or Improvement of Road, Culvert, Bridge and Utility Line Actions Authorized or Carried Out by the U.S. Army Corps of Engineers in Oregon (SLOPES IV Roads, Culverts, Bridges, and Utility Lines) (refer to: NWR-2008-4070) (August 13, 2008).

Table 1. Number of permits for maintenance or improvement of roads, culverts, bridges and utility lines issued by the Corps using SLOPES, by recovery domain and year (n=580).

Recovery Domain	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Willamette/Lower Columbia (n=351)	21	27	36	40	47	26	20	3	25	32	20	54
Interior Columbia (n=38)	8	6	0	2	4	0	0	0	3	4	7	4
Oregon Coast (n=147)	3	4	8	4	9	6	8	9	24	19	32	21
Southern Oregon/Northern California Coasts (n=44)	1	1	2	2	1	3	1	5	5	8	6	9
TOTAL	33	38	46	48	61	35	29	17	57	63	65	88

By design, SLOPES provides a focus for discussion between NMFS, the Corps, and applicants regarding ways to reduce or remove the adverse effects of regulated actions on ESA-listed species, designated critical habitat, and EFH. The delivery of technical assistance for administration of individual actions under SLOPES, interagency training in the use of SLOPES, the SLOPES annual review process, and many individual consultations that are beyond the range of actions authorized by SLOPES, have all been informed by previous SLOPES opinions, and thus helped to ensure that SLOPES will continue to be adaptive, accountable, and credible as a conservation and regulatory tool. Over the years, the Federal Highway Administration (FHWA), Natural Resources Conservation Service, Oregon Department of Environmental Quality (ODEQ), Oregon Department of Fish and Wildlife (ODFW), Oregon Department of Transportation (ODOT), Oregon Division of State Lands, Oregon Marine Board, Oregon Watershed Enhancement Board, Oregon Public Ports Association, the City of Portland, various port authorities, and others with a substantial and recurrent stake in the Corps' regulatory program have each made major contributions to the development of SLOPES.[6]

In some cases, requests by those action agencies for a separate programmatic consultation have been collected into SLOPES. This was possible because the Corps consented to act as the lead agency for consultation, and the SLOPES opinion already encompassed analyses of effects of those actions and corresponding measures to minimize take, or could be easily expanded to do so (*e.g.*, activities related to geological drilling and surveying; maintenance of boat docks, commercial marinas, ports, and roads; regulatory streamlining; stormwater facilities, stream and wetland restoration). This helped to ensure that SLOPES is based on the highest quality scientific information and strong, collaborative partnerships, and will continue to yield the highest degree of conservation effectiveness and regulatory efficiency.

In this way, NMFS and the Corps have examined the shared characteristics of many regulatory actions with similar effects and identified those types of actions for which short-term environmental effects are likely to be low intensity, repetitive, and predictable, and for which long-term effects are likely to contribute to the recovery of listed species. These individual actions also have similar requirements for regulatory approval and, beyond confirmation that each action meets applicable constraints on design and the use of conservation practices, would not reward additional analysis or deliberation with further conservation benefits. NMFS and the Corps have used the information in SLOPES to set clear expectations and achieve consistent outcomes that, with other important regulatory initiatives, have significantly reduced conflict over listed species and regulatory actions, thus improving public relations and creating new opportunities for further advances in listed species conservation.

The broad scope of the Corps' regulatory program, the rapid pace at which interested parties have gained and shared practical experience using SLOPES, and the need to assure adequate oversight in light of evolving ESA policies often require the Corps to adjust the actions authorized by SLOPES. Moreover, many requests by the Corps and various applicants for assistance regarding

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[6] See *e.g.*, Letter from Lawrence C. Evans, U.S. Army Corps of Engineers, to Michael Crouse, NMFS, (December 26, 2002) (requesting programmatic consultation for maintenance and restoration activities conducted by port authorities and commercial/industrial organizations); NMFS (2003).

the use of SLOPES for actions related to stream and wetland restoration, streambank stabilization, transportation, and over and in-water structures, led NMFS to conclude that SLOPES can be better managed if these categories are addressed in separate opinions. This will allow these consultation documents to be more focused on specific consultation needs, rather than dependent on reissuance of the entire opinion. Accordingly, on April 5, 2012, NMFS issued a SLOPES opinion for In-water Over-water Structures) (NMFS 2012d) and on March 19, 2013, NMFS issued an updated SLOPES opinion for Stream Restoration and Fish Passage Improvement Actions (NMFS 2013d).

Additionally, on November 28, 2012, NMFS completed a programmatic biological opinion with the Federal Highways Administration on the effects of the Oregon Division of the Federal Highways Administration's proposal to use the Federal Aid Highway Program to fund, in whole or in part, capital improvements of the transportation system in the State of Oregon, including aquatic habitat restoration and fish passage projects, through a system of Federal grants that are apportioned by legislative formulas, at the discretion of the FHWA, or by Congressional earmark, as governed by Title 23 of the United State Code. The aquatic habitat restoration and fish passage projects to be funded in this way are intended to mitigate for the adverse impact of transportation projects, to meet ecological stewardship goals related to the conservation of ESA-listed species, or as an initial step toward development of a conservation or wetland mitigation bank (NMFS 2011h).

Experience with the Oregon Transportation Improvement Act (OTIA III) was developed primarily through implementation of a joint biological opinion issued by NMFS and the USFWS to the Corps and FHWA on the effects of authorizing and funding the OTIA III program (NOAA Fisheries and USFWS 2004. The program is administered by the Oregon Bridge Delivery Partners, a private-sector firm under contract with ODOT, and has earned national and regional recognition for excellence in environmental stewardship and regulatory streamlining.[7] As of April 2013, 264 bridges have been built, and seven are under construction using OTIA III performance standards.[8] The fluvial performance standard developed for OTIA III to allow normative physical processes within the stream-floodplain corridor was used in this consultation as a model for the project design criteria (PDC) for permanent stream crossing design.

In 2012, the Corps coordinated with NMFS to develop a revised set of SLOPES for the maintenance or improvement of stormwater, transportation or utility actions in Oregon (SLOPES for Stormwater, Transportation or Utilities) and, as indicated above, on August 12, 2013, submitted a request to NMFS to consult on these SLOPES. The Corps determined that the proposed program covered in this opinion and projects funded under that program "may affect, but are not likely to adversely affect" the eastern distinct population segment (DPS) Steller sea

[7] E.g., American Association of State Highway and Transportation Officials (AASHTO) Team Excellence Award (2007); AASHTO Best Program Award for Environmental Excellence (2005); FHWA Environmental Excellence Award (2004); USFWS Environmental Stewardship Excellence Award (2004).

[8] Testimony of Tom Lauer, major projects branch manager, ODOT, before the Oregon House Committee on Transportation (February 20, 2008) (OTIA III state bridge delivery program and context sensitive and sustainable solutions).

lions (*Eumetopias jubatus)* and southern resident killer whales (*Orcinus orca*). The Corps also concluded that the proposed program and funded projects "may affect, and are likely to adversely affect" 17 ESA-listed species and their designated critical habitats. Critical habitat has been proposed for LCR coho salmon; therefore, NMFS is issuing a conference opinion on this critical habitat.

In Section 2.11 of this opinion, NMFS concurred with the Corps' finding that the proposed action is not likely to adversely southern resident killer whales. On October 23, 2013, NMFS removed Steller sea lion from ESA list effective December 4, 2013. Also, the proposed action "would adversely affect" areas designated by the Pacific Fisheries Management Council as EFH for Pacific salmon (PFMC 1999), groundfish (PFMC 2005), and coastal pelagic species (PFMC 1998), including estuarine areas designated as Habitat Areas of Particular Concern. Detailed information on the status and trends of these listed resources, and their biology and ecology, are in the listing regulations and critical habitat designations published in the Federal Register (Table 2).

Table 2. Listing status, status of critical habitat designations and protective regulations, and relevant Federal Register (FR) decision notices for ESA-listed species considered in this opinion. Listing status: 'T' means listed as threatened under the ESA; 'E' means listed as endangered; 'P' means proposed for listing or designation.

Species	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon *(Oncorhynchus tshawytscha)*			
Lower Columbia River	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Willamette River spring-run	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Columbia River spring-run	E 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	ESA section 9 applies
Snake River spring/summer-run	T 6/28/05; 70 FR 37160	10/25/99; 64 FR 57399	6/28/05; 70 FR 37160
Snake River fall-run	T 6/28/05; 70 FR 37160	12/28/93; 58 FR 68543	6/28/05; 70 FR 37160
Chum salmon *(O. keta)*			
Columbia River	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Coho salmon *(O. kisutch)*			
Lower Columbia River	T 6/28/05; 70 FR 37160	P 1/14/13; 78 FR 2726	6/28/05; 70 FR 37160
Oregon Coast	T 6/20/11; 76 FR 35755	2/11/08; 73 FR 7816	2/11/08; 73 FR 7816
Southern Oregon/Northern California Coasts	T 6/28/05; 70 FR 37160	5/5/99; 64 FR 24049	6/28/05; 70 FR 37160
Sockeye salmon *(O. nerka)*			
Snake River	E 8/15/11; 70 FR 37160	12/28/93; 58 FR 68543	ESA section 9 applies
Steelhead (*O. mykiss*)			
Lower Columbia River	T 1/5/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Willamette River	T 1/5/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Middle Columbia River	T 1/5/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Columbia River	T 1/5/06; 71 FR 834	9/02/05; 70 FR 52630	2/1/06; 71 FR 5178
Snake River Basin	T 1/5/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Green sturgeon (*Acipenser medirostris*)			
Southern DPS	T 4/07/06; 71 FR 17757	10/09/09; 74 FR 52300	6/2/10; 75 FR 30714
Eulachon *(Thaleichthys pacificus)*			
Southern DPS	T 3/18/10; 75 FR 13012	10/20/11; 76 FR 65324	None.

1.3 Proposed Action

For this consultation, the proposed action is a revised set of SLOPES that the Corps uses to guide the permitting of stormwater facilities, maintenance and improvement of roads, culverts, bridges and utility lines as regulated under section 10 of the Rivers and Harbors Act of 1899 and section 404 of the Clean Water Act, including NWP27, or that are carried out by the Corps as part of civil works programs authorized by sections 206, 536, and 1135 of the Water Resources Development Act. Use of the revised SLOPES will ensure that the Corps' regulatory oversight of these aquatic habitat actions will continue to meet requirements of the ESA and MSA with procedures that are simpler to use, more efficient, and more accountable for all parties.

The Corps is proposing to use SLOPES for Stormwater, Transportation or Utilities to authorize four categories of actions, specifically:

Natural hazard response to complete an unplanned, immediate, or short-term repair of a stormwater facility, road, culvert, bridge, or utility line without federal assistance. 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. Natural hazards may include, but are not limited to, a flood that causes scour erosion and significantly weakens the foundation of a road or bridge; culvert failure due to blockage by fluvial debris, overtopping, or crushing; and ground saturation that causes a debris slide, earth flow, or rock fall to cover a road. This category of actions is only included to the extent that they require Corps permits or are undertaken by the Corps, but otherwise do not require federal authorization, funding, or federal agency involvement.. The response will include an assessment of its effects to listed species and critical habitats and a plan to bring the response into conformance with all other applicable PDC in this opinion, including compensatory mitigation based on the baseline conditions prior to the natural hazard.

Streambank and channel stabilization to ensure that roads, culverts, bridges and utility lines do not become hazardous due to the long-term effects of toe erosion, scour, subsurface entrainment, or mass failure. This action includes installation and maintenance of scour protection, such as at a footing, facing, or headwall, to prevent scouring or down-cutting of an existing culvert, road foundation, or bridge support. It does not include scour protection for bridge approach fills. Proposed streambank stabilization methods include alluvium placement, vegetated riprap with large wood (LW), log or roughened rock toe, woody plantings, herbaceous cover, deformable soil reinforcement, coir logs, bank reshaping and slope grading, floodplain flow spreaders, floodplain roughness, and engineered log jams (ELJs), alone or in combination. Any action that requires additional excavation or structural changes to a road, culvert, or bridge foundation is covered under road, culvert and bridge maintenance, rehabilitation, and replacement.

Road surface, culvert and bridge maintenance, rehabilitation and replacement. Maintenance, rehabilitation, and replacement to ensure that roads, culverts and bridges remain safe and reliable for their intended use without impairing fish passage, to extend their service life, and to withdraw temporary access roads from service in a way that promotes watershed restoration when their usefulness has ended. This includes actions necessary to complete geotechnical surveys, such as access road construction, drill pad preparation, mobilization and set up, drilling and sampling operations, demobilization, boring abandonment, and access road and drill pad reclamation. It also includes, excavation, grading, and filling necessary to maintain, rehabilitate, or replace existing roads, culverts, and bridges. This type of action does not include significant channel realignment, installation of fish passage (*e.g.*, fish ladders, juvenile fish bypasses, culvert baffles, roughened chutes, step weirs), tidegate maintenance or replacements other than full removal, construction of new permanent roads within the riparian zone that are not a bridge approach, or construction of a new bridge where a culvert or other road stream crossing did not previously exist, or any project which will result in or contribute to other land use changes that trigger effects, including indirect effects not considered in this opinion.

Stormwater facilities and utility line stream crossings to install, maintain, rehabilitate, or replace stormwater facilities, or pipes or pipelines used to transport gas or liquids, including new or upgraded stormwater outfalls, and cables, or lines or wires used to transmit electricity or communication. Construction, maintenance or improvement of stormwater facilities include surveys, access road construction, excavation, grading, and filling necessary to maintain, rehabilitate, or replace existing stormwater treatment or flow control best management practices (BMPs). Utility line actions involve excavation, temporary side casting of excavated material, backfilling of the trench, and restoration of the work site to preconstruction contours and vegetation. This type of action does not include construction or enlargement of gas, sewer, or water lines to support a new or expanded service area for which effects, including indirect effects from interrelated or interdependent activities, have not been analyzed in this opinion. This opinion also does not include construction of any line that transits the bed of an estuary or saltwater area at depths less than -10.0 feet (mean lower low water).

1.3.1 Proposed Design Criteria (PDC)

The Corps proposed to apply the following PDC, in relevant part, to every action authorized under this opinion. Measures described under "Administration" apply to the Corps as it manages the SLOPES for Stormwater, Transportation or Utilities program. Measures described under "General Construction" apply, in relevant part, to each action that involves a construction component. Measures described under "Types of Action" apply, in relevant part, to each specific type of actions as described.

1.3.1.1 Program Administration

1. **Initial Rollout.** The Corps will cooperate with NMFS to provide an initial rollout of this opinion for Corps staff to ensure that these conditions 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 hydrologic engineering, are resolved early on and not under-designed as add-on features.
2. **Corps Review and Approval.** The Corps will review and approve each project to be covered under this opinion to ensure that:

a. Projects are within the present or historical range of an ESA-listed salmon, steelhead, southern green sturgeon, or eulachon, or designated critical habitat.
b. Project effects are within the range considered in this opinion.
c. Permits will include each of the relevant PDC as an enforceable condition of every action authorized under this opinion. The Corps will also include each applicable PDC as a final action specification of every WRDA civil works action carried out under this opinion.
d. Activities <u>not</u> included in this SLOPES and therefore not covered by this opinion (but available for individual consultation) include the following actions, or result in the following conditions:
    i. Installation, replacement or repair of a tide gate.
    ii. Use of preservative or pesticide-treated wood ("treated wood"), except as described in PDC #29.
    iii. Installation of stream barbs, non-porous partially spanning weirs, or full-spanning weirs.
    iv. In-water work in the Willamette River downstream of Willamette Falls between December 1 and January 31, unless the in-water work is part of a natural hazard response.
    v. Any action that would cause the program to exceed the amount or extent of incidental take described in the incidental take statement issued with this opinion.
    vi. Land use changes (*i.e.*, new subdivision or other large development requiring a CWA§404 permit) that trigger effects, including indirect effects, not considered in this opinion.
    vii. Any action that requires an environmental impact statement (EIS) under the National Environmental Policy Act (NEPA) that evaluates alternatives affecting listed species.
    viii. Construction of a new permanent road within a riparian area[9] that is not a stream-road crossing approach, except as necessary to restore an historical stream channel.

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[9] For this opinion only, "riparian area" means land: (1) within a distance equal to the height of one "site potential tree " (SPTH) of any natural waterbody occupied by ESA-listed salmon or steelhead during any part of the year, or designated as critical habitat; (2) within 100 feet of any "natural waterbody" within ¼ mile upstream of areas occupied by ESA-listed salmon or steelhead, or designated as critical habitat, and that is physically connected by an aboveground channel system such that water, sediment, or woody material delivered to such waters will eventually be delivered to water occupied by ESA-listed salmon or steelhead or designated as critical habitat; and (3) within 50 feet of any "natural water" more than a ¼ mile upstream of areas occupied by ESA-listed salmon or steelhead, or designated as critical habitat, and that is physically connected by an above-ground channel system such that water, sediment, or woody material delivered to such waters will eventually be delivered to water occupied by listed salmon or designated as critical habitat.

"SPTH" means the average height, at age 100, of the tallest, mature, native conifer species that is capable of growing in the soils found at that site and for which height measurements are noted in the soil survey reports published by National Resource Conservation Service (NRCS). Each local NRCS field office maintains the surveys for its area. West of the Cascade Mountains summit, the STPH will be based on either Douglas-fir or western hemlock. East of Cascade Mountains summit, the species could be ponderosa pine, lodgepole pine, western larch, Engelmann spruce, subalpine fir, grand fir or Douglas-fir. For sites that historically supported cottonwood as the largest tree, the SPTH is the average height, at age 75, of a black cottonwood tree growing under those site

3. **NMFS Review and Approval.** The Corps will also ensure that NMFS reviews and approves each project with any of the following elements for consistency with this opinion before the action is authorized or carried out:
   a. Pile installation (PDC 15)
   b. Fish screens on pump intakes for dewatering at a rate that exceeds 3 cfs (PDC 34)
   c. Stormwater facilities (PDC 36 & 43)
   d. New or upgraded stormwater outfalls (PDC 36 & 43)
   e. Compensatory mitigation (PDC 39)
   f. Alluvium placement that occupies more than 25% of the channel bed or more than 25% of the bankfull cross sectional area (PDC 41d)
   g. LW placement that occupies greater than 25% of the bankfull cross section area (PDC 41e)
   h. Vegetated riprap with LW (PDC 41f)
   i. Engineered log jams (PDC 41h)
   j. Grade stabilization (PDC 42b)
   k. Road-stream crossing replacement or retrofit (42e)
   l. Fish passage restoration
   m. Restoration of a historic stream channel
   n. Blasting
   o. Earthwork at an 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 the Corps' best professional judgment.
   p. Modification or variance of any requirement in a manner that does not require reinitiation of consultation (see Section 2.10).
4. **Electronic Notification.** The Corps will initiate NMFS' review by submitting an Action Implementation Form (Appendix A) with Part 1, the project notification portion, completed to the "SLOPES mailbox," at slopes.nwr@noaa.gov, at least 30-days before start of construction with sufficient detail for NMFS to ensure that the proposed action is consistent with all provisions of this opinion.[10]

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conditions. For saltwater areas, the riparian area will begin at the mean higher high water (MHHW); for lakes, the riparian area begins at the high-water mark or the edge of an immediately contiguous wetland, and for wetlands the riparian area begins at the upper wetland boundary. Distances from a stream or waterbody are measured horizontally from, and perpendicular to, the bankfull elevation, the edge of the channel migration area, or the edge of any associated wetland, whichever results in the greatest riparian area width.

"Natural waterbody" means any perennial or seasonal water or wetland, except water conveyance systems that are artificially constructed and actively maintained for irrigation.

"Channel" means the channel migration zone, (*i.e.*, the area where the active channel of a stream is prone to movement over time) (Rapp and Abbe 2003). Streams, regardless of size, that are tributary to a main channel have the same width riparian area as the main channel. All side channels that have flowing water when the main channel is at bankfull stage have a riparian area along each bank that is similar in size and plant composition to the riparian area along the main channel. A riparian area that follows the bankfull line of a watercourse continues around the upland edge of contiguous wetlands. Wetlands that are within the active floodplain, (*i.e.*, the floodprone area) but are not contiguous to a channel, will have a riparian area as described above for waterbodies.

For discussions of the ability of a riparian area to protect aquatic habitats against the adverse effects of upland disturbance. See Johnson and Ryba (1992), FEMAT (1993), Castelle *et al.* (1994), Spence *et al.* (1996), and USDA-Natural Resources Conservation Service (1999).

[10] NMFS will notify the Corps within 30 calendar days if the action is approved or disqualified.

5. **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 NMFS to a different conclusion regarding the effects of that project.
6. **Site Access.** The Corps will retain the right of reasonable access to each project site to monitor the use and effectiveness of these conditions.
7. **Project Completion Report.** The Corps will submit, or ensure that the permittee submits, the Action Implementation Form (Appendix A, PDC 4) with the completion report portion completed (Parts 1 and 2) to the SLOPES mailbox within 60 days of the end of construction for any project authorized or carried out by the Corps.
8. **Natural Hazard Response Report.** The Corps will submit the Action Implementation Form (Appendix A, PDC 4) with the natural hazard response report (Parts 1 and 2) to the SLOPES mailbox within 30 days of the initial reaction to any natural hazard that is authorized or carried out by the Corps.
9. **Site Restoration or Compensatory Mitigation Report.** The Corps will submit a site restoration or compensatory mitigation report (Appendix A, with Parts 1-4 completed) to the SLOPES mailbox by December 31 of the year that the Corps approves that the site restoration or compensatory mitigation is complete.
10. **Annual Program Report.** The Corps' Regulatory and Civil Works Branches will each submit a monitoring report to the SLOPES mailbox by February 15 each year that describes the Corps' efforts to carry out this opinion, including an assessment of overall program activity, a map showing the location and type of each action authorized or carried out under this opinion, and any other data or analyses the Corps deems necessary or helpful to assess habitat trends as a result of actions authorized under this opinion.
11. **Annual Coordination Meeting.** The Corps' Regulatory and Civil Works branches will attend an annual coordination meeting with NMFS by March 31 each year to discuss the annual report and any actions that can improve conservation under this opinion, or make the program more efficient or accountable.
12. **Failure to Report May Trigger Reinitiation.** NMFS may recommend reinitiation of this consultation if the Corps, or the permittee if applicable, fails to provide all applicable notification, completion, fish salvage, site restoration/compensatory mitigation reports or annual program reports, or attend the annual coordination meeting.

1.3.1.2 Project Design Criteria - General Construction Measures

13. **Project Design**
    a. Use the best available scientific information regarding the likely impacts of climate change on resources in the project area to design the project so that it will be resilient to those impacts, including projections of local stream flow, water temperature, and extreme events.
    b. Assess whether the project area is contaminated by chemical substances that may cause harm if released by the project. 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 regulatory permits and authorizations before starting construction.
d. Minimize the extent and duration of earthwork, *e.g.*, compacting, dredging, drilling, excavation, and filling.

14. In-Water Work Timing

a. Unless the in-water work is part of a natural hazard response, complete all work within the wetted channel during dates listed in the most recent version of Oregon In-water Work Guidelines (ODFW 2008), except that that in-water work in the Willamette River below Willamette Falls is not approved between December 1 and January 31.
b. Hydraulic and topographic measurements and placement of LW or gravel may be completed anytime, provided the affected area is not occupied by adult fish congregating for spawning, or redds containing eggs or pre-emergent alevins.

15. Pile 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. Any proposal to use treated wood pilings is not covered by this consultation and will require individual consultation.

a. NMFS will review and approve pile installation plans.
b. When practical, use a vibratory hammer for in-water pile installation. In the lower Columbia River only a vibratory hammer may be used in October.
c. 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).
d. 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), 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.

16. **Pile Removal.** The following steps will be used to minimize creosote release, sediment disturbance and total suspended solids:
    a. Install a floating surface boom to capture floating surface debris.
    b. 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.
    c. Dislodge the pile with a vibratory hammer, when possible; never intentionally break a pile by twisting or bending.
    d. Slowly lift the pile from the sediment and through the water column.
    e. Place the pile 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.
    f. Fill the hole left by each pile with clean, native sediments immediately after removal
    g. Dispose of all removed piles, floating surface debris, any sediment spilled on work surfaces, and all containment supplies at a permitted upland disposal site.

17. **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 (GPS) device to note the location of all broken piles for future use in site debris characterization.

18. **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).
    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.
    c. Conduct fish capture activities during 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 the 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, 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 (DC) or pulsed direct current within the following ranges:[11]
        1. If conductivity is less than 100 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 or, if no shade is available, covered by a canopy.
    iii. Limit the number of fish within a bucket; fish will be of relatively comparable 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 is acceptable provided the release site is below the influence of construction.
    vi. Be careful to avoid mortality counting errors.

g. Monitor and record fish presence, handling, and injury during all phases of fish capture and submit a fish salvage report (Appendix A, Part 1 with Part 3 completed) to the Corps and the SLOPES mailbox (slopes.nwr@noaa.gov) within 60 days.

19. Fish Passage

a. Provide fish passage for any adult or juvenile ESA-listed fish likely to be present in the action 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 for any adult or juvenile ESA-listed fish that meets NMFS's fish passage criteria (NMFS 2011a) for the life of the action.

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[11] National Marine Fisheries Service. 2000. Guidelines for electrofishing waters containing salmonids listed under the Endangered Species Act. Portland, Oregon and Santa Rosa, California. http://swr.nmfs.noaa.gov/sr/Electrofishing_Guidelines.pdf

20. Fish Screens

a. Submit to NMFS for review and approval fish screen designs for surface water diverted by gravity or by pumping at a rate that exceeds 3 cubic feet per second (cfs).
b. All other diversions will have a fish screen that meets the following specifications:
    i. An automated cleaning device with a minimum effective surface area of 2.5 square feet per cubic foot per second, and a nominal maximum approach velocity of 0.4 feet per second, or no automated cleaning device, a minimum effective surface area of 1 square foot per cubic foot per second, and a nominal maximum approach rate of 0.2 foot per second; and
    ii. A round or square screen mesh that is no larger than 2.38 millimeters (mm) (0.094") in the narrow dimension, or any other shape that is no larger than 1.75 mm (0.069") in the narrow dimension.
c. Each fish screen will be installed, operated, and maintained according to NMFS's fish screen criteria.

21. Surface Water Withdrawal

a. Surface water may be diverted to meet construction needs, including dust abatement, only if water from developed sources (*e.g.*, municipal supplies, small ponds, reservoirs, or tank trucks) are unavailable or inadequate; and
b. Diversions may not exceed 10% of the available flow and will have a juvenile fish exclusion device that is consistent with NMFS's criteria (NMFS 2011a).[12]

22. Construction Discharge Water. 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. 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. Treat water used to cure concrete until pH stabilizes to background levels.

23. Temporary Access Roads and Paths

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

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[12] National Marine Fisheries Service. 2011. Anadromous salmonid passage facility design. Northwest Region. http://www.nwr.noaa.gov/publications/hydropower/ferc/fish-passage-design.pdf

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.

24. Temporary Stream Crossings

a. No stream crossing may occur at active spawning sites, when holding adult listed fish are present, or when eggs or alevins are in the gravel.
b. 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.
c. Minimize the number of temporary stream crossings; use existing stream crossings whenever reasonable.
d. Install temporary bridges and culverts to allow for equipment and vehicle crossing over perennial streams during construction.
e. Wherever possible, vehicles and machinery will cross streams at right angles to the main channel.
f. Equipment and vehicles may cross the stream in the wet only where the streambed is bedrock, or where mats or off-site logs are placed in the stream and used as a crossing.
g. Obliterate all temporary stream crossings as soon as they are no longer needed, and restore any damage to affected stream banks or channel.

25. 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 the surface.
   ii. Replace petroleum-based hydraulic fluids with biodegradable products[13] in hydraulic equipment, vehicles, and power tools.
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) unless project specialists determine such work is necessary, or would

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[13] 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 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.

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.

26. 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, OHW, spawning areas.
    ii. Equipment entry and exit points.
    iii. Road and stream crossing alignments.
    iv. Staging, storage, and stockpile areas.
b. Before the use of herbicides, clearly flag no-application buffer zones.

27. 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 that are displaced by construction and reserved for restoration, *e.g.*, LW, gravel, and boulders, may be stockpiled within the 100-year floodplain.
c. Dispose of any material not used in restoration and not native to the floodplain outside of the functional floodplain.
d. After construction is complete, obliterate all staging, storage, or stockpile areas, stabilize the soil, and revegetate the area.[14]

28. Drilling and Boring

a. If drilling or boring are used, isolate drilling operations in wetted stream channels using a steel casing or other appropriate isolation method to prevent drilling fluids from contacting water.
b. If drilling through a bridge deck is necessary, use containment measures to prevent drilling debris from entering the channel.
c. Sampling and directional drill recovery/recycling pits, and any associated waste or spoils will be completely isolated from surface waters, off-channel habitats and wetlands.
d. All waste or spoils will be covered if precipitation is falling or imminent.
e. All drilling fluids and waste will be recovered and recycled or disposed to prevent entry into flowing water.

[14] 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.

f. If a drill boring case breaks and drilling fluid or waste is visible in water or a wetland, make all possible efforts to contain the waste and contact NMFS within 48 hours.

g. Waste containment

   i. All drilling equipment, drill recovery and recycling pits, and any waste or spoil produced, will be contained and then completely recovered and recycled or disposed of as necessary to prevent entry into any waterway. Use a tank to recycle drilling fluids.

   ii. When drilling is completed, remove as much of the remaining drilling fluid as possible from the casing (*e.g.*, by pumping) to reduce turbidity when the casing is removed.

29. Pesticide and Preservative-Treated Wood[15]

a. Treated wood may not be used in a structure that will be in or over water or permanently or seasonally flooded wetlands, *except to maintain or repair an existing wood bridge*. The following criteria in b, c, and d below apply to the use of treated wood for maintenance or repair of existing wood bridges.

b. No part of the treated wood may be exposed to leaching by precipitation, overtopping waves, or submersion (*e.g.*, no treated wood piles (per PDC#10, and stringers or decking of a timber bridge can be made from treated wood only if they will be covered by a non-treated wood wearing surface that covers the entire roadway width), and all elements of the structure using the treated wood are designed to avoid or minimize impacts or abrasion that could create treated wood debris or dust.

c. Installation of treated wood

   i. Treated wood shipped to the project area will be stored out of contact with standing water and wet soil, and protected from precipitation.

   ii. Each load and piece of treated wood will be visually inspected and rejected for use in or above aquatic environments if visible residue, bleeding of preservative, preservative-saturated sawdust, contaminated soil, or other matter is present.

   iii. Prefabrication will be used whenever possible to minimize cutting, drilling and field preservative treatment.

   iv. When field fabrication is necessary, all cutting, drilling, and field preservative treatment of exposed treated wood will be done above OHW to minimize discharge of sawdust, drill shavings, excess preservative and other debris.

   v. Tarps, plastic tubs or similar devices will be used to contain the bulk of any fabrication debris, and any excess field preservative will be removed from the treated wood by wiping and proper disposal.

d. Removal of treated wood

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[15] Treated woods may contain chromated copper arsenate (CCA), ammoniacal copper zinc arsenate (ACZA), alkaline copper quat (ACQ-B and ACQ-D), ammoniacal copper citrate (CC), copper azole (CBA-A), copper dimethyldithiocarbamate (CDDC), borate preservatives, and oil-type wood preservatives, such as creosote, pentachlorophenol, and copper naphthenate.

i. Evaluate all wood construction debris removed during a project, including pile, to ensure proper disposal of treated wood.
ii. Ensure that no treated wood debris falls into the water or, if debris does fall into the water, remove it immediately.
iii. After removal, place treated wood debris in an appropriate dry storage site until it can be removed from the project area.
iv. Do not leave any treated wood debris in the water or stacked on the streambank at or below OHW.

30. Erosion Control

a. Use site planning and site erosion control measures commensurate with the scope of the project to 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. Remove sediment from erosion controls if it reaches 1/3 of the exposed height of the control.
    vii. Whenever surface water is present, maintain a supply of sediment control materials and an oil-absorbing floating boom at the project site.
    viii. 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.

31. Hazardous Material Safety

a. At the project site:
    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.
iv. 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.

32. **Barge Use.** Any barge used as a work platform to support construction will be:
   a. Large enough to remain stable under foreseeable loads and adverse conditions.
   b. Inspected before arrival to ensure vessel and ballast are free of invasive species.
   c. Secured, stabilized and maintained as necessary to ensure no loss of balance, stability, anchorage, or other condition that can result in the release of contaminants or construction debris.

33. **Dust Abatement**
   a. Use 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.

34. **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, or if the work area is less than 300 feet upstream from known spawning habitats.
   b. Engineering design plans for work area isolation will include all isolation elements and fish release areas.
   c. Dewater the shortest linear 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.[16]
      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 of fish, preferably into pool habitat with cover.
      ii. Where gravity feed is not possible, pump water from the work site to avoid rewatering. Maintain a fish screen on the pump intake to avoid juvenile fish entrainment.
      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

[16] 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).

vegetation before reentering the stream channel with a treatment system 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 stream turbidity.

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's fish screen criteria (NMFS 2011a). NMFS approval is required for pumping at a rate that exceeds 3 cfs.

35. Invasive and Non-Native Plant Control

a. ***Non-herbicide methods.*** Limit vegetation removal and soil disturbance within the riparian zone by limiting the number of workers there to the minimum necessary to complete manual, mechanical, or hydro-mechanical plant control (*e.g.*, hand pulling, bending[17], 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))[18]. Do not allow cut, mowed, or pulled vegetation to enter waterways.

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

c. ***Power equipment.*** Refuel gas-powered equipment with tanks larger than 5 gallons in a vehicle staging area placed 150 feet or more from any natural water body, or in an isolated hazard zone such as a paved parking lot.

d. ***Maximum herbicide treatment area.*** Do not exceed treating 1.0% of the acres of riparian habitat within a 6th-field HUC with herbicides per year.

e. ***Herbicide applicator qualifications.*** Herbicides may only be applied by an appropriately licensed applicator using an herbicide specifically targeted for a particular plant species that will cause the least impact. The applicator will be responsible for preparing and carrying out the herbicide transportation and safely plan, as follows.

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 proposed for use under this opinion are (some common trade names are shown in parentheses):[19]

  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)

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

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

[19] 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.

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)

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 ethoxylates (including alkyl phenol ethoxylate phosphate esters), or herbicides that contain these compounds are **not** covered by this opinion. The following product names are covered by this opinion:

i. Agri-Dex
ii. AquaSurf
iii. Bond
iv. Bronc Max
v. Bronc Plus Dry-EDT
vi. Class Act NG
vii. Competitor
viii. Cut Rate
ix. Cygnet Plus
x. Destiny HC
xi. Exciter
xii. Fraction
xiii. InterLock
xiv. Kinetic
xv. Level 7
xvi. Liberate
xvii. Magnify
xviii. One-AP XL
xix. Pro AMS Plus
xx. Spray-Rite
xxi. Superb HC
xxii. Tactic
xxiii. 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 water body 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 (HWM), keep the spray nozzle within 6 feet of the ground.
   vi. Apply spray in swaths parallel towards the project area, away from the creek 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 salmon bearing waters from the treated area is forecasted by the 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 3). 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 3. 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

36. Actions Requiring Stormwater Management[20]

a. Provide stormwater management for any project that will:
   i. Increase the contributing impervious area within the project area.
   ii. Construct new pavement that increases capacity or widens the road prism.
   iii. Reconstructs pavement down to subgrade.
   iv. Rehabilitate or restore a bridge 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-tensioning, supplementary dampening) but do not affect the bridge deck or drainage.
   v. Replace a stream crossing
   vi. Change stormwater conveyance
b. Stormwater management is not required for the following pavement actions: minor repairs, patching, chip seal, grind/inlay, overlay or resurfacing (*i.e.*, nonstructural pavement preservation, a single lift or inlay).
c. Stormwater management plans will consist of:
   i. Low impact development.
   ii. Water quality (pollution reduction) treatment for post-construction stormwater runoff from all contributing impervious area.
   iii. Water quantity treatment (retention or detention facilities), unless the outfall discharges directly into a major water body (*e.g.*, mainstem Columbia River, Willamette River (downstream of Eugene), large lakes, reservoir, ocean, or estuary). Retention or detention facilities must limit discharge to match pre-developed discharge rates (i.e., the discharge rate of the site based on its natural groundcover and grade before any development occurred) using a continuous simulation for flows between 50% of the 2-year event and the 10-year flow event (annual series).
d. Stormwater management plans will:
   i. Explain how runoff from all contributing impervious area that is within or contiguous with the project area will be managed using site sketches, drawings, specifications, calculations, or other information commensurate with the scope of the action.
   ii. Identify the pollutants of concern.

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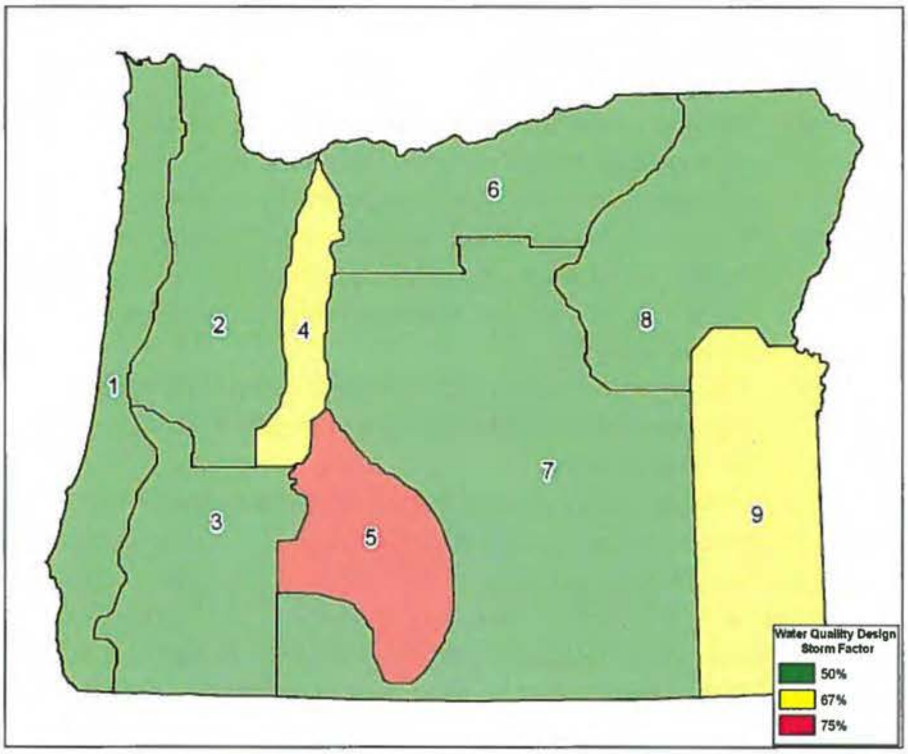
[20] The most efficient way for an applicant or the Corps to prepare and submit a stormwater management plan for NMFS' review is to attach a completed *Checklist for Submission of a Stormwater Management Plan* (the *Checklist*, ODEQ updated 2012, or the most recent version) with the electronic notification when it is sent to the SLOPES mailbox. However, stormwater conveyance to a DEQ permitted Municipal Separate Storm Sewer System (MS4) or consistency with any other program acknowledged by DEQ as adequate for stormwater management will not meet the requirements of this opinion unless NMFS determines that the facility accepting the stormwater will provide a level of treatment that is equivalent to that called for in this opinion. The *Checklist* and guidelines for its use are available from NMFS or the ODEQ in Portland Oregon. The latest version of the *Checklist* is also available online in a portable document format (pdf) through the ODEQ Water Quality Section 401 certification webpage (ODEQ 2014) at http://www.deq.state.or.us/wq/sec401cert/process.htm#add (see "Post Construction Stormwater Management Plan").

iii. Identify all contributing and non-contributing impervious areas that are within and contiguous with the project area.
iv. Describe the BMPs that will be used to treat the identified pollutants of concern, and the proposed maintenance activities and schedule for the treatment facilities.
v. Provide a justification for the capacity of the facilities provided based on the expected runoff volume, including, *e.g.*, the design storm, BMP geometry, analyses of residence time, as appropriate.
vi. Include the name, email address, and telephone number of the person responsible for designing the stormwater management facilities that NMFS may contact if additional information is necessary to complete the effects analysis.
vii. The proposed action will include a maintenance, repair, and component replacement plan that details what needs to be done, when, and by whom for each facility.

e. All stormwater quality treatment practices and facilities will be designed to accept and fully treat the volume of water equal to 50% of the cumulative rainfall from the 2-year, 24-hour storm for that site, except as follows: climate zone 4 – 67%; climate zone 5 – 75%; and climate zone 9 – 67% (Figure 1). (ESA-listed species considered in this opinion are unlikely to occur in Zones 5 or 9.) A continuous rainfall/runoff model may be used instead of runoff depths to calculate water quality treatment depth.

Figure 1. Water Quality Design Storm Factor – Oregon Climate Regions (Oregon Department of Transportation 2008)



f. Use low impact development practices to infiltrate or evaporate runoff to the maximum extent feasible. For runoff that cannot be infiltrated or evaporated and therefore will discharge into surface or subsurface waters, apply one or more of the following specific primary treatment practices, supplemented with appropriate soil amendments:
    i. Bioretention cell
    ii. Bioslope, also known as an "ecology embankment"
    iii. Bioswale
    iv. Constructed wetlands
    v. Infiltration pond
    vi. Media filter devices with demonstrated effectiveness. Propriety devices should be on a list of "Approved Proprietary Stormwater Treatment Technologies" *i.e.*, City of Portland (2008) Stormwater Management Manual. Bureau of Environmental Services.
    vii. Porous pavement, with no soil amendments and appropriate maintenance
    viii. All stormwater flow control treatment practices and facilities will be designed to maintain the frequency and duration of instream flows generated by storms within the following end-points:
        1. Lower discharge endpoint, by U.S. Geological Survey (USGS) flood frequency zone:
            a. Western Region = 42% of 2-year event
            b. Eastern Region

            i. Southeast, Northeast, North Central = 48% of 2-year event
            ii. Eastern Cascade = 56% of 2-year event
      2. Upper discharge endpoint
         a. Entrenchment ratio <2.2 = 10-year event, 24-hour storm
         b. Entrenchment ratio >2.2 = bank overtopping event

g. When conveyance is necessary to discharge treated stormwater directly into surface water or a wetland, the following requirements apply:
   i. Maintain natural drainage patterns.
   ii. To the maximum extent feasible, ensure that water quality treatment for contributing impervious area runoff is completed before commingling with offsite runoff for conveyance.
   iii. Prevent erosion of the flow path from the project 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 OHW.
h. **NMFS review and approval.** NMFS will review proposed stormwater treatment and new or upgraded stormwater outfalls plans.

37. 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 all temporary access roads, crossings, and staging areas.
d. Loosen compacted areas of soil when necessary for revegetation or infiltration.
e. Although no single criterion is sufficient to measure restoration success, the intent is that the following features should be present in the upland parts of the project area, within reasonable limits of natural and management variation:
   i. Human and livestock disturbance, if any, are confined to small areas necessary for access or other special management situations.
   ii. Areas with signs of significant past erosion are completely stabilized and healed, bare soil spaces are small and well-dispersed.
   iii. Soil movement, such as active rills and soil deposition around plants or in small basins, is absent or slight and local.
   iv. Native woody and herbaceous vegetation, and germination microsites, are present and well distributed across the site; invasive plants are absent.
   v. Plants have normal, vigorous growth form, and a high probability of remaining vigorous, healthy and dominant over undesired competing vegetation.
   vi. Plant litter is well distributed and effective in protecting the soil with little or no litter accumulated against vegetation as a result of active sheet erosion ("litter dams").
   vii. A continuous corridor of shrubs and trees appropriate to the site are present to provide shade and other habitat functions for the entire streambank.

38. Revegetation

a. Plant and 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 action 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. Use 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.
h. Conduct post-construction monitoring and treatment to remove or control invasive plants until native plant species are well-established.

39. Actions That Require Compensatory Mitigation

a. The Corps will rely on 33 CFR 332.3 when considering appropriate mitigation. The first option for an applicant is to purchase credits from an appropriate mitigation bank. The second option is to purchase credits from an approved in-lieu-fee sponsor. The third option is permittee-responsible mitigation. The fourth option is a combination of some or all of the above options that collectively satisfies the mitigation requirements.
b. NMFS will review and approve compensatory mitigation plans.
c. The following actions require compensatory mitigation:
    i. Any stormwater management facility that requires a new or enlarged structure within the riparian zone; or that has insufficient capacity to infiltrate and retain the volume of stormwater called for by this opinion.
    ii. Any riprap revetment that extends rock above the streambank toe, extends the use of riprap laterally into an area that was not previously revetted, or revetment that does not include adequate vegetation and LW.
    iii. Any bridge rehabilitation or replacement that does not span the functional floodplain, or causes a net increase in fill within the functional floodplain.
d. The electronic notification (Appendix A, Part 1 with Part 4 completed) for an action that requires compensatory mitigation will explain how the Corps or applicant will complete the mitigation, including site sketches, drawings, specifications, calculations, or other information commensurate with the scope of the action.
e. Include the name, address, and telephone number of a person responsible for designing this part of the action that NMFS may contact if additional information is necessary to complete the effects analysis.

f. Describe practices that will be used to ensure:
    i. No net loss of habitat function
    ii. Completion before, or concurrent with, construction whenever possible
    iii. Achieve a mitigation ratio that is greater than one-to-one and larger (*e.g.*, 1.5 to1.0 when necessary to compensate for time lags between the loss of conservation value in the project area and replacement of conservation value in the mitigation area, uncertainty of conservation value replacement in the mitigation area, or when the affected area has demonstrably higher conservation value than the mitigation area.[21]
    iv. When practicable and environmentally sound, mitigation should be near the project impact site, or within the same local watershed and area occupied by the affected population(s) and age classes. Mitigation should be completed prior to or concurrent with the adverse impacts, or have an increased ratio as noted above.
    v. To minimize delays and objections during the review process, applicants are encouraged to seek the advice of NMFS during the planning and design of mitigation plans. For complex mitigation projects, such consultation may improve the likelihood of mitigation success and reduce permit-processing time.

g. For stormwater management:
    i. The primary habitat functions of concern are related to the physical and biological features essential to the long-term conservation of listed species, *i.e.*, water quality, water quantity, channel substrate, floodplain connectivity, forage, natural cover (such as submerged and overhanging LW, aquatic vegetation, large rocks and boulders, side channels and undercut banks), space, and free passage.
    ii. Acceptable mitigation for riparian habitat displaced by a stormwater treatment facility is restoration of shallow-water or off-channel habitat
    iii. Acceptable mitigation for inadequate stormwater treatment includes providing adequate stormwater treatment where it did not exist before, and retrofitting an existing but substandard stormwater facility to provide capacity necessary to infiltrate and retain the proper volume of stormwater. Such mitigation can be measured in terms of deficit stormwater treatment capacity.

h. For riprap:
    i. The primary habitat functions of concern are related to floodplain connectivity, forage, natural cover, and free passage.
    ii. Acceptable mitigation for those losses include removal of existing riprap; retrofit existing riprap with vegetated riprap and LW, or one or more other streambank stabilization methods described in this opinion, and restoration of shallow water or off-channel habitats.

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[21] For additional information on compensatory mitigation, see Compensatory Mitigation for Losses of Aquatic Resources (33CFR332) at *www.poa.usace.army.mil/Portals/34/docs/regulatory/33cfr332.pdf*. More information is available from the U.S. Army Corps of Engineers, Portland District, Portland, Oregon. See: http://www.nwp.usace.army.mil/Missions/Regulatory/Mitigation.aspx

i. For a bridge replacement:
   i. The primary habitat functions of concern are floodplain connectivity, forage, natural cover, and free passage.
   ii. Acceptable mitigation is removing fill from elsewhere in the floodplain – native channel material, soil and vegetation may not be counted as fill.

j. Mitigation actions will meet general construction criteria and other appropriate minimization measures (dependent on the type of proposed mitigation).

1.3.1.3 Project Design Criteria - Types of Actions

40. Natural Hazard Response

a. A manager of a state, regional, county, or municipal stormwater facility, public transportation feature, or utility must initiate a natural hazard response by notifying the Corps.[22] The Corps will encourage the applicant to:
   i. Act as necessary to resolve the initial natural hazard.
   ii. 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 response to the maximum extent possible.

b. The Corps will also contact NMFS as part of the natural hazard response.
   i. As soon as possible after the onset of the natural hazard, the Corps will require the applicant to contact the Corps and NMFS to describe the nature and location of the natural hazard, 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 response action on listed species or their critical habitat.
   ii. For the Oregon Coast contact Ken Phippen (541-957-3385), for the Willamette Basin contact Marc Liverman (503-231-2336), and Lower Columbia River up to and including Oregon tributaries contact Jeff Fisher (360-534-9342), and for eastern Oregon contact Dale Bambrick (509-962-8911x221).

41. Streambank and Channel Stabilization

a. The following streambank stabilization methods may be used individually or in combination:
   i. Alluvium placement
   ii. Large wood placement
   iii. Vegetated riprap with large wood
   iv. Roughened toe
   v. Woody plantings
   vi. Herbaceous cover, in areas where the native vegetation does not include trees or shrubs
   vii. Bank reshaping and slope grading

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[22] Natural hazard response actions do not include federal assistance following a gubernatorial, county or local declaration of emergency or disaster with a request for federal assistance; a federal declaration of emergency or disaster; or any response to an emergency or disaster that takes place on federal property or to a federal asset because those actions are subject to emergency consultation provisions of 50 CFR 402.05

viii. Coir logs
ix. Deformable soil reinforcement
x. Engineered log jams (ELJ)
xi. Floodplain flow spreaders
xii. Floodplain roughness

b. For more information on the above methods see Federal Emergency Management Agency (2009)[23] or Cramer *et al.* (2003).[24] 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.
c. Stream barbs and full-spanning weirs are not allowed for stream bank stabilization under this opinion.
d. 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, and stabilize riffles. 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. **NMFS fish passage review and approval.** NMFS will review alluvium placement projects that would occupy more than 25% of the channel bed or more than 25% of the bankfull cross sectional area.
    ii. This design method is only approved 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 D_{84} to D_{max} size class material.
    v. Spawning gravels will constitute at least one-third of the total alluvial material used in the design.
    vi. Spawning gravels are to be placed at or below an elevation consistent with the water surface elevation of a bankfull event.
    vii. Spawning size gravel can be used to fill the voids within toe and bank material and placed directly onto stream banks in a manner that mimics natural debris flows and erosion.
    viii. 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*

[23] http://www.fema.gov/pdf/about/regions/regionx/Engineering_With_Nature_Web.pdf
[24] http://wdfw.wa.gov/publications/00046/wdfw00046.pdf

Providing Passage for Aquatic Organisms at Road-Stream Crossings (USDA-Forest Service 2008) to determine gravel sizes appropriate for the stream.

ix. Material can be mined from the floodplain at elevations above bankfull, but not in a manner that will cause stranding during future flood events.

x. Crushed rock is not permitted.

xi. After placement in areas accessible to higher stream flow, allow the stream to naturally sort and distribute the material.

xii. Do not place material directly on bars and riffles that are known spawning areas, which may cause fish to spawn on the unsorted and unstable gravel, thus potentially resulting in redd destruction.

xiii. Imported material will be free of invasive species and non-native seeds. If necessary, wash prior to placement.

e. **Large Wood Placements** are defined as 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. **NMFS fish passage review and approval.** NMFS will review LW placement projects that would occupy greater than 25% of the bankfull cross section area.

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

iii. Structures may partially or completely span stream channels or be positioned along stream banks.

iv. Where structures partially or completely span the stream channel LW should be comprised of whole conifer and hardwood trees, logs, and rootwads. LW size (diameter and length) should account for bankfull width and stream discharge rates.

v. Structures will incorporate a diverse size (diameter and length) distribution of rootwad or non-rootwad, trimmed or untrimmed, whole trees, logs, snags, slash, *etc.*

vi. For individual logs that are completely exposed, or embedded less than half their length, logs 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 width.

vii. Consider orienting key pieces such that the hydraulic forces upon the LW increase stability.

f. Vegetated riprap with large wood (LW)

i. NMFS will review and approve bank stabilization projects that use vegetated riprap with LW.
ii. When this method is necessary, limit installation to the areas identified as most highly erodible, with highest shear stress, or at greatest risk of mass-failure, and provide compensatory mitigation. The greatest risk of mass-failure will usually be at the toe of the slope and will not extend above OHW elevation except in incised streams.
iii. Do not use invasive or non-native species for site restoration.
iv. Remove or control invasive plants until native plant species are well-established.
v. Do not apply surface fertilizer within 50-feet of any stream channel.
vi. Install fencing as necessary to prevent access to revegetated sites by livestock or unauthorized persons.
vii. Vegetated riprap with LW will be installed as follows:
    1. When present, use natural hard points, such as large, stable trees or rock outcrops, to begin or end the toe of the revetment.
    2. Develop rock size gradations for elevation zones on the bank, especially if the rock will extend above OHW – the largest rock should be placed at the toe of the slope, while small rock can be used higher in the bank where the shear stress is generally lower. Most upper bank areas will not require the use of any rock but can depend on the vegetation for erosion protection.
    3. For bank areas above OHW where rock is still deemed necessary, mix rock with soil to provide a better growing medium for plants.
    4. Minimum amount of wood incorporated into the treated area, for mitigation of riprap, is equal to the number of whole trees whose cumulative summation of rootwad diameters is equal to 80% of linear-feet of treated streambank or 20% of the treated area (square feet) of streambank, whichever is greater.
    5. Where whole trees are not used (*i.e.,* snags, logs, and partial trees) designers are required to estimate the dimensions of parent material based on rootwad diameter, and calculating a cumulative equivalency of whole trees.
    6. LW should be distributed throughout the structure (not just concentrated at the toe) to engage flows up to the bankfull flow. LW placed above the toe may be in the form of rootwad or non-rootwad, trimmed or untrimmed, whole trees, logs, snags, slash, *etc.* Maximize the exposure of wood to water by placing and orienting wood to project into the water column up to the bankfull elevation.
    7. Develop an irregular toe and bank line to increase roughness and habitat value.
    8. Use LW and irregular rock to create large interstitial spaces and small alcoves to create planting spaces and habitat to mitigate for flood-refuge impacts – do not use geotextile fabrics as filter behind

the riprap whenever possible, if a filter is necessary to prevent sapping, use a graduated gravel filter.

9. Structure toe will incorporate LW with intact rootwads. Minimum spacing between rootwads placed at the toe will be no greater than an average rootwad diameter.
10. Minimum rootwad diameter for LW placed at the toe of the structure shall be 1.0 times the bankfull depth, unless LW availability constrains the project to a smaller rootwad size. Where rootwad size is constrained due to availably, the largest diameter rootwads available should be used.
11. LW placed at the toe will be sturdy material, intact, hard, and undecayed and should be sized or embedded sufficiently to withstand the design flood.
12. Space between root wads may be filled with large boulders, trimmed or untrimmed, whole trees, logs, snags, slash, *etc.* When used, diameter of boulders placed between toe logs with rootwads should be 1.5 to 2.0 times log diameter at breast height (dbh) of adjacent toe logs. A reasonable maximum rock size is 5-6 feet in diameter.
13. Plant woody vegetation in the joints between the rocks to enhance streambank vegetation.
14. Where possible, use terracing, or other bank shaping, to increase habitat diversity.
15. When possible, create or enhance a vegetated riparian buffer.

viii. Monitor vegetated riprap each year following installation by visual inspection during low flows to examine transitions between undisturbed and treated banks to ensure that native soils above and behind the riprap are not collapsing, sinking, or showing other evidence of piping loss or movement of rock materials; and the overall integrity of the riprap treatment, including:

1. Loss of rock materials
2. Survival rate of vegetation
3. Anchoring success of LW placed in the treatment.
4. Any channel changes since construction.

g. Roughened toe

i. Where designs use any of the approved streambank stabilization methods outlined in this section, in lieu of lining the bank with riprap above the toe, the design of any rock-filled toe will adhere to project criteria outlined in (f) Vegetated riprap with large wood (7-15, from above).

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

h. **Engineered log jams (ELJ).** ELJs are structures composed of LW with at least three key members and incorporating the use of any mechanical anchoring system (*i.e.*, rebar, rope, angular or large rock, *etc.*). Native soil, simulated streambed and bank materials, wood, or buttressing with adjacent trees, are not mechanical anchoring systems. ELJs are designed to redirect flow, provide roughness, and provide stability to adjacent streambed and banks or downstream reaches, while providing valuable fish and wildlife habitat.

   i. **NMFS fish passage review and approval.** NMFS will review proposed ELJ projects.
   ii. ELJs will be patterned, to the greatest degree possible, after stable natural log jams.
   iii. Stabilizing or key pieces of LW will be intact and solid (little decay). If possible, acquire LW with untrimmed rootwads to provide functional refugia habitat for fish.

i. If LW mechanical anchoring is required, a variety of methods may be used. These include large angular rock, buttressing the wood between adjacent trees, 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. Use of cable is not covered by this opinion.

j. When a hole in the channel bed caused by local scour will be filled with rock to prevent damage to a culvert, road, or bridge foundation, the amount of rock will be limited to the minimum necessary to protect the integrity of the structure.

k. When a footing, facing, head wall, or other protection will be constructed with rock to prevent scouring or down-cutting of, or fill slope erosion or failure at, an existing culvert or bridge, the amount of rock used will be limited to the minimum necessary to protect the integrity of the structure. Whenever feasible, include soil and woody vegetation as a covering and throughout the structure.

42. Road Maintenance, Rehabilitation and Replacement

a. All maintenance and rehabilitation actions shall observe applicable criteria detailed in the most recent version of NMFS fish passage criteria

   i. Projects affecting fish passage shall adhere to industry design standards found in the most recent version of any of the following:
      1. *Water Crossings Design Guidelines* (Barnard *et al.* 2013)[25]
      2. *Part XII, Fish Passage Design and Implementation, Salmonid Stream Habitat Restoration Manual* (California Department of Fish and Game 2009)[26]
      3. *Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream* (USDA-Forest Service 2008)[27]
      4. Or other design references approved by NMFS.
   ii. Routine road surface, culvert and bridge maintenance activity will be completed in accordance with the *ODOT Routine Road Maintenance: Water Quality and Habitat Guide Best Management Practices* (ODOT

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[25] http://wdfw.wa.gov/publications/01501/

[26] https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=12512

[27] http://stream.fs.fed.us/fishxing/aop_pdfs.html

2009) or the most recent version approved by NMFS, unless maintenance activities and practices in that manual conflict with PDC in this opinion.

1. Any conflict between ODOT (2009) and this opinion (*e.g.*, stormwater management for maintenance yards, erosion repair related to use of riprap, dust abatement, and use of pesticides) will be resolved in favor of PDC in this opinion.

b. Grade stabilization

i. Grade control materials may include both rock and LW. Material shall not in any part consist of gabion baskets, sheet piles, concrete, articulated concrete blocks, or cable anchors.

ii. Grade control shall be provided using morphologically-appropriate constructed riffles for riffle-pool morphologies, rough constructed riffles/ramps for plane bed morphologies, wood/debris jams, rock bands, and boulder weirs for step-pool morphologies, and roughened channels for cascade morphologies.

iii. LW placements and ELJs may be used to control grade individually or together with other grade control methods by simulating natural log jams and debris accumulation that traps sediment and creates forced, riffle-pool, step-pool, or cascade-pool morphologies.

iv. Stream banks and bed shall be designed to be immobile at the design event to reduce undermining and flanking.

v. The crest of channel spanning structures will be slightly sloped on either side, with the low point in the center, to direct flows to the middle of channel and away from streambanks. Install these structures low in relation to channel dimensions so that they are completely overtopped during channel-forming flow events (approximately a 1.0- to 1.5-year flow event).

vi. Construct boulder weir structures in a 'V' or 'U' shape, oriented with the apex upstream.

vii. Key all structures into the streambed at a depth which minimizes structure undermining due to scour, at least 2.5 times their exposure height, or the Lower Vertical Adjustment Potential (LVAP) line with an offset of 2 times D_{90}, whichever is deeper.

1. LVAP, and 2 times D_{90} offset, as calculated in *Stream Simulation: An ecological approach to providing passage for aquatic organisms at road crossings* (USDA-Forest Service 2008).

viii. Structures should be keyed into both banks—if feasible greater than 8 feet.

ix. If several drop structures will be used in series, space them at the appropriate distances to promote fish passage of target species and life histories. Incorporate NMFS (2011a) fish passage criteria (jump height, pool depth, *etc.*) in the design of drop structures.

x. Recommended spacing for boulder weirs should be no closer than the net drop divided by the channel slope (for example, a one-foot high step structure designed with a project slope of two-percent gradient will have a minimum spacing of 50-feet [1/0.02]). Maximum project slope for boulder weir designs is 5%.

xi. A series of short steep rough ramps/chutes, cascades, or roughened channel type structures, broken up by energy dissipating pools, are required where project slope is greater than 5%.

c. Rock Structures
    i. Rock structures will be constructed out of a mix of well-graded boulder, cobble, and gravel, including the appropriate level of fines, to allow for compaction and sealing to ensure minimal loss of surface flow through the newly placed material.
    ii. Rock sizing depends on the size of the stream, maximum depth of flow, plan form, entrenchment, and ice and debris loading.
    iii. The project designer or an inspector experienced in these structures should be present during installation.
    iv. To ensure that the structure is adequately sealed, no sub-surface flow will be present before equipment leaves the site.
    v. Rock shall be durable and of suitable quality to assure long-term stability in the climate in which it is to be used.
    i. Where feasible, channel spanning structures should be coupled with LW to improve habitat complexity of riparian areas.

d. Structure Stabilization
    i. When a footing, facing, head wall, or other protection will be constructed with rock to prevent scouring or down-cutting of, or fill slope erosion or failure at, an existing culvert or bridge, the amount of rock used is limited to the minimum necessary to protect the integrity of the structure. Include soil, vegetation, and wood throughout the structure to the level possible.

e. Road-stream crossing replacement or retrofit
    i. Projects shall adhere to industry design standards found in the most recent version any of the following:
        1. *Water Crossings Design Guidelines* (Barnard *et al.* 2013)[28]
        2. *Part XII, Fish Passage Design and Implementation, Salmonid Stream Habitat Restoration Manual* (California Department of Fish and Game 2009)[29]
        3. *Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream* (USDA-Forest Service 2008)[30]
        4. Or other design references approved by NMFS.
    ii. General road-stream crossing criteria
        1. Span
            a. Span is determined by the crossing width at the proposed streambed grade.

[28] http://wdfw.wa.gov/publications/01501/

[29] https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=12512

[30] http://stream.fs.fed.us/fishxing/aop_pdfs.html

b. Single span structures will maintain a clear, unobstructed opening above the general scour elevation that is at least as wide as 1.5 times the active channel width.[31]
c. Multi-span structures will maintain clear, unobstructed openings above the general scour elevation (except for piers or interior bents) that are at least as wide as 2.2 times the active channel width.
d. Entrenched streams: If a stream is entrenched (entrenchment ratio of less than 1.4), the crossing width will accommodate the flood prone width. Flood prone width is the channel width measured at twice the maximum bankfull depth (Rosgen 1996).
e. Minimum structure span is 6 feet.

2. Bed Material
    a. Install clean alluvium with similar angularity as the natural bed material, no crushed rock.
    b. Bed material shall be designed based on the native particle size distribution of the adjacent channel or reference reach, as quantified by a pebble count.
    c. Rock band designs as detailed in *Water Crossings Design Guidelines* (Barnard *et al.* 2013) are authorized.
    d. Bed material in systems where stream gradient exceeds 3% may be conservatively sized to resist movement.
3. Scour Prism
    a. Designs shall maintain the general scour prism, as a clear, unobstructed opening (*i.e.*, free of any fill, embankment, scour countermeasure, or structural material to include abutments, footings, and culvert inverts). No scour or stream stability countermeasure may be applied above the general scour elevation.[32]
        a. The lateral delineation of the scour prism is defined by the criteria span.
        b. The vertical delineation of the scour prism is defined by the Lower Vertical Adjustment Potential (LVAP) with an additional offset of 2 times D_{90}, as calculated in *Stream Simulation: An ecological approach to providing passage for aquatic*

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[31] Active channel width means the stream width measured perpendicular to stream flow between the OHW lines, or at the channel bankfull elevation if the OHW lines are indeterminate. This width includes the cumulative active channel width of all individual side- and off-channel components of channels with braided and meandering forms, and measure outside the area influence of any existing stream crossing, *e.g.*, five to seven channel widths upstream and downstream.

[32] For guidance on how to complete bridge scour and stream stability analysis, see Lagasse *et al.* (2012) (HEC-20), Lagasse *et al.* (2001) (HEC-23), Richardson and Davis (2001) (HEC-18), ODOT (2011), and AASHTO (2013).

organisms at road crossings (USDA-Forest Service 2008).

b. When bridge abutments or culvert footings are set back beyond the applicable criteria span they are outside the scour prism.

4. Embedment
   a. All abutments, footings, and inverts shall be placed below the thalweg a depth of 3 feet, or the LVAP line with an offset of 2 times D_{90}, whichever is deeper.
      i. LVAP, and 2 times D_{90} offset, as calculated in *Stream Simulation: An ecological approach to providing passage for aquatic organisms at road crossings* (USDA-Forest Service 2008).
   b. In addition to embedment depth, embedment of closed bottom culverts shall be between 30% and 50% of the culvert rise.
5. Bridges
   a. Primary bridge structural elements will be concrete, metal, fiberglass, or untreated timber. The use of treated wood for bridge construction or replacement is not part of this proposed action. The use of treated wood for maintenance and repair of existing wooden bridges is part of the proposed action if in conformance with project design criterion 29.
   b. All concrete will be poured in the dry, or within confined waters not connected to surface waters, and will be allowed to cure a minimum of 7 days before contact with surface water as recommended by Washington State Department of Transportation (2010).
   c. Riprap may only be placed below bankfull height of the stream when necessary for protection of abutments and pilings. The amount and placement of riprap will not constrict the bankfull flow.
   d. Temporary work bridges will also meet the latest version of NMFS (2011a) criteria.

iii. The electronic notification for each permanent stream crossing replacement will contain the following:
   1. Site sketches, drawings, aerial photographs, or other supporting specifications, calculations, or information that is commensurate with the scope of the action, that show the active channel, the 100-year floodplain, the functional floodplain, any artificial fill within the project area, the existing crossing to be replaced, and the proposed crossing.
   2. A completed scour and stream stability analysis for any crossing that includes scour or stream stability countermeasures within the

crossing opening that shows the general scour elevation and the local scour elevation for any pier or interior bent.

3. The name, address, and telephone number of a person responsible for designing this part of the action that NMFS may contact if additional information is necessary to complete the effects analysis.

f. **NMFS fish passage review and approval.** The Corps will not issue a permit to install, replace, or improve a road-stream crossing, step structure, fish ladder, or projects containing grade control, stream stability, or headcut countermeasures, until the action has been reviewed and approved by NMFS for consistency with NMFS's fish passage criteria (NMFS 2011a).

43. Utility Line Stream Crossings

a. Design utility line stream crossings in the following priority:
   i. Aerial lines, including lines hung from existing bridges.
   ii. Directional drilling, boring and jacking that spans the channel migration zone and any associated wetland.
   iii. Trenching – this method is restricted to intermittent streams and may only be used when the stream is naturally dry, all trenches will be backfilled below the OHW line with native material and capped with clean gravel suitable for fish use in the project area.

b. Align each crossing as perpendicular to the watercourse as possible. Ensure that the drilled, bored or jacked crossings are below the total scour prism.

c. Any large wood displaced by trenching or plowing will be returned as nearly as possible to its original position, or otherwise arranged to restore habitat functions.

d. Any action involving a stormwater outfall will meet the stormwater management criteria.[33]

e. NMFS will review new or upgraded stormwater outfalls.

The NMFS relied on the foregoing description of the proposed action, including all PDCs, to complete this consultation.

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). For this consultation, the overall program action area consists of the combined action areas for each action to be authorized

[33] The most efficient way for an applicant or the Corps to prepare and submit a stormwater management plan for NMFS' review is to attach a completed *Checklist for Submission of a Stormwater Management Plan* (the *Checklist*, ODEQ updated 2012, or the most recent version) with the electronic notification when it is sent to the SLOPES mailbox. However, stormwater conveyance to a DEQ permitted Municipal Separate Storm Sewer System (MS4) or consistency with any other program acknowledged by DEQ as adequate for stormwater management will not meet the requirements of this opinion unless NMFS determines that the facility accepting the stormwater will provide a level of treatment that is equivalent to that called for in this opinion. The *Checklist* and guidelines for its use are available from NMFS or the ODEQ in Portland Oregon. The latest version of the *Checklist* is also available online in a portable document format (pdf) through the ODEQ Water Quality Section 401 certification webpage (ODEQ 2014) at http://www.deq.state.or.us/wq/sec401cert/process.htm#add (see "Post Construction Stormwater Management Plan").

or carried out under this opinion within the range of ESA-listed salmon, steelhead, green sturgeon, eulachon, designated critical habitat, or designated EFH in Oregon. This includes all upland, riparian and aquatic areas affected by site preparation, construction, and site restoration PDC at each action site. This includes streams, rivers, estuaries and nearshore areas in 12 of the 18 river basins that occur in Oregon: North Coast, Mid Coast, Umpqua, South Coast, Rogue, Willamette, Sandy, Hood, Deschutes, John Day, Umatilla (including part of the Walla Walla River), and Grande Ronde. Five river basins in Oregon are not included because those basins have natural or artificial barriers that preclude anadromous migration, thus making them inaccessible to species considered in this opinion: Goose and Summer Lakes, Harney, Owyhee, Malheur, and Powder. All actions authorized by this opinion will occur within the jurisdiction of the Corps Portland District in Oregon. The waters that form the Klamath River system do not fall within the geographic jurisdiction of the Portland District and thus no SLOPES projects will be authorized within that basin (nor will SLOPES projects authorized in other areas have effects in that basin).

2. ENDANGERED SPECIES ACT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the U.S. Fish and Wildlife Service, NMFS, or both, to 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. Section 7(b)(3) requires that at the conclusion of consultation, the Service provide an opinion stating how the agencies' actions will affect listed species or their critical habitat. If incidental take is expected, section 7(b)(4) requires the provision of an incidental take statement specifying the impact of any incidental taking, and including reasonable and prudent measures to minimize such impacts.

2.1 Approach to the Analysis

Section 7(a)(2) of the ESA requires Federal agencies to consult with NMFS to 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. The jeopardy analysis considers both survival and recovery of the species. The adverse modification analysis considers the impacts to the conservation value of the designated critical habitat.
"To jeopardize the continued existence of a listed species" means 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).

This opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.[34]

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[34] Memorandum from William T. Hogarth to Regional Administrators, Office of Protected Resources, NMFS

We will use the following approach to determine whether the proposed action described in Section 1.3 is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Identify the rangewide 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.
- 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 affected by the proposed action. The status is the level of risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. The species status section 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 physical and biological features 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.

2.2.1 Status of Listed Species

For Pacific salmon, steelhead, and other relevant species NMFS commonly uses four parameters to assess the viability of the populations that, together, constitute the species: spatial structure, diversity, abundance, and productivity (McElhany *et al.* 2000). These "viable salmonid population" (VSP) criteria therefore encompass the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. When these parameters are collectively at appropriate levels, they maintain a population's capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment. These attributes are influenced by survival, behavior, and experiences throughout a species' entire life cycle, and these characteristics, in turn, are influenced by habitat and other environmental conditions.

"Spatial structure" refers both to the spatial distributions of individuals in the population and the processes that generate that distribution. A population's spatial structure depends fundamentally

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(Application of the "Destruction or Adverse Modification" Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005).

on habitat quality and spatial configuration and the dynamics and dispersal characteristics of individuals in the population.

"Diversity" refers to the distribution of traits within and among populations. These range in scale from DNA sequence variation at single genes to complex life history traits (McElhany *et al.* 2000).

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

"Productivity," as applied to viability factors, refers to the entire life cycle; *i.e.*, the number of naturally-spawning adults produced per parent. When progeny replace or exceed the number of parents, a population is stable or increasing. When progeny fail to replace the number of parents, the population is declining. McElhany *et al.* (2000) use the terms "population growth rate" and "productivity" interchangeably when referring to production over the entire life cycle. They also refer to "trend in abundance," which is the manifestation of long-term population growth rate.

For species with multiple populations, once the biological status of a species' populations has been determined, NMFS assesses the status of the entire species using criteria for groups of populations, as described in recovery plans and guidance documents from technical recovery teams. Considerations for species viability include having multiple populations that are viable, ensuring that populations with unique life histories and phenotypes are viable, and that some viable populations are both widespread to avoid concurrent extinctions from mass catastrophes and spatially close to allow functioning as metapopulations (McElhany *et al.* 2000).

The summaries that follow describe the status of the ESA-listed species, and their designated critical habitats, that occur within the geographic area of this proposed action and are considered in this opinion.

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. These changes will not be spatially homogeneous across the Pacific Northwest. Areas with elevations high enough to maintain temperatures well below freezing for most of the winter and early-spring will be less affected. Low-elevation areas are likely to be more affected. During the last century, average regional air temperatures increased by 1.5°F, and increased up to 4°F in some areas. Warming is likely to continue during the next century as average temperatures increase another 3 to 10°F. Overall, about one-third of the current cold-water fish habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (USGCRP 2009).

Precipitation trends during the next century are less certain than for temperature but more precipitation is likely to occur during October through March and less during summer months, and more of the winter precipitation is likely to fall as rain rather than snow (ISAB 2007; USGCRP 2009). Where snow occurs, a warmer climate will cause earlier runoff so stream flows in late spring, summer, and fall will be lower and water temperatures will be warmer (ISAB 2007; USGCRP 2009).

Higher winter stream flows increase the risk that winter floods in sensitive watersheds will damage spawning redds and wash away incubating eggs. Earlier peak stream flows will also flush some young salmon and steelhead from rivers to estuaries before they are physically mature, increasing stress and the risk of predation. Lower stream flows and warmer water temperatures during summer will degrade summer rearing conditions, in part by increasing the prevalence and virulence of fish diseases and parasites (USGCRP 2009). Other adverse effects are likely to include altered migration patterns, accelerated embryo development, premature emergence of fry, variation in quality and quantity of tributary rearing habitat, and increased competition and predation risk from warm-water, non-native species (ISAB 2007).

The earth's oceans are also warming, with considerable interannual and inter-decadal variability superimposed on the longer-term trend (Bindoff *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 (Scheuerell and Williams 2005; USGCRP 2009; Zabel *et al.* 2006). Ocean conditions adverse to salmon and steelhead may be more likely under a warming climate (Zabel *et al.* 2006).

The status of species and critical habitat sections below are organized under four recovery domains (Table 4) to better integrate recovery planning information that NMFS is developing on the conservation status of the species and critical habitats considered in this consultation.

Table 4. Recovery planning domains identified by NMFS and their ESA-listed salmon and steelhead species.

Recovery Domain	Species
Willamette-Lower Columbia (WLC)	LCR Chinook salmon UWR Chinook salmon CR chum salmon LCR coho salmon LCR steelhead UWR steelhead
Interior Columbia (IC)	UCR spring-run Chinook salmon SR spring/summer-run Chinook salmon SR fall-run Chinook salmon SR sockeye salmon MCR steelhead UCR steelhead SRB steelhead
Oregon Coast (OC)	OC coho salmon
Southern Oregon/Northern California Coasts (SONCC)	SONCC coho salmon

For each recovery domain, a technical review team (TRT) appointed by NMFS has developed, or is developing, criteria necessary to identify independent populations within each species, recommended viability criteria for those species, and descriptions of factors that limit species survival. Viability criteria are prescriptions of the biological conditions for populations, biogeographic strata, and evolutionarily significant units (ESU) that, if met, would indicate that an ESU will have a negligible risk of extinction over a 100-year time frame.[35]

Although the TRTs operated from the common set of biological principals described in McElhany *et al.* (2000), they worked semi-independently from each other and developed criteria suitable to the species and conditions found in their specific recovery domains. All of the criteria have qualitative as well as quantitative aspects. The diversity of salmonid species and populations makes it impossible to set narrow quantitative guidelines that will fit all populations in all situations. For this and other reasons, viability criteria vary among species, mainly in the number and type of metrics and the scales at which the metrics apply (*i.e.*, population, major population group (MPG), or ESU) (Busch *et al.* 2008).

The abundance and productivity (A&P) score considers the TRT's estimate of a populations' minimum threshold population, natural spawning abundance and the productivity of the population. Productivity over the entire life cycle and factors that affect population growth rate provide information on how well a population is "performing" in the habitats it occupies during the life cycle. Estimates of population growth rate that indicate a population is consistently failing to replace itself are an indicator of increased extinction risk. The four metrics (abundance, productivity, spatial structure, and diversity) are not independent of one another and their relationship to sustainability depends on a variety of interdependent ecological processes (Wainwright *et al.* 2008).

Integrated spatial structure and diversity (SS/D) risk combines risk for likely, future environmental conditions, and diversity (Ford 2011; McElhany *et al.* 2007; McElhany *et al.* 2000). Diversity factors include:

- Life history traits: Distribution of major life history strategies within a population, variability of traits, mean value of traits, and loss of traits.
- Effective population size: One of the indirect measures of diversity is effective population size. A population at chronic low abundance or experiencing even a single episode of low abundance is at a higher extinction risk because of loss of genetic variability, inbreeding and the expression of inbreeding depression, or the effects of mutation accumulation.
- Impact of hatchery fish: Interbreeding of wild populations and hatchery origin fish are a significant risk factor to the diversity of wild populations if the proportion of hatchery fish in the spawning population is high and their genetic similarity to the wild population is low.

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[35] For Pacific salmon, NMFS uses its 1991 ESU policy, that states that a population or group of populations will be considered a Distinct Population Segment if it is an Evolutionarily Significant Unit. An ESU represents a distinct population segment of Pacific salmon under the Endangered Species Act that: (1) is substantially reproductively isolated from conspecific populations; and (2) represents an important component of the evolutionary legacy of the species. The species *O. mykiss* is under the joint jurisdiction of NMFS and the Fish and Wildlife Service, so in making its listing January, 2006 determinations NMFS elected to use the 1996 joint FWS-NMFS DPS policy for this species.

- Anthropogenic mortality: The susceptibility to mortality from harvest or habitat alterations will differ depending on size, age, run timing, disease resistance or other traits.
- Habitat diversity: Habitat characteristics have clear selective effects on populations, and changes in habitat characteristics are likely to eventually lead to genetic changes through selection for locally adapted traits. In assessing risk associated with altered habitat diversity, historical diversity is used as a reference point.

Overall viability risk scores (high to low) and population persistence scores are based on combined ratings for the A&P and SS/D[36] metrics (Table 5) (McElhany *et al.* 2006). Persistence probabilities, which are provided here for Lower Columbia River salmon and steelhead, are the complement of a population's extinction risk (*i.e.*, persistence probability = 1 – extinction risk) (NMFS 2013a). The IC-TRT has provided viability criteria that are based on McElhany (2000) and McElhany (2006), as well as the results of previous applications in other TRTs and a review of specific information available relative to listed IC ESU populations (Ford 2011; IC-TRT 2007).

Table 5. Population persistence categories from McElhany *et al.* (2006). A low or negligible risk of extinction is considered "viable" (Ford 2011). Population persistence categories correspond to: 4 = very low (VL), 3 = low (L), 2 = moderate (M), 1 = high (H), and 0 = very high (VH) in Oregon populations, which corresponds to "extirpated or nearly so" (E) in Washington populations (Ford 2011).

Population Persistence Category	Probability of population persistence in 100 years	Probability of population extinction in 100 years	Description
0	0-40%	60-100%	Either extinct or "high" risk of extinction
1	40-75%	25-60%	Relatively "high" risk of extinction in 100 years
2	75-95%	5-25%	"Moderate" risk of extinction in 100 years
3	95-99%	1-5%	"Low" (negligible) risk of extinction in 100 years
4	>99%	<1%	"Very low" risk of extinction in 100 years

The boundaries of each population were defined using a combination of genetic information, geography, life-history traits, morphological traits, and population dynamics that indicate the extent of reproductive isolation among spawning groups. To date, the TRTs have divided the 15 species of salmon and steelhead considered in this opinion into a total of 304 populations, although the population structure of PS steelhead has yet to be resolved. The overall viability of a species is a function of the VSP attributes of its constituent populations. Until a viability analysis of a species is completed, the VSP guidelines recommend that all populations should be managed to retain the potential to achieve viable status to ensure a rapid start along the road to recovery,

[36] The WLC-TRT provided ratings for diversity and spatial structure risks. The IC-TRT provided spatial structure and diversity ratings combined as an integrated SS/D risk.

and that no significant parts of the species are lost before a full recovery plan is implemented (McElhany *et al.* 2000).

The size and distribution of the populations considered in this opinion generally have declined over the last few decades due to natural phenomena and human activity, including climate change (as described in Section 2.2), the operation of hydropower systems, over-harvest, effects of hatcheries, and habitat degradation. Enlarged populations of terns, seals, California sea lions, and other aquatic predators in the Pacific Northwest may be limiting the productivity of some Pacific salmon and steelhead populations (Ford 2011).

Viability status or probability or population persistence is described below for each of the populations considered in this opinion. Although southern DPS eulachon are part of more than one recovery domain structure, they are presented below for convenience as part of the WLC recovery domain.

Willamette-Lower Columbia Recovery Domain. Species in the WLC recovery domain we considered include LCR Chinook salmon, UWR Chinook salmon, CR chum salmon, LCR coho salmon, LCR steelhead, UWR steelhead, southern green sturgeon, and southern DPS eulachon. The WLC-TRT has identified 107 demographically independent populations of Pacific salmon and steelhead (Table 6). These populations were further aggregated into strata, groupings above the population level that are connected by some degree of migration, based on ecological subregions. All 107 populations use parts of the mainstem of the Columbia River and the Columbia River estuary for migration, rearing, and smoltification.

Table 6. Populations of ESA-listed salmon and steelhead in the WLC recovery domain.

Species	Populations
LCR Chinook salmon	32
UWR Chinook salmon	7
CR chum salmon	17
LCR coho salmon	24
LCR steelhead	23
UWR steelhead	4

Status of LCR Chinook Salmon

Spatial Structure and Diversity. This species includes all naturally-spawned populations of Chinook salmon in the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River; the Willamette River to Willamette Falls, Oregon, exclusive of spring-run Chinook salmon in the Clackamas River; and progeny of seventeen artificial propagation programs.[37] LCR Chinook populations exhibit three different life history types base on return timing and other features: fall-run (a.k.a. "tules"), late-fall-run (a.k.a. "brights"), and spring-run. The WLC-TRT identified 32 historical populations of LCR Chinook salmon— seven in the coastal subregion, six in the Columbia Gorge, and 19 in the Cascade Range (Table 7). Spatial structure has been substantially reduced in several populations. Low abundance, past brood stock transfers and other legacy hatchery effects, and ongoing hatchery straying may have reduced genetic diversity within and among LCR Chinook salmon populations. Hatchery-origin fish spawning naturally may also have reduced population productivity (Lower Columbia Fish Recovery Board 2010; NMFS 2013a; ODFW 2010). Out of the 32 populations that make up this ESU, only the two late-fall runs, the North Fork Lewis and Sandy, are considered viable. Most populations (26 out of 32) have a very low probability of persistence over the next 100 years (and some are extirpated or nearly so) (Ford 2011; Lower Columbia Fish Recovery Board 2010; NMFS 2013a; ODFW 2010). Five of the six strata fall significantly short of the WLC-TRT criteria for viability; one stratum, Cascade late-fall, meets the WLC TRT criteria (NMFS 2013a).

[37] In 2009, the Elochoman tule fall Chinook salmon program was discontinued and four new fall Chinook salmon programs have been initiated. In 2011, NMFS recommended removing the Elochoman program from the ESU and adding the new programs to the ESU (NMFS 2011b).

Table 7. LCR Chinook salmon strata, ecological subregions, run timing, populations, and scores for the key elements (A&P, spatial structure, and diversity) used to determine overall net persistence probability of the population (NMFS 2013a). Persistence probability ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH).

Stratum: Ecological Subregion	Stratum: Run Timing	Spawning Population (Watershed)	A&P	Spatial Structure	Diversity	Overall Persistence Probability
Cascade Range	Spring	Upper Cowlitz River (WA)	VL	L	M	VL
		Cispus River (WA)	VL	L	M	VL
		Tilton River (WA)	VL	VL	VL	VL
		Toutle River (WA)	VL	H	L	VL
		Kalama River (WA)	VL	H	L	VL
		North Fork Lewis (WA)	VL	L	M	VL
		Sandy River (OR)	M	M	M	M
	Fall	Lower Cowlitz River (WA)	VL	H	M	VL
		Upper Cowlitz River (WA)	VL	VL	M	VL
		Toutle River (WA)	VL	H	M	VL
		Coweeman River (WA)	L	H	H	L
		Kalama River (WA)	VL	H	M	VL
		Lewis River (WA)	VL	H	H	VL
		Salmon Creek (WA)	VL	H	M	VL
		Clackamas River (OR)	VL	VH	L	VL
		Sandy River (OR)	VL	M	L	VL
		Washougal River (WA)	VL	H	M	VL
	Late Fall	North Fork Lewis (WA)	VH	H	H	VH
		Sandy River (OR)	VH	M	M	H
Columbia Gorge	Spring	White Salmon River (WA)	VL	VL	VL	VL
		Hood River (OR)	VL	VH	VL	VL
	Fall	Lower Gorge (WA & OR)	VL	M	L	VL
		Upper Gorge (WA & OR)	VL	M	L	VL
		White Salmon River (WA)	VL	L	L	VL
		Hood River (OR)	VL	VH	L	VL
Coast Range	Fall	Young Bay (OR)	L	VH	L	L
		Grays/Chinook rivers (WA)	VL	H	VL	VL
		Big Creek (OR)	VL	H	L	VL
		Elochoman/Skamokawa creeks (WA)	VL	H	L	VL
		Clatskanie River (OR)	VL	VH	L	VL
		Mill, Germany, and Abernathy creeks (WA)	VL	H	L	VL
		Scappoose River (OR)	L	H	L	L

Abundance and Productivity. A&P ratings for LCR Chinook salmon populations are currently "low" to "very low" for most populations, except for spring Chinook salmon in the Sandy River, which are "moderate" and late-fall Chinook salmon in North Fork Lewis River and Sandy River, which are "very high" (NMFS 2013a). Low abundance of natural-origin spawners (100 fish or fewer) has increased genetic and demographic risks. Other LCR Chinook populations have higher total abundance, but several of these also have high proportions of hatchery-origin spawners. Particularly for tule fall Chinook salmon populations, poor data quality prevents precise quantification of population abundance and productivity; data quality has been poor because of inadequate spawning surveys and the presence of unmarked hatchery-origin spawners (Ford 2011).

Limiting Factors include (NMFS 2013a; NOAA Fisheries 2011):

- Degraded estuarine and near-shore marine habitat resulting from cumulative impacts of land use and flow management by the Columbia River hydropower system
- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas, stream substrate, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, and development.
- Reduced access to spawning and rearing habitat mainly as a result of tributary hydropower projects
- Hatchery-related effects
- Harvest-related effects on fall Chinook salmon
- An altered flow regime and Columbia River plume has altered the temperature regime and estuarine food web, and has reduced ocean productivity
- 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 strandings that result from ship wakes
- Contaminants affecting fish health and reproduction

Status of UWR Chinook Salmon

Spatial Structure and Diversity. This species includes all naturally spawned populations of spring-run Chinook salmon in the Clackamas River; in the Willamette River and its tributaries above Willamette Falls, Oregon; and progeny of seven artificial propagation programs. All seven historical populations of UWR Chinook salmon identified by the WLC-TRT occur within the action area and are contained within a single ecological subregion, the western Cascade Range (Table 8). The McKenzie River population currently characterized as at a "low" risk of extinction and the Clackamas population has a "moderate" risk. (Ford 2011). Consideration of data collected since the last status review in 2005 has confirmed the high fraction of hatchery origin fish in all of the populations of this species (even the Clackamas and McKenzie rivers have hatchery fractions above WLC-TRT viability thresholds). All of the UWR Chinook salmon populations have "moderate" or "high" risk ratings for diversity. Clackamas River Chinook salmon have a "low" risk rating for spatial structure (Ford 2011).

Table 8. Scores for the key elements (A&P, diversity, and spatial structure) used to determine current overall viability risk for UWR Chinook salmon (ODFW and NMFS 2011). All populations are in the Western Cascade Range ecological subregion. Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH).

Population (Watershed)	A&P	Diversity	Spatial Structure	Overall Extinction Risk
Clackamas River	M	M	L	M
Molalla River	VH	H	H	VH
North Santiam River	VH	H	H	VH
South Santiam River	VH	M	M	VH
Calapooia River	VH	H	VH	VH
McKenzie River	VL	M	M	L
Middle Fork Willamette River	VH	H	H	VH

Abundance and Productivity. The Clackamas and McKenzie river populations currently have the best risk ratings for A&P, spatial structure, and diversity. Data collected since the BRT status update in 2005 highlighted the substantial risks associated with pre-spawning mortality. Although recovery plans are targeting key limiting factors for future actions, there have been no significant on-the-ground-actions since the last status review to resolve the lack of access to historical habitat above dams nor have there been substantial actions removing hatchery fish from the spawning grounds. Overall, the new information does not indicate a change in the biological risk category since the last status review (Ford 2011).

Limiting Factors include (NOAA Fisheries 2011; ODFW and NMFS 2011):

- Significantly reduced access to spawning and rearing habitat because of tributary dams
- Degraded freshwater habitat, especially floodplain connectivity and function, channel structure and complexity, and riparian areas and LW recruitment as a result of cumulative impacts of agriculture, forestry, and development
- Degraded water quality and altered temperature as a result of both tributary dams and the cumulative impacts of agriculture, forestry, and urban development
- Hatchery-related effects
- Anthropogenic introductions of non-native species and out-of-ESU races of salmon or steelhead have increased predation on, and competition with, native UWR Chinook salmon
- Ocean harvest rates of approximately 30%

Status of CR Chum Salmon

Spatial Structure and Diversity. This species includes all naturally-spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon, and progeny of three artificial propagation programs. The WLC-TRT identified 17 historical populations of CR chum salmon and aggregated these into four strata (Myers *et al.* 2006)

(Table 9). CR chum salmon spawning aggregations identified in the mainstem Columbia River were included in the population associated with the nearest river basin.

Table 9. CR chum salmon strata, ecological subregions, run timing, populations, and scores for the key elements (A&P, spatial structure, and diversity) used to determine current overall net persistence probability of the population (NMFS 2013a). Persistence probability ratings are very low (VL), low (L), moderate (M), high (H), to very high (VH).

Stratum		Spawning Population (Watershed)	A&P	Diversity	Spatial Structure	Overall Persistence Probability
Ecological Subregion	**Run Timing**					
Coast Range	Fall	Young's Bay (OR)	*	*	*	VL
		Grays/Chinook rivers (WA)	VH	M	H	M
		Big Creek (OR)	*	*	*	VL
		Elochoman/Skamakowa rivers (WA)	VL	H	L	VL
		Clatskanie River (OR)	*	*	*	VL
		Mill, Abernathy and Germany creeks (WA)	VL	H	L	VL
		Scappoose Creek (OR)	*	*	*	VL
Cascade Range	Summer	Cowlitz River (WA)	VL	L	L	VL
	Fall	Cowlitz River (WA)	VL	H	L	VL
		Kalama River (WA)	VL	H	L	VL
		Lewis River (WA)	VL	H	L	VL
		Salmon Creek (WA)	VL	L	L	VL
		Clackamas River (OR)	*	*	*	VL
		Sandy River (OR)	*	*	*	VL
		Washougal River (WA)	VL	H	L	VL
Columbia Gorge	Fall	Lower Gorge (WA & OR)	VH	H	VH	H
		Upper Gorge (WA & OR)	VL	L	L	VL

* No data are available to make a quantitative assessment.

The very low persistence probabilities or possible extirpations of most chum salmon populations are due to low abundance, productivity, spatial structure, and diversity. Although, hatchery production of chum salmon has been limited and hatchery effects on diversity are thought to have been relatively small, diversity has been greatly reduced at the ESU level because of presumed extirpations and the low abundance in the remaining populations (fewer than 100 spawners per year for most populations) (Lower Columbia Fish Recovery Board 2010; NMFS 2013a). The Lower Gorge population meets abundance and productivity criteria for very high levels of viability, but the distribution of spawning habitat (*i.e.*, spatial structure) for the population has been significantly reduced (Lower Columbia Fish Recovery Board 2010); spatial structure may need to be improved, at least in part, through better performance from the Oregon portion of the population (NMFS 2013a).

Abundance and Productivity. Of the 17 populations that historically made up this ESU, 15 of them (six in Oregon and nine in Washington) are so depleted that either their baseline probability of persistence is very low or they are extirpated or nearly so (Ford 2011; Lower Columbia Fish Recovery Board 2010; NMFS 2013a; ODFW 2010). All three strata in the ESU fall significantly short of the WLC-TRT criteria for viability. Currently almost all natural production occurs in just two populations: the Grays/Chinook and the Lower Gorge. The Grays/Chinook population has a moderate persistence probability, and the Lower Gorge population has a high probability of persistence (Lower Columbia Fish Recovery Board 2010; NMFS 2013a).

Limiting Factors include (NMFS 2013a; NOAA Fisheries 2011):

- Degraded estuarine and nearshore marine habitat resulting from cumulative impacts of land use and flow management by the Columbia River hydropower system
- Degraded freshwater habitat, in particular of floodplain connectivity and function, channel structure and complexity, stream substrate, and riparian areas and LW recruitment as a result of cumulative impacts of agriculture, forestry, and development
- Degraded stream flow as a result of hydropower and water supply operations
- Loss of access and loss of some habitat types as a result of passage barriers such as roads and railroads
- Reduced water quality
- Current or potential predation from hatchery-origin salmonids, including coho salmon
- An altered flow regime and Columbia River plume has altered the temperature regime and estuarine food web, and has reduced ocean productivity
- 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 strandings that result from ship wakes
- Contaminants affecting fish health and reproduction

Status of LCR Coho Salmon

Spatial Structure and Diversity. This species includes all naturally-spawned populations of coho salmon in the Columbia River and its tributaries in Washington and Oregon, from the mouth of the Columbia up to and including the White Salmon and Hood rivers; in the Willamette River to Willamette Falls, Oregon; and progeny of 25 artificial propagation programs.[38] Spatial diversity is rated "moderate" to "very high" for all the populations, except the North Fork Lewis River, which has a "low" rating for spatial structure.

Three status evaluations of LCR coho salmon status, all based on WLC-TRT criteria, have been conducted since the last NMFS status review in 2005 (McElhany *et al.* 2007; NMFS 2013a). Out of the 24 populations that make up this ESU (Table 10), 21 are considered to have a very low probability of persisting for the next 100 years, and none is considered viable (Ford 2011; Lower Columbia Fish Recovery Board 2010; NMFS 2013a; ODFW 2010).

[38] The Elochoman Hatchery Type-S and Type-N coho salmon programs were eliminated in 2008. The last adults from these two programs returned to the Elochoman in 2010. NMFS has recommended that these two programs be removed from the ESU (NMFS 2011b).

Table 10. LCR coho salmon strata, ecological subregions, run timing, populations, and scores for the key elements (A&P, spatial structure, and diversity) used to determine current overall net persistence probability of the population (NMFS 2013a). Persistence probability ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH).

Ecological Subregions	Population (Watershed)	A&P	Spatial Structure	Diversity	Overall Persistence Probability
Coast Range	Young's Bay (OR)	VL	VH	VL	VL
	Grays/Chinook rivers (WA)	VL	H	VL	VL
	Big Creek (OR)	VL	H	L	VL
	Elochoman/Skamokawa creeks (WA)	VL	H	VL	VL
	Clatskanie River (OR)	L	VH	M	L
	Mill, Germany, and Abernathy creeks (WA)	VL	H	L	VL
	Scappoose River (OR)	M	H	M	M
Cascade Range	Lower Cowlitz River (WA)	VL	M	M	VL
	Upper Cowlitz River (WA)	VL	M	L	VL
	Cispus River (WA)	VL	M	L	VL
	Tilton River (WA)	VL	M	L	VL
	South Fork Toutle River (WA)	VL	H	M	VL
	North Fork Toutle River (WA)	VL	M	L	VL
	Coweeman River (WA)	VL	H	M	VL
	Kalama River (WA)	VL	H	L	VL
	North Fork Lewis River (WA)	VL	L	L	VL
	East Fork Lewis River (WA)	VL	H	M	VL
	Salmon Creek (WA)	VL	M	VL	VL
	Clackamas River (OR)	M	VH	H	M
	Sandy River (OR)	VL	H	M	VL
	Washougal River (WA)	VL	H	L	VL
Columbia Gorge	Lower Gorge Tributaries (WA & OR)	VL	M	VL	VL
	Upper Gorge/White Salmon (WA)	VL	M	VL	VL
	Upper Gorge Tributaries/Hood (OR)	VL	VH	L	VL

Abundance and Productivity. In Oregon, the Clatskanie Creek and Clackamas River populations have "low" and "moderate" persistence probability ratings for A&P, while the rest are rated "very low." All of the Washington populations have "very low" A&P ratings. The persistence probability for diversity is "high" in the Clackamas population, "moderate" in the Clatskanie, Scappoose, Lower Cowlitz, South Fork Toutle, Coweeman, East Fork Lewis, and Sandy populations, and "low" to "very low" in the rest (NMFS 2013a). Uncertainty is high because of a lack of adult spawner surveys. Smolt traps indicate some natural production in Washington populations, though given the high fraction of hatchery origin spawners suspected to occur in these populations it is not clear that any are self-sustaining. Overall, the new information considered does not indicate a change in the biological risk category since the last status review (Ford 2011; NMFS 2011b; NMFS 2013a).

Limiting Factors include (NMFS 2013a; NOAA Fisheries 2011):

- Degraded estuarine and near-shore marine habitat resulting from cumulative impacts of land use and flow management by the Columbia River hydropower system
- Fish passage barriers that limit access to spawning and rearing habitats
- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and LW supply, stream substrate, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, and development
- Hatchery-related effects
- Harvest-related effects
- An altered flow regime and Columbia River plume has altered the temperature regime and estuarine food web, and has reduced ocean productivity
- 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 strandings that result from ship wakes
- Contaminants affecting fish health and reproduction

Status of LCR Steelhead

Spatial Structure and Diversity. Four strata and 23 historical populations of LCR steelhead occur within the DPS: 17 winter-run populations and six summer-run populations, within the Cascade and Gorge ecological subregions (Table 11).[39] The DPS also includes the progeny of ten artificial propagation programs.[40] Summer steelhead return to freshwater long before spawning. Winter steelhead, in contrast, return from the ocean much closer to maturity and spawn within a few weeks. Summer steelhead spawning areas in the Lower Columbia River are found above waterfalls and other features that create seasonal barriers to migration. Where no temporal barriers exist, the winter-run life history dominates.

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[39] The White Salmon and Little White Salmon steelhead populations are part of the Middle Columbia steelhead DPS and are addressed in a separate species-level recovery plan, the Middle Columbia River Steelhead Distinct Population Segment ESA Recovery Plan (NMFS 2009).

[40] In 2007, the release of Cowlitz Hatchery winter steelhead into the Tilton River was discontinued; in 2009, the Hood River winter steelhead program was discontinued; and in 2010, the release of hatchery winter steelhead into the Upper Cowlitz and Cispus rivers was discontinued. In 2011, NMFS recommended removing these programs from the DPS. A Lewis River winter steelhead program was initiated in 2009, and in 2011, NMFS proposed that it be included in the DPS (NMFS 2011b).

Table 11. LCR steelhead strata, ecological subregions, run timing, populations, and scores for the key elements (A&P, spatial structure, and diversity) used to determine current overall net persistence probability of the population (NMFS 2013a) Persistence probability ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH).

Stratum		Population (Watershed)	A&P	Spatial Structure	Diversity	Overall Persistence Probability
Ecological Subregion	**Run Timing**					
Cascade Range	Summer	Kalama River (WA)	H	VH	M	M
		North Fork Lewis River (WA)	VL	VL	VL	VL
		East Fork Lewis River (WA)	VL	VH	M	VL
		Washougal River (WA)	M	VH	M	M
	Winter	Lower Cowlitz River (WA)	L	M	M	L
		Upper Cowlitz River (WA)	VL	M	M	VL
		Cispus River (WA)	VL	M	M	VL
		Tilton river (WA)	VL	M	M	VL
		South Fork Toutle River (WA)	M	VH	H	M
		North Fork Toutle River (WA)	VL	H	H	VL
		Coweeman River (WA)	L	VH	VH	L
		Kalama River (WA)	L	VH	H	L
		North Fork Lewis River (WA)	VL	M	M	VL
		East Fork Lewis River (WA)	M	VH	M	M
		Salmon Creek (WA)	VL	H	M	VL
		Clackamas River (OR)	M	VH	M	M
		Sandy River (OR)	L	M	M	L
		Washougal River (WA)	L	VH	M	L
Columbia Gorge	Summer	Wind River (WA)	VH	VH	H	H
		Hood River (OR)	VL	VH	L	VL
	Winter	Lower Gorge (WA & OR)	L	VH	M	L
		Upper Gorge (OR & WA)	L	M	M	L
		Hood River (OR)	M	VH	M	M

It is likely that genetic and life history diversity has been reduced as a result of pervasive hatchery effects and population bottlenecks. Spatial structure remains relatively high for most populations Out of the 23 populations, 16 are considered to have a "low" or "very low" probability of persisting over the next 100 years, and six populations have a "moderate" probability of persistence (Ford 2011; Lower Columbia Fish Recovery Board 2010; NMFS 2013a; ODFW 2010). All four strata in the DPS fall short of the WLC-TRT criteria for viability (NMFS 2013a).

Baseline persistence probabilities were estimated to be "low" or "very low" for three out of the six summer steelhead populations that are part of the LCR DPS, moderate for two, and high for one, the Wind, which is considered viable. Thirteen of the 17 LCR winter steelhead populations have "low" or "very low" baseline probabilities of persistence, and the remaining four are at "moderate" probability of persistence (Table 11) (Lower Columbia Fish Recovery Board 2010; NMFS 2013a; ODFW 2010).

Abundance and Productivity. The "low" to "very low" baseline persistence probabilities of most Lower Columbia River steelhead populations reflects low abundance and productivity (NMFS 2013a). All of the populations increased in abundance during the early 2000s, generally peaking in 2004. Most populations have since declined back to levels within one standard deviation of the long term mean. Exceptions are the Washougal summer-run and North Fork Toutle winter-run, which are still higher than the long term average, and the Sandy, which is lower. In general, the populations do not show any sustained dramatic changes in abundance or fraction of hatchery origin spawners since the 2005 status review (Ford 2011). Although current LCR steelhead populations are depressed compared to historical levels and long-term trends show declines, many populations are substantially healthier than their salmon counterparts, typically because of better habitat conditions in core steelhead production areas (Lower Columbia Fish Recovery Board 2010; NMFS 2013a).

Limiting Factors include (NMFS 2013a; NOAA Fisheries 2011):

- Degraded estuarine and nearshore marine habitat resulting from cumulative impacts of land use and flow management by the Columbia River hydropower system
- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and recruitment of LW, stream substrate, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, and development
- Reduced access to spawning and rearing habitat mainly as a result of tributary hydropower projects and lowland development
- Avian and marine mammal predation in the lower mainstem Columbia River and estuary.
- Hatchery-related effects
- An altered flow regime and Columbia River plume has altered the temperature regime and estuarine food web, and has reduced ocean productivity
- 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 strandings that result from ship wakes
- Contaminants affecting fish health and reproduction

Status of UWR Steelhead

Spatial Structure and Diversity. This species includes all naturally-spawned steelhead populations below natural and manmade impassable barriers in the Willamette River, Oregon, and its tributaries upstream from Willamette Falls to the Calapooia River. One stratum and four extant populations of UWR steelhead occur within the DPS (Table 12). Historical observations, hatchery records, and genetics suggest that the presence of UWR steelhead in many tributaries on the west side of the upper basin is the result of recent introductions. Nevertheless, the WLC-TRT recognized that although west side UWR steelhead does not represent a historical population, those tributaries may provide juvenile rearing habitat or may be temporarily (for one or more generations) colonized during periods of high abundance. Hatchery summer-run steelheads that are released in the subbasins are from an out-of-basin stock, not part of the DPS. Additionally, stocked summer steelhead that have become established in the McKenzie River were not considered in the identification of historical populations (ODFW and NMFS 2011).

Table 12. Scores for the key elements (A&P, diversity, and spatial structure) used to determine current overall viability risk for UWR steelhead (ODFW and NMFS 2011). All populations are in the Western Cascade Range ecological subregion. Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH).

Population (Watershed)	A&P	Diversity	Spatial Structure	Overall Extinction Risk
Molalla River	VL	M	M	L
North Santiam River	VL	M	H	L
South Santiam River	VL	M	M	L
Calapooia River	M	M	VH	M

Abundance and Productivity. Since the last status review in 2005, UWR steelhead initially increased in abundance but subsequently declines and current abundance is at the levels observed in the mid-1990s when the DPS was first listed. The DPS appears to be at lower risk than the UWR Chinook salmon ESU, but continues to demonstrate the overall low abundance pattern that was of concern during the last status review. 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. Overall, the new information considered does not indicate a change in the biological risk category since the last status review (Ford 2011).

Limiting Factors include (NOAA Fisheries 2011; ODFW and NMFS 2011):

- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and LW recruitment, and stream flow have been degraded as a result of cumulative impacts of agriculture, forestry, and development
- Degraded water quality and altered temperature as a result of both tributary dams and the cumulative impacts of agriculture, forestry, and urban development
- Reduced access to spawning and rearing habitats mainly as a result of artificial barriers in spawning tributaries
- Hatchery-related effects: impacts from the non-native summer steelhead hatchery program
- Anthropogenic introductions of non-native species and out-of-ESU races of salmon or steelhead have increased predation and competition on native UWR steelhead.

Status of Southern DPS Green Sturgeon

Spatial Structure and Diversity. Two DPSs have been defined for green sturgeon (*Acipenser medirostris*), a northern DPS (spawning populations in the Klamath and Rogue rivers) and a southern DPS (spawners in the Sacramento River). Southern green sturgeon includes all naturally-spawned populations of green sturgeon that occur south of the Eel River in Humboldt County, California. When not spawning, this anadromous species is broadly distributed in nearshore marine areas from Mexico to the Bering Sea. Although it is commonly observed in bays, estuaries, and sometimes the deep riverine mainstem in lower elevation reaches of non-natal rivers along the west coast of North America, the distribution and timing of estuarine use are poorly understood.

In addition to the WLC recovery domain, southern green sturgeon occur in the OC and SONCC recovery domains.

Limiting factors. The principal factor for the decline of southern green sturgeon is the reduction of its spawning area to a single known population limited to a small portion of the Sacramento River. It is currently at risk of extinction primarily because of human-induced ''takes'' involving elimination of freshwater spawning habitat, degradation of freshwater and estuarine habitat quality, water diversions, fishing, and other causes (USDC 2010). Adequate water flow and temperature are issues of concern. Water diversions pose an unknown but potentially serious threat within the Sacramento and Feather Rivers and the Sacramento River Delta. Poaching also poses an unknown but potentially serious threat because of high demand for sturgeon caviar. The effects of contaminants and nonnative species are also unknown but potentially serious threats. As mentioned above, retention of green sturgeon in both recreational and commercial fisheries is now prohibited within the western states, but the effect of capture/release in these fisheries is unknown. There is evidence of fish being retained illegally, although the magnitude of this activity likely is small (NOAA Fisheries 2011).

Status of Southern DPS Eulachon

Spatial Structure and Diversity. The southern DPS of eulachon occur in four salmon recovery domains: Puget Sound, the Willamette and Lower Columbia, Oregon Coast, and Southern Oregon/Northern California Coasts. The ESA-listed population 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. Core populations for this species include the Fraser River, Columbia River and (historically) the Klamath River. Eulachon leave saltwater to spawn in their natal streams late winter through early summer, and typically spawn at night in the lower reaches of larger rivers fed by snowmelt. After hatching, larvae are carried downstream and widely dispersed by estuarine and ocean currents. Eulachon movements in the ocean are poorly known although the amount of eulachon bycatch in the pink shrimp fishery seems to indicate that the distribution of these organisms overlap in the ocean.

Abundance and Productivity. In the early 1990s, there was an abrupt decline in the abundance of eulachon returning to the Columbia River with no evidence of returning to their former population levels since then (Drake *et al.* 2008). Persistent low returns and landings of eulachon in the Columbia River from 1993 to 2000 prompted the states of Oregon and Washington to adopt a Joint State Eulachon Management Plan in 2001 that provides for restricted harvest management when parental run strength, juvenile production, and ocean productivity forecast a poor return (WDFW and ODFW 2001). Despite a brief period of improved returns in 2001–2003, the returns and associated commercial landings have again declined to the very low levels observed in the mid-1990s (Joint Columbia River Management Staff 2009), and since 2005, the fishery has operated at the most conservative level allowed in the management plan (Joint Columbia River Management Staff 2009). Large commercial and recreational fisheries have occurred in the Sandy River in the past. The most recent commercial harvest in the Sandy River was in 2003. No commercial harvest has been recorded for the Grays River from 1990 to the present, but larval sampling has confirmed successful spawning in recent years (USDC 2011).

Limiting Factors include (Gustafson *et al.* 2011; Gustafson *et al.* 2010; NOAA Fisheries 2011):

- Changes in ocean conditions due to climate change, particularly in the southern portion of its range where ocean warming trends may be the most pronounced and may alter prey, spawning, and rearing success.
- Climate-induced change to freshwater habitats, dams and water diversions (particularly in the Columbia and Klamath Rivers where hydropower generation and flood control are major activities)
- Bycatch of eulachon in commercial fisheries
- Adverse effects related to dams and water diversions
- Artificial fish passage barriers
- Increased water temperatures, insufficient streamflow
- Altered sediment balances
- Water pollution
- Over-harvest
- Predation

Interior Columbia Recovery Domain. Species in the Interior Columbia (IC) recovery domain include UCR spring-run Chinook salmon, SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, SR sockeye salmon, UCR steelhead, MCR steelhead, and SRB steelhead. The IC-TRT identified 82 populations of those species based on genetic, geographic (hydrographic), and habitat characteristics (Table 13). In some cases, the IC-TRT further aggregated populations into "major groupings" based on dispersal distance and rate, and drainage structure, primarily the location and distribution of large tributaries (IC-TRT 2003). All 82 populations identified use the lower mainstem of the Snake River, the mainstem of the Columbia River, and the Columbia River estuary, or part thereof, for migration, rearing, and smoltification.

Table 13. Populations of ESA-listed salmon and steelhead in the IC recovery domain.

Species	Populations
UCR spring-run Chinook salmon	3
SR spring/summer-run Chinook salmon	28
SR fall-run Chinook salmon	1
SR sockeye salmon	1
MCR steelhead	17
UCR steelhead	4
SRB steelhead	24

The IC-TRT also recommended viability criteria that follow the VSP framework (McElhany *et al.* 2006) and described biological or physical performance conditions that, when met, indicate a population or species has a 5% or less risk of extinction over a 100-year period (IC-TRT 2007; NRC 1995).

Status of UCR Spring-Run Chinook Salmon

Spatial Structure and Diversity. This species includes all naturally-spawned populations of Chinook salmon in all river reaches accessible to Chinook salmon in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam (excluding the Okanogan River), the Columbia River upstream to Chief Joseph Dam, and progeny of six artificial propagation programs. The IC-TRT identified four independent populations of UCR spring-run Chinook salmon in the upriver tributaries of Wenatchee, Entiat, Methow, and Okanogan (extirpated), but no major groups due to the relatively small geographic area affected (Ford 2011; IC-TRT 2003) (Table 14).

Table 14. Scores for the key elements (A/P, diversity, and SS/D) used to determine current overall viability risk for spring-run UCR Chinook salmon (Ford 2011). Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH), and extirpated.

Population	A/P	Diversity	Integrated SS/D	Overall Viability Risk
Wenatchee River	H	H	H	H
Entiat River	H	H	H	H
Methow River	H	H	H	H
Okanogan River				E

The composite SS/D risks for all three of the extant populations in this MPG are at "high" risk. The spatial processes component of the SS/D risk is "low" for the Wenatchee River and Methow River populations and "moderate" for the Entiat River (loss of production in lower section increases effective distance to other populations). All three of the extant populations in this MPG are at "high" risk for diversity, driven primarily by chronically high proportions of hatchery-origin spawners in natural spawning areas and lack of genetic diversity among the natural-origin spawners (Ford 2011).

Increases in natural origin abundance relative to the extremely low spawning levels observed in the mid-1990s are encouraging; however, average productivity levels remain extremely low. Overall, the viability of Upper Columbia Spring Chinook salmon ESU has likely improved somewhat since the last status review, but the ESU is still clearly at "moderate-to-high" risk of extinction (Ford 2011).

Abundance and Productivity. UCR spring-run Chinook salmon is not currently meeting the viability criteria (adapted from the IC-TRT) in the Upper Columbia Recovery Plan. A/P remains at "high" risk for each of the three extant populations in this MPG/ESU (Table 14). The

10-year geometric mean abundance of adult natural origin spawners has increased for each population relative to the levels for the 1981-2003 series, but the estimates remain below the corresponding IC-TRT thresholds. Estimated productivity (spawner to spawner return rate at low to moderate escapements) was on average lower over the years 1987-2009 than for the previous period. The combinations of current abundance and productivity for each population result in a "high" risk rating.

Limiting Factors include (NOAA Fisheries 2011; Upper Columbia Salmon Recovery Board 2007):

- Mainstem Columbia River hydropower–related adverse effects: upstream and downstream fish passage, ecosystem structure and function, flows, and water quality
- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and LW debris recruitment, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, and development
- Degraded estuarine and nearshore marine habitat
- Hatchery related effects: including past introductions and persistence of non-native (exotic) fish species continues to affect habitat conditions for listed species
- Harvest in Columbia River fisheries

Status of SR Spring/Summer-Run Chinook Salmon

Spatial Structure and Diversity. This species includes all naturally-spawned populations of spring/summer-run Chinook salmon in the mainstem Snake River and the Tucannon River, Grande Ronde River, Imnaha River, and Salmon River subbasins; and progeny of fifteen artificial propagation programs. The IC-TRT currently believes there are 27 extant and 4 extirpated populations of SR spring/summer-run Chinook salmon, and aggregated these into major population groups (Ford 2011; IC-TRT 2007). Each of these populations faces a "high" risk of extinction (Ford 2011) (Table 15).

Table 15. SR spring/summer-run Chinook salmon ecological subregions, populations, and scores for the key elements (A/P, diversity, and SS/D) used to determine current overall viability risk for SR spring/summer-run Chinook salmon (Ford 2011). Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH), and extirpated (E).

Ecological Subregions	Spawning Populations (Watershed)	A/P	Diversity	Integrated SS/D	Overall Viability Risk
Lower Snake River	Tucannon River	H	M	M	H
	Asotin River				E
Grande Ronde and Imnaha rivers	Wenaha River	H	M	M	H
	Lostine/Wallowa River	H	M	M	H
	Minam River	H	M	M	H
	Catherine Creek	H	M	M	H
	Upper Grande Ronde R.	H	M	H	H
	Imnaha River	H	M	M	H
	Big Sheep Creek				E
	Lookingglass Creek				E
South Fork Salmon River	Little Salmon River	*	*	*	H
	South Fork mainstem	H	M	M	H
	Secesh River	H	L	L	H
	EF/Johnson Creek	H	L	L	H
Middle Fork Salmon River	Chamberlin Creek	H	L	L	H
	Big Creek	H	M	M	H
	Lower MF Salmon	H	M	M	H
	Camas Creek	H	M	M	H
	Loon Creek	H	M	M	H
	Upper MF Salmon	H	M	M	H
	Sulphur Creek	H	M	M	H
	Bear Valley Creek	H	L	L	H
	Marsh Creek	H	L	L	H
Upper Mainstem Salmon	N. Fork Salmon River	H	L	L	H
	Lemhi River	H	H	H	H
	Pahsimeroi River	H	H	H	H
	Upper Salmon-lower mainstem	H	L	L	H
	East Fork Salmon River	H	H	H	H
	Yankee Fork	H	H	H	H
	Valley Creek	H	M	M	H
	Upper Salmon main	H	M	M	H
	Panther Creek				E

* Insufficient data.

The ability of SR spring/summer-run Chinook salmon populations to be self-sustaining through normal periods of relatively low ocean survival remains uncertain. Factors cited by Good (2005) remain as concerns or key uncertainties for several populations. Overall, the new information considered does not indicate a change in the biological risk category since the last status review (Ford 2011).

Abundance and Productivity. Population level status ratings remain at "high" risk across all MPGs within the ESU, although recent natural spawning abundance estimates have increased, all populations remain below minimum natural origin abundance thresholds (Table 15). Spawning escapements in the most recent years in each series are generally well below the peak returns but above the extreme low levels in the mid-1990s. Relatively low natural production rates and spawning levels below minimum abundance thresholds remain a major concern across the ESU.

Limiting Factors include (NOAA Fisheries 2011):

- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and LW supply, stream substrate, elevated water temperature, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, and development
- Mainstem Columbia River and Snake River hydropower impacts
- Harvest-related effects
- Predation

Status of SR Fall-Run Chinook Salmon

Spatial Structure and Diversity. This species includes all naturally-spawned populations of fall-run Chinook salmon in the mainstem Snake River below Hells Canyon Dam, and in the Tucannon River, Grande Ronde River, Imnaha River, Salmon River, and Clearwater River, and progeny of four artificial propagation programs. The IC-TRT identified three populations of this species, although only the lower mainstem population exists at present, and it spawns in the lower main stem of the Clearwater, Imnaha, Grande Ronde, Salmon and Tucannon rivers. The extant population of Snake River fall-run Chinook salmon is the only remaining population from an historical ESU that also included large mainstem populations upstream of the current location of the Hells Canyon Dam complex (Ford 2011; IC-TRT 2003). The population is at moderate risk for diversity and spatial structure. Overall, the new information considered does not indicate a change in the biological risk category since the last status review (Ford 2011).

Abundance and Productivity. The recent increases in natural origin abundance are encouraging. However, hatchery origin spawner proportions have increased dramatically in recent years – on average, 78% of the estimated adult spawners have been hatchery origin over the most recent brood cycle. The apparent leveling off of natural returns in spite of the increases in total brood year spawners may indicate that density dependent habitat effects are influencing production or that high hatchery proportions may be influencing natural production rates. The A/P risk rating for the population is "moderate." Given the combination of current A/P and SS/D ratings summarized above, the overall viability rating for Lower SR fall Chinook salmon is rated as "maintained."[41]

[41] "Maintained" population status is for populations that do not meet the criteria for a viable population but do

Limiting Factors include (NOAA Fisheries 2011):

- Degraded freshwater habitat: Floodplain connectivity and function, and channel structure and complexity have been degraded as a result of cumulative impacts of agriculture, forestry, and development.
- Harvest-related effects
- Loss of access to historic habitat above Hells Canyon and other Snake River dams
- Mainstem Columbia River and Snake River hydropower impacts
- Hatchery-related effects
- Degraded estuarine and nearshore habitat

Status of SR Sockeye Salmon

Spatial Structure and Diversity. This species includes all anadromous and residual sockeye salmon from the Snake River basin, Idaho, and artificially-propagated sockeye salmon from the Redfish Lake captive propagation program. The IC-TRT identified historical sockeye salmon production in at least five Stanley Basin and Sawtooth Valley lakes and in lake systems associated with Snake River tributaries currently cut off to anadromous access (*e.g.*, Wallowa and Payette Lakes), although current returns of SR sockeye salmon are extremely low and limited to Redfish Lake (IC-TRT 2007).

Abundance and Productivity. This species is still at extremely high risk across all four basic risk measures (abundance, productivity, spatial structure and diversity. Although the captive brood program has been successful in providing substantial numbers of hatchery produced *O. nerka* for use in supplementation efforts, substantial increases in survival rates across life history stages must occur to re-establish sustainable natural production (Hebdon *et al.* 2004; Keefer *et al.* 2008). Overall, although the risk status of the Snake River sockeye salmon ESU appears to be on an improving trend, the new information considered does not indicate a change in the biological risk category since the last status review (Ford 2011).

Limiting Factors. The key factor limiting recovery of SR sockeye salmon ESU is survival outside of the Stanley Basin. Portions of the migration corridor in the Salmon River are impeded by water quality and temperature (Idaho Department of Environmental Quality 2011). Increased temperatures likely reduce the survival of adult sockeye returning to the Stanley Basin. The natural hydrological regime in the upper mainstem Salmon River Basin has been altered by water withdrawals. In most years, sockeye adult returns to Lower Granite suffer catastrophic losses (Reed *et al.* 2003) (*e.g.*, > 50% mortality in one year) before reaching the Stanley Basin, although the factors causing these losses have not been identified. In the Columbia and lower Snake River migration corridor, predation rates on juvenile sockeye salmon are unknown, but terns and cormorants consume 12% of all salmon smolts reaching the estuary, and piscivorous fish consume an estimated 8% of migrating juvenile salmon (NOAA Fisheries 2011).

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support ecological functions and preserve options for ESU/DPS recovery.

Status of MCR Steelhead

Spatial Structure and Diversity. This species includes all naturally-spawned steelhead populations below natural and artificial impassable barriers in streams from above the Wind River, Washington, and the Hood River, Oregon (exclusive), upstream to, and including, the Yakima River, Washington, excluding steelhead from the Snake River basin; and progeny of seven artificial propagation programs. The IC-TRT identified 17 extant populations in this DPS (IC-TRT 2003). The populations fall into four major population groups: the Yakima River Basin (four extant populations), the Umatilla/Walla-Walla drainages (three extant and one extirpated populations); the John Day River drainage (five extant populations) and the Eastern Cascades group (five extant and two extirpated populations) (Table 16) (Ford 2011; NMFS 2009).

Table 16. Ecological subregions, populations, and scores for the key elements (A/P, diversity, and SS/D) used to determine current overall viability risk for MCR steelhead (Ford 2011; NMFS 2009). Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH), and extirpated (E). Maintained (MT) population status indicates that the population does not meet the criteria for a viable population but does support ecological functions and preserve options for recovery of the DPS.

Ecological Subregions	Population (Watershed)	A/P	Diversity	Integrated SS/D	Overall Viability Risk
Cascade Eastern Slope Tributaries	Fifteenmile Creek	L	L	L	Viable
	Klickitat River	M	M	M	MT?
	Eastside Deschutes River	L	M	M	Viable
	Westside Deschutes River	H	M	M	H*
	Rock Creek	H	M	M	H?
	White Salmon				E*
	Crooked River				E*
John Day River	Upper Mainstem	M	M	M	MT
	North Fork	VL	L	L	Highly Viable
	Middle Fork	M	M	M	MT
	South Fork	M	M	M	MT
	Lower Mainstem	M	M	M	MT
Walla Walla and Umatilla rivers	Umatilla River	M	M	M	MT
	Touchet River	M	M	M	H
	Walla Walla River	M	M	M	MT
Yakima River	Satus Creek	M	M	M	Viable (MT)
	Toppenish Creek	M	M	M	Viable (MT)
	Naches River	H	M	M	H
	Upper Yakima	H	H	H	H

* Re-introduction efforts underway (NMFS 2009).

Straying frequencies into at least the Lower John Day River population are high. Out-of-basin hatchery stray proportions, although reduced, remain very high in the Deschutes River basin.

Abundance and Productivity. 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 MCR steelhead DPS is not currently meeting the viability criteria (adopted from the IC-TRT) in the MCR steelhead recovery plan (NMFS 2009). In addition, several of the factors cited by Good (2005) remain as concerns or key uncertainties. Natural origin spawning estimates of populations have been highly variable with respect to meeting minimum abundance thresholds. Overall, the new information considered does not indicate a change in the biological risk category since the last status review (Ford 2011).

Limiting Factors include (NMFS 2009; NOAA Fisheries 2011):

- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas, fish passage, stream substrate, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, tributary hydro system activities, and development
- Mainstem Columbia River hydropower–related impacts
- Degraded estuarine and nearshore marine habitat
- Hatchery-related effects
- Harvest-related effects
- Effects of predation, competition, and disease

Status of UCR Steelhead

Spatial Structure and Diversity. This species includes all naturally-spawned steelhead populations below natural and manmade impassable barriers in streams in the Columbia River Basin upstream from the Yakima River, Washington, to the U.S.-Canada border, and progeny of six artificial propagation programs. Four independent populations of UCR steelhead were identified by the IC-TRT in the same upriver tributaries as for UC spring-run Chinook salmon (*i.e.*, Wenatchee, Entiat, Methow, and Okanogan; Table 17) and, similarly, no major population groupings were identified due to the relatively small geographic area involved (Ford 2011; IC-TRT 2003). All extant populations are considered to be at high risk of extinction (Table 17)(Ford 2011). With the exception of the Okanogan population, the Upper Columbia populations rated as "low" risk for spatial structure. The "high" risk ratings for SS/D are largely driven by chronic high levels of hatchery spawners within natural spawning areas and lack of genetic diversity among the populations. The proportions of hatchery origin returns in natural spawning areas remain extremely high across the DPS, especially in the Methow and Okanogan River populations. Overall, the new information considered does not indicate a change in the biological risk category since the last status review (Ford 2011).

Table 17. Summary of the key elements (A/P, diversity, and SS/D) and scores used to determine current overall viability risk for UCR steelhead populations (Ford 2011). Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH).

Population (Watershed)	A/P	Diversity	Integrated SS/D	Overall Viability Risk
Wenatchee River	H	H	H	H
Entiat River	H	H	H	H
Methow River	H	H	H	H
Okanogan River	H	H	H	H

Abundance and Productivity. Upper Columbia steelhead populations have increased in natural origin abundance in recent years, but productivity levels remain low. The modest improvements in natural returns in recent years are probably primarily the result of several years of relatively good natural survival in the ocean and tributary habitats.

Limiting Factors include (NOAA Fisheries 2011; Upper Columbia Salmon Recovery Board 2007):

- Mainstem Columbia River hydropower–related adverse effects
- Impaired tributary fish passage
- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and LW recruitment, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, and development.
- Effects of predation, competition, and disease mortality: Fish management, including past introductions and persistence of non-native (exotic) fish species continues to affect habitat conditions for listed species.
- Hatchery-related effects
- Harvest-related effects

Status of SRB Steelhead

Spatial Structure and Diversity. This species includes all naturally-spawned steelhead populations below natural and manmade impassable barriers in streams in the Snake River Basin of southeast Washington, northeast Oregon, and Idaho, and progeny of six artificial propagation programs. The IC-TRT identified 25 historical populations in five major groups (Table 18) (Ford 2011; IC-TRT 2010). The IC-TRT has not assessed the viability of this species. The relative proportion of hatchery fish in natural spawning areas near major hatchery release sites is highly uncertain. There is little evidence for substantial change in ESU viability relative to the previous BRT and IC-TRT reviews. Overall, therefore, the new information considered does not indicate a change in the biological risk category since the last status review (Ford 2011).

Table 18. Ecological subregions, populations, and scores for the key elements (A/P, diversity, and SS/D) used to determine current overall viability risk for SRB steelhead (Ford 2011; NMFS 2011c). Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH). Maintained (MT) population status indicates that the population does not meet the criteria for a viable population but does support ecological functions and preserve options for recovery of the DPS.

Ecological subregions	Spawning Populations (Watershed)	A/P	Diversity	Integrated SS/D	Overall Viability Risk
Lower Snake River	Tucannon River	*	M	M	H
	Asotin Creek	*	M	M	MT
Grande Ronde River	Lower Grande Ronde	*	M	M	Not rated
	Joseph Creek	VL	L	L	Highly viable
	Upper Grande Ronde	M	M	M	MT
	Wallowa River	*	L	L	H
Clearwater River	Lower Clearwater	M	L	L	MT
	South Fork Clearwater	H	M	M	H
	Lolo Creek	H	M	M	H
	Selway River	H	L	L	H
	Lochsa River	H	L	L	H
Salmon River	Little Salmon River	*	M	M	MT
	South Fork Salmon	*	L	L	H
	Secesh River	*	L	L	H
	Chamberlain Creek	*	L	L	H
	Lower MF Salmon	*	L	L	H
	Upper MF Salmon	*	L	L	H
	Panther Creek	*	M	H	H
	North Fork Salmon	*	M	M	MT
	Lemhi River	*	M	M	MT
	Pahsimeroi River	*	M	M	MT
	East Fork Salmon	*	M	M	MT
	Upper Main Salmon	*	M	M	MT
Imnaha	Imnaha River	M	M	M	MT

* These ratings are uncertain due to a lack of population-specific data.

Abundance and Productivity. The level of natural production in the two populations with full data series and the Asotin Creek index reaches is encouraging, but the status of most populations in this DPS remains highly uncertain. Population-level natural origin abundance and productivity inferred from aggregate data and juvenile indices indicate that many populations are likely below the minimum combinations defined by the IC-TRT viability criteria.

Limiting Factors include (IC-TRT 2010; NMFS 2011c):

- Mainstem Columbia River hydropower–related adverse effects
- Impaired tributary fish passage

- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and LW recruitment, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, and development
- Impaired water quality and increased water temperature
- Related harvest effects, particularly for B-run steelhead
- Predation
- Genetic diversity effects from out-of-population hatchery releases

Oregon Coast Recovery Domain. Species we considered in the OC recovery domain include OC coho salmon, green sturgeon, and southern DPS eulachon, in Oregon coastal streams south of the Columbia River and north of Cape Blanco. Streams and rivers in this area drain west into the Pacific Ocean, and vary in length from less than a mile to more than 210 miles in length.

Status of OC Coho Salmon

Spatial Structure and Diversity. This species includes populations of coho salmon in Oregon coastal streams south of the Columbia River and north of Cape Blanco. The Cow Creek stock (South Umpqua population) is included as part of the ESU because the original brood stock was founded from the local, natural origin population and natural origin coho salmon have been incorporated into the brood stock on a regular basis.

The OC-TRT identified 56 populations; 21 independent and 35 dependent. The dependent populations were dependent on strays from other populations to maintain them over long time periods. The TRT also identified 5 biogeographic strata (Table 19) (Lawson *et al.* 2007).

Table 19. OC coho salmon populations. Dependent Populations (D) are populations that historically would not have had a high likelihood of persisting in isolation for 100 years. These populations relied upon periodic immigration from other populations to maintain their abundance. Independent Populations are populations that historically would have had a high likelihood of persisting in isolation from neighboring populations for 100 years and are rated as functionally independent (FI) and potentially independent (PI) (Lawson *et al.* 2007; McElhany *et al.* 2000).

Stratum	Population	Type	Stratum	Population	Type
North Coast	Necanicum River	PI	Mid-Coast (cont.)	Alsea River	FI
	Ecola Creek	D		Big Creek (Alsea)	D
	Arch Cape Creek	D		Vingie Creek	D
	Short Sands Creek	D		Yachats River	D
	Nehalem River	FI		Cummins Creek	D
	Spring Creek	D		Bob Creek	D
	Watseco Creek	D		Tenmile Creek	D
	Tillamook Bay	FI		Rock Creek	D
	Netarts Bay	D		Big Creek (Siuslaw)	D
	Rover Creek	D		China Creek	D
	Sand Creek	D		Cape Creek	D
	Nestucca River	FI		Berry Creek	D
	Neskowin Creek	D		Sutton Creek	D
Mid-Coast	Salmon River	PI	Lakes	Siuslaw River	FI
	Devils Lake	D		Siltcoos Lake	PI
	Siletz River	FI		Tahkenitch Lake	PI
	Schoolhouse Creek	D		Tenmile Lakes	PI
	Fogarty Creek	D	Umpqua	Lower Umpqua River	FI
	Depoe Bay	D		Middle Umpqua River	FI
	Rocky Creek	D		North Umpqua River	FI
	Spencer Creek	D		South Umpqua River	FI
	Wade Creek	D	Mid-South Coast	Threemile Creek	D
	Coal Creek	D		Coos River	FI
	Moolack Creek	D		Coquille River	FI
	Big Creek (Yaquina)	D		Johnson Creek	D
	Yaquina River	FI		Twomile Creek	D
	Theil Creek	D		Floras Creek	PI
	Beaver Creek	PI		Sixes River	PI

A 2010 BRT noted significant improvements in hatchery and harvest practices have been made (Stout *et al.* 2012). However, harvest and hatchery reductions have changed the population dynamics of the ESU. Current concerns for spatial structure focus on the Umpqua River. Of the four populations in the Umpqua stratum, the North Umpqua and South Umpqua were of particular concern. The North Umpqua is controlled by Winchester Dam and has historically been dominated by hatchery fish. Hatchery influence has recently been reduced, but the natural productivity of this population remains to be demonstrated. The South Umpqua is a large, warm system with degraded habitat. Spawner distribution appears to be seriously restricted in this population, and it is probably the most vulnerable of any population in this ESU to increased temperatures.

Current status of diversity shows improvement through the waning effects of hatchery fish on populations of OC coho salmon. In addition, recent efforts in several coastal estuaries to restore lost wetlands should be beneficial. However, diversity is lower than it was historically because of the loss of both freshwater and tidal habitat loss coupled with the restriction of diversity from very low returns over the past 20 years.

Abundance and Productivity. It has not been demonstrated that productivity during periods of poor marine survival is now adequate to sustain the ESU. Recent increases in adult escapement do not provide strong evidence that the century-long downward trend has changed. The ability of the OC coho salmon ESU to survive another prolonged period of poor marine survival remains in question. Wainwright (2008) determined that the weakest strata of OC coho salmon were in the North Coast and Mid-Coast of Oregon, which had only "low" certainty of being persistent. The strongest strata were the Lakes and Mid-South Coast, which had "high" certainty of being persistent. To increase certainty that the ESU as a whole is persistent, they recommended that restoration work should focus on those populations with low persistence, particularly those in the North Coast, Mid-Coast, and Umpqua strata.

Limiting Factors include (NOAA Fisheries 2011; Stout *et al.* 2012):

- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and LW supply, stream substrate, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, instream mining, dams, road crossings, dikes, levees, *etc.*
- Fish passage barriers that limit access to spawning and rearing habitats
- Adverse climate, altered past ocean/marine productivity, and current ocean ecosystem conditions have favored competitors and predators and reduced salmon survival rates in freshwater rivers and lakes, estuaries, and marine environments

Southern Oregon and Northern California Coasts Recovery Domain. Species we considered in the SONCC recovery domain include coho salmon, green sturgeon, and southern DPS eulachon. The SONCC recovery domain extends from Cape Blanco, Oregon, to Punta Gorda, California. This area includes many small-to-moderate-sized coastal basins, where high quality habitat occurs in the lower reaches of each basin, and three large basins (Rogue, Klamath and Eel) where high quality habitat is in the lower reaches, little habitat is provided by the middle reaches, and the largest amount of habitat is in the upper reaches of the subbasins.

Status of SONCC Coho Salmon

Spatial Structure and Diversity. This species includes all naturally-spawned populations of coho salmon in coastal streams from the Elk River near Cape Blanco, Oregon, through and including the Mattole River near Punta Gorda, California, and progeny of three artificial propagation programs (NMFS 2012b). Williams *et al.* (2006) designated 45 populations of coho salmon in the SONCC coho salmon ESU. These populations were further grouped into seven diversity strata based on the geographical arrangement of the populations and basin-scale genetic, environmental, and ecological characteristics (Table 20).

Table 20. SONCC coho salmon populations in Oregon. Williams (2006) classified populations as dependent or independent based on their historic population size. Independent populations are populations that historically would have had a high likelihood of persisting in isolation from neighboring populations for 100 years and are rated as functionally independent (FI) and potentially independent (PI). Core population types are independent populations judged most likely to become viable most quickly. Non-core 1 population types are independent populations judged to have lesser potential for rapid recovery than the core populations. Dependent populations (D) are populations that historically would not have had a high likelihood of persisting in isolation for 100 years. These populations relied upon periodic immigration from other populations to maintain their abundance. Two ephemeral populations (E) are defined as populations both small enough and isolated enough that they are only intermittently present (McElhany *et al.* 2000; NMFS 2012b; Williams *et al.* 2006).

Stratum	Population	Population Type
Northern Coastal	Elk River	FI Core
	Hubbard Creek	E
	Brush Creek	D
	Mussel Creek	D
	Euchre Creek	E
	Lower Rogue River	PI Non-Core 1
	Hunter Creek	D
	Pistol River	D
	Chetco River	FI Core
	Winchuck River*	PI Non-Core 1
Interior Rogue	Upper Rogue River	FI Core
	Middle Rogue/Applegate*	FI Non-Core 1
	Illinois River*	FI Core
Interior Klamath	Upper Klamath River*	FI Core
Central Coastal	Smith River*	FI Core

* Populations that also occur partly in California.

NMFS considered the role each population is expected to play in a recovered ESU to determine population abundance and juvenile occupancy targets for all the populations in the SONCC coho salmon ESU. Independent populations are evaluated using a modified Bradbury (1995) framework. This model uses three groupings of criteria for ranking watersheds for Pacific salmon restoration prioritization: (1) biological and ecological resources (Biological Importance); (2) watershed integrity and salmonid extinction risk (Integrity and Risk); and (3) potential for restoration (Optimism and Potential). Scores for Biological Importance are based on the concept of VSPs (McElhany *et al.* 2000), and are used to describe the current status of the population, *i.e.*, population size, productivity, spatial structure, and diversity. "Core" populations were designated based on current condition, geographic location in the ESU, low risk threshold compared to the number of spawners needed for the entire stratum, and other factors. "Non-core

1" populations are in the moderate risk threshold, which is the depensation threshold[42] multiplied by four. NMFS chooses this target if the population is likely to ultimately produce considerably more than the depensation threshold, but less than the low risk threshold.

The draft recovery plan establishes the following criteria at the ESU, diversity strata, and population scales to measure whether the recovery objectives are met (NMFS 2012b).

VSP Parameter	Population Type	Recovery Objective	Recovery Criteria
Abundance	Core	Low risk of extinction.	The geometric mean of wild spawners over 12 years at least meets the "low risk threshold" of spawners for each core population
	Non-Core 1	Moderate or low risk of extinction.	The annual number of wild spawners meets or exceeds the moderate risk threshold for each non-core population
Productivity	Core and Non-Core 1	Population growth rate is not negative.	Slope of regression of the geometric mean of wild spawners over the time series ≥ zero
Spatial Structure	Core and Non-Core 1	Ensure populations are widely distributed.	Annual within-population distribution ≥ 80% of habitat (outside of a temperature mask)
	Non-Core 2 and Dependent	Achieve inter- and intra-stratum connectivity.	20% of accessible habitat is occupied in years following spawning of cohorts that experienced good marine survival
Diversity	Core and Non-Core 1	Achieve low or moderate hatchery impacts on wild fish.	Proportion of hatchery-origin spawners (pHOS) ≤ 0.10
	Core and Non-Core 1	Achieve life history diversity.	Variation is present in migration timing, age structure, size and behavior. Variation in these parameters is retained.

Abundance and Productivity. Although long-term data on abundance of SONCC coho salmon are scarce, available evidence from shorter-term research and monitoring efforts indicate that conditions have worsened for populations since the last formal status review was published (Good *et al.* 2005; NMFS 2012b). Because the extinction risk of an ESU depends upon the extinction risk of its constituent independent populations and 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 (NMFS 2012b; Williams *et al.* 2008).

Limiting Factors. Threats from natural or man-made factors have worsened in the past 5 years, primarily due to four factors: small population dynamics, climate change, multi-year drought, and poor ocean survival conditions (NMFS 2012b; NOAA Fisheries 2011). Limiting factors include:

- Lack of floodplain and channel structure
- Impaired water quality
- Altered hydrologic function (timing of volume of water flow)

[42] Williams (2008) defines the depensation threshold as one spawner per km of stream with estimated rearing potential or Intrinsic Potential.

- Impaired estuary/mainstem function
- Degraded riparian forest conditions
- Altered sediment supply
- Increased disease/predation/competition
- Barriers to migration
- Adverse fishery-related effects
- Adverse hatchery-related effects

2.2.2 Status of the Critical Habitats

This section examines the status of designated critical habitat affected by the proposed action by examining the condition and trends of essential physical and biological features throughout the designated areas. These features are essential to the conservation of the 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 salmon and steelhead, NMFS ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC_5) in terms of the conservation value they provide to each listed species they support.[43] The conservation rankings are high, medium, or low. To determine the conservation value of each watershed to species viability, NMFS' critical habitat analytical review teams (CHARTs) evaluated the quantity and quality of habitat features (for example, spawning gravels, wood and water condition, side channels), 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 (NOAA Fisheries 2005). Thus, even a location that has poor quality of habitat could be ranked with a high conservation value if it were essential due to factors such as limited availability (*e.g.*, one of a very few spawning areas), a unique contribution of the population it served (*e.g.*, a population at the extreme end of geographic distribution), or the fact that it serves another important role (*e.g.*, obligate area for migration to upstream spawning areas).

The physical or biological features of freshwater spawning and incubation sites, include water flow, quality and temperature conditions and suitable substrate for spawning and incubation, as well as migratory access for adults and juveniles (Table 21-22). These features are essential to conservation because without them the species cannot successfully spawn and produce offspring. The physical or biological features of freshwater migration corridors associated with spawning and incubation sites include water flow, quality and temperature conditions supporting larval and adult mobility, abundant prey items supporting larval feeding after yolk sac depletion, and free passage (no obstructions) for adults and juveniles. These features are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow larval fish to proceed downstream and reach the ocean.

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[43] The conservation value of a site depends upon "(1) the importance of the populations associated with a site to the ESU [or DPS] conservation, and (2) the contribution of that site to the conservation of the population through demonstrated or potential productivity of the area" (NOAA Fisheries 2005).

Table 21. Primary constituent elements (PCEs) of critical habitats designated for ESA-listed salmon and steelhead species considered in the opinion (except SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, SR sockeye salmon, and SONCC coho salmon), and corresponding species life history events.

Primary Constituent Elements		Species Life History Event
Site Type	**Site Attribute**	
Freshwater spawning	Substrate Water quality Water quantity	Adult spawning Embryo incubation Alevin growth and development
Freshwater rearing	Floodplain connectivity Forage Natural cover Water quality Water quantity	Fry emergence from gravel Fry/parr/smolt growth and development
Freshwater migration	Free of artificial obstruction Natural cover Water quality Water quantity	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Estuarine areas	Forage Free of artificial obstruction Natural cover Salinity Water quality Water quantity	Adult sexual maturation and "reverse smoltification" Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Nearshore marine areas	Forage Free of artificial obstruction Natural cover Water quantity Water quality	Adult growth and sexual maturation Adult spawning migration Nearshore juvenile rearing
Offshore marine areas	Forage Water quality	Adult growth and sexual maturation Adult spawning migration Subadult rearing

Table 22. PCEs of critical habitats designated for SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, SR sockeye salmon, SONCC coho salmon, and corresponding species life history events.

Primary Constituent Elements		Species Life History Event
Site	**Site Attribute**	
Spawning and juvenile rearing areas	Access (sockeye) Cover/shelter Food (juvenile rearing) Riparian vegetation Space (Chinook, coho) Spawning gravel Water quality Water temp (sockeye) Water quantity	Adult spawning Embryo incubation Alevin growth and development Fry emergence from gravel Fry/parr/smolt growth and development
Adult and juvenile migration corridors	Cover/shelter Food (juvenile) Riparian vegetation Safe passage Space Substrate Water quality Water quantity Water temperature Water velocity	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Areas for growth and development to adulthood	Ocean areas – not identified	Nearshore juvenile rearing Subadult rearing Adult growth and sexual maturation Adult spawning migration

<u>CHART Salmon and Steelhead Critical Habitat Assessments</u>. The CHART for each recovery domain assessed biological information pertaining to areas under consideration for designation as critical habitat to identify the areas occupied by listed salmon and steelhead, determine whether those areas contained PCEs essential for the conservation of those species and whether unoccupied areas existed within the historical range of the listed salmon and steelhead that are also essential for conservation. The CHARTs assigned a 0 to 3 point score for the PCEs in each HUC_5 watershed for:

Factor 1. Quantity,
Factor 2. Quality – Current Condition,
Factor 3. Quality – Potential Condition,
Factor 4. Support of Rarity Importance,
Factor 5. Support of Abundant Populations, and
Factor 6. Support of Spawning/Rearing.

Thus, the quality of habitat in a given watershed was characterized by the scores for Factor 2 (quality - current condition), which considers the existing condition of the quality of PCEs in the HUC_5 watershed; and Factor 3 (quality – potential condition), which considers the likelihood of achieving PCE potential in the HUC_5 watershed, either naturally or through active conservation/restoration, given known limiting factors, likely biophysical responses, and feasibility.

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

For freshwater rivers north of and including the Eel River, the areas upstream of the head of the tide were not considered part of the geographical area occupied by the southern DPS. However, the critical habitat designation recognizes not only the importance of natal habitats, but of habitats throughout their range. Critical habitat has been designated in coastal U.S. marine waters within 60 fathoms depth from Monterey Bay, California (including Monterey Bay), north to Cape Flattery, Washington, including the Strait of Juan de Fuca, Washington, to its United States boundary; the Sacramento River, lower Feather River, and lower Yuba River in California; the Sacramento-San Joaquin Delta and Suisun, San Pablo, and San Francisco bays in California; the lower Columbia River estuary; and certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor) and freshwater (USDC 2009). Table 23 below delineates physical and biological features for Southern DPS green sturgeon.

Table 23. Physical and biological features of critical habitat designated for southern green sturgeon and corresponding species life history events.

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

<u>Southern DPS Eulachon</u>. Critical habitat for eulachon includes portions of 16 rivers and streams in California, Oregon, and Washington (USDC 2011). All of these areas are designated as migration and spawning habitat for this species. In Oregon, 24.2 miles of the lower Umpqua River, 12.4 miles of the lower Sandy River, and 0.2 miles of Tenmile Creek have been designated. The mainstem Columbia River from the mouth to the base of Bonneville Dam, a distance of 143.2 miles is also designated as critical habitat. Table 24 delineates the designated physical or biological features for eulachon.

Table 24. Physical or biological features of critical habitats designated for eulachon and corresponding species life history events.

Physical or biological features		Species Life History Event
Site Type	**Site Attribute**	
Freshwater spawning and incubation	Flow Water quality Water temperature Substrate	Adult spawning Incubation
Freshwater migration	Flow Water quality Water temperature Food	Adult and larval mobility Larval feeding

The range of eulachon in the Pacific Northwest completely overlaps with the range of several ESA-listed stocks of salmon and steelhead. Although the habitat requirements of these fishes differ somewhat from eulachon, efforts to protect habitat generally focus on the maintenance of watershed processes that would be expected to benefit eulachon. The BRT identified dams and water diversions as 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 systems, large-scale impoundment of water has increased winter water temperatures, potentially altering the water temperature during eulachon spawning periods (Gustafson *et al.* 2010). Numerous chemical contaminants are also present in spawning rivers, but the exact effect these compounds have on spawning and egg development is unknown (Gustafson *et al.* 2010). The BRT identified dredging as a low to moderate threat to eulachon in the Columbia River. Dredging during eulachon spawning would be particularly detrimental because eggs could be destroyed by mechanical disturbance or smothered by in-water disposal of dredged materials. The lower Columbia River mainstem provides spawning and incubation sites, and a large migratory corridor to spawning areas in the tributaries. Prior to the construction of Bonneville Dam, eulachon ascended the Columbia River as far as Hood River, Oregon. Major tributaries that support spawning runs include the Grays, Skamokawa, Elochoman, Kalama, Lewis and Sandy rivers.

The number of eulachon returning to the Umpqua River seems to have declined in the 1980s, and does not appear to have rebounded to previous levels. Additionally, eulachon are regularly caught in salmonid smolt traps operated in the lower reaches of Tenmile Creek by the ODFW.

Willamette-Lower Columbia Recovery Domain. Critical habitat was designated in the WLC recovery domain for UWR spring-run Chinook salmon, LCR Chinook salmon, LCR steelhead, UWR steelhead, and CR chum salmon. In addition to the Willamette and Columbia River mainstems, important tributaries on the Oregon side of the WLC include Youngs Bay, Big Creek, Clatskanie River, and Scappoose River in the Oregon Coast subbasin; Hood River in the Gorge; and the Sandy, Clackamas, Molalla, North and South Santiam, Calapooia, McKenzie, and Middle Fork Willamette rivers in the West Cascades subbasin.

Land management activities have severely degraded stream habitat conditions in the Willamette River mainstem above Willamette Falls and associated subbasins. In the Willamette River mainstem and lower sub-basin mainstem reaches, high density urban development and widespread agricultural effects have reduced aquatic and riparian habitat quality and complexity, and altered sediment and water quality and quantity, and watershed processes. The Willamette River, once a highly braided river system, has been dramatically simplified through channelization, dredging, and other activities that have reduced rearing habitat by as much as 75%. In addition, the construction of 37 dams in the basin blocked access to more than 435 miles of stream and river spawning habitat. The dams alter the temperature regime of the Willamette River and its tributaries, affecting the timing and development of naturally-spawned eggs and fry. Agriculture, urbanization, and gravel mining on the valley floor logging in the Cascade and Coast Ranges contribute to increased erosion and sediment loads throughout the basin.

The mainstem Willamette River has been channelized and stripped of LW. Development began to encroach on the riparian forest beginning in the 1870s (Sedell and Froggatt 1984). Gregory (2002a) calculated that the total mainstem Willamette River channel area decreased from 41,000 to 23,000 acres between 1895 and 1995. They noted that the lower reach, from the mouth of the river to Newberg (RM 50), is confined within a basaltic trench, and that due to this geomorphic constraint, less channel area has been lost than in upstream areas. The middle reach from Newberg to Albany (RM 50 to 120) incurred losses of 12% primary channel area, 16% side channels, 33% alcoves, and 9% islands. Even greater changes occurred in the upper reach, from Albany to Eugene (RM 187). There, approximately 40% of both channel length and channel area were lost, along with 21% of the primary channel, 41% of side channels, 74% of alcoves, and 80% of island areas.

The banks of the Willamette River have more than 96 miles of revetments; approximately half were constructed by the ACOE. Generally, the revetments were placed in the vicinity of roads or on the outside bank of river bends, so that while only 26% of the total length is revetted, 65% of the meander bends are revetted (Gregory *et al.* 2002b). The majority of dynamic sections have been armored, reducing adjustments in channel bed and sediment storage by the river, and thereby diminishing both the complexity and productivity of aquatic habitats (Gregory *et al.* 2002b).

Riparian forests have diminished considerably in the lower reaches of the Willamette River (Gregory *et al.* 2002c). Sedell and Froggatt (1984) noted that agriculture and cutting of streamside trees were major agents of change for riparian vegetation, along with snagging of LW in the channel. The reduced shoreline, fewer and smaller snags, and reduced riparian forest comprise large functional losses to the river, reducing structural features, organic inputs from litter fall, entrained allochthonous materials, and flood flow filtering capacity. Extensive changes began before the major dams were built, with navigational and agricultural demands dominating the early use of the river. The once expansive forests of the Willamette River floodplain provided valuable nutrients and organic matter during flood pulses, food sources for macroinvertebrates, and slow-water refugia for fish during flood events. These forests also cooled river temperatures as the river flowed through its many channels.

Gregory *et al.* (2002c) described the changes in riparian vegetation in river reaches from the mouth to Newberg, from Newberg to Albany, and from Albany to Eugene. They noted that the riparian forests were formerly a mosaic of brush, marsh, and ash tree openings maintained by annual flood inundation. Below the City of Newberg, the most noticeable change was that conifers were almost eliminated. Above Newberg, the formerly hardwood-dominated riparian forests along with mixed forest made up less than half of the riparian vegetation by 1990, while agriculture dominated. This conversion has reduced river shading and the potential for recruitment of wood to the river, reducing channel complexity and the quality of rearing, migration and spawning habitats.

Hyporheic flow in the Willamette River has been examined through discharge measurements and found to be significant in some areas, particularly those with gravel deposits (Fernald *et al.* 2001; Wentz *et al.* 1998). The loss of channel complexity and meandering that fosters creations of gravel deposits decreases the potential for hyporheic flows, as does gravel mining. Hyporheic flow processes water and affects its quality on reemerging into the main channel, stabilizing variations in physical and chemical water characteristics. Hyporheic flow is important for ecological functions, some aspects of water quality (such as temperature and dissolved oxygen), and some benthic invertebrate life stages. Alcove habitat, which has been limited by channelization, combines low hydraulic stress and high food availability with the potential for hyporheic flows across the steep hydraulic gradients in the gravel separating them from the main channel (Fernald *et al.* 2001).

On the mainstem of the Columbia River, hydropower projects, including the Federal Columbia River Hydropower System (FCRPS), have significantly degraded salmon and steelhead habitats (Bottom *et al.* 2005; Fresh *et al.* 2005; NMFS 2011d; NMFS 2013a). The series of dams and reservoirs that make up the FCRPS block an estimated 12 million cubic yards of debris and sediment that would otherwise naturally flow down the Columbia River and replenish shorelines along the Washington and Oregon coasts.

Industrial harbor and port development are also significant influences on the Lower Willamette and Lower Columbia rivers (Bottom *et al.* 2005; Fresh *et al.* 2005; NMFS 2011d; NMFS 2013a). Since 1878, 100 miles of river channel within the mainstem Columbia River, its estuary, and Oregon's Willamette River have been dredged as a navigation channel by the ACOE. Originally dredged to a 20-foot minimum depth, the Federal navigation channel of the Lower Columbia River is now maintained at a depth of 43 feet and a width of 600 feet. The Lower Columbia River supports five ports on the Washington State side: Kalama, Longview, Skamania County, Woodland, and Vancouver. In addition to loss of riparian habitat, and disruption of benthic habitat due to dredging, high levels of several sediment chemicals, such as arsenic and polycyclic aromatic hydrocarbons, have been identified in Lower Columbia River watersheds in the vicinity of the ports and associated industrial facilities.

The most extensive urban development in the Lower Columbia River subbasin has occurred in the Portland/Vancouver area. Outside of this major urban area, the majority of residences and businesses rely on septic systems. Common water quality issues with urban development and residential septic systems include higher water temperatures, lowered dissolved oxygen, increased fecal coliform bacteria, and increased chemicals associated with pesticides and urban runoff.

The Columbia River estuary has lost a significant amount of the tidal marsh and tidal swamp habitats that are critical to juvenile salmon and steelhead, particularly small or ocean-type species (Bottom *et al.* 2005; Fresh *et al.* 2005; NMFS 2011d; NMFS 2013a). Edges of marsh areas provide sheltered habitats for juvenile salmon and steelhead where food, in the form of amphipods or other small invertebrates which feed on marsh detritus, is plentiful, and larger predatory fish can be avoided. Historically, floodwaters of the Columbia River inundated the margins and floodplains along the estuary, allowing juvenile salmon and steelhead access to a wide expanse of low-velocity marshland and tidal channel habitats. In general, the riverbanks were gently sloping, with riparian and wetland vegetation at the higher elevations of the river floodplain becoming habitat for salmon and steelhead during flooding river discharges or flood tides. Sherwood (1990) estimated that the Columbia River estuary lost 20,000 acres of tidal swamps, 10,000 acres of tidal marshes, and 3,000 acres of tidal flats between 1870 and 1970. This study further estimated an 80% reduction in emergent vegetation production and a 15% decline in benthic algal production.

Habitat and food-web changes within the estuary, and other factors affecting salmon population structure and life histories, have altered the estuary's capacity to support juvenile salmon (Bottom *et al.* 2005; Fresh *et al.* 2005; NMFS 2011d; NMFS 2013a). Diking and filling activities have reduced the tidal prism and eliminate emergent and forested wetlands and floodplain habitats. These changes have likely reduced the estuary's salmon-rearing capacity. Moreover, water and sediment in the Lower Columbia River and its tributaries have toxic contaminants that are harmful to aquatic resources (Lower Columbia River Estuary Partnership 2007).

Contaminants of concern include dioxins and furans, heavy metals, PCBs (polychlorinated biphenyls) and organochlorine pesticides such as DDT (dichloro-diphenyl-trichloroethane). Simplification of the population structure and life-history diversity of salmon possibly is yet another important factor affecting juvenile salmon viability. Restoration of estuarine habitats, particularly diked emergent and forested wetlands, reduction of avian predation by terns, and flow manipulations to restore historical flow patterns have likely begun to enhance the estuary's productive capacity for salmon, although historical changes in population structure and salmon life histories may prevent salmon from making full use of the productive capacity of estuarine habitats.

The WLC recovery domain CHART determined that most HUC_5 watersheds with PCEs for salmon or steelhead are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some or a high potential for improvement. Only watersheds in the upper McKenzie River and its tributaries are in good to excellent condition with no potential for improvement (Table 25).

Table 25. **Willamette-Lower Columbia Recovery Domain:** Current and potential quality of HUC_5 watersheds identified as supporting historically independent populations of ESA-listed Chinook salmon (CK), chum salmon (CM), and steelhead (ST) (NOAA Fisheries 2005).[44] Watersheds are ranked primarily by "current quality" and secondly by their "potential for restoration."

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name(s) and HUC_5 Code(s)	Listed Species	Current quality	Restoration Potential
Columbia Gorge #1707010xxx			
Wind River (511)	CK/ST	2/2	2/2
East Fork Hood (506), & Upper (404) & Lower Cispus (405) rivers	CK/ST	2/2	2/2
Plympton Creek (306)	CK	2	2
Little White Salmon River (510)	CK	2	0
Grays Creek (512) & Eagle Creek (513)	CK/CM/ST	2/1/2	1/1/2
White Salmon River (509)	CK/CM	2/1	1/2
West Fork Hood River (507)	CK/ST	1/2	2/2
Hood River (508)	CK/ST	1/1	2/2
Unoccupied habitat: Wind River (511)	Chum conservation value "Possibly High"		
Cascade and Coast Range #1708000xxx			
Lower Gorge Tributaries (107)	CK/CM/ST	2/2/2	2/3/2
Lower Lewis (206) & North Fork Toutle (504) rivers	CK/CM/ST	1/3/1	2/1/2
Salmon (101), Zigzag (102), & Upper Sandy (103) rivers	CK/ST	2/2	2/2
Big Creek (602)	CK/CM	2/2	2/2
Coweeman River (508)	CK/CM/ST	2/2/1	2/1/2
Kalama River (301)	CK/CM/ST	1/2/2	2/1/2
Cowlitz Headwaters (401)	CK/ST	2/2	1/1
Skamokawa/Elochoman (305)	CK/CM	2/1	2
Salmon Creek (109)	CK/CM/ST	1/2/1	2/3/2
Green (505) & South Fork Toutle (506) rivers	CK/CM/ST	1/1/2	2/1/2
Jackson Prairie (503) & East Willapa (507)	CK/CM/ST	1/2/1	1/1/2
Grays Bay (603)	CK/CM	1/2	2/3
Upper Middle Fork Willamette River (101)	CK	2	1
Germany/Abernathy creeks (304)	CK/CM	1/2	2
Mid-Sandy (104), Bull Run (105), & Lower Sandy (108) rivers	CK/ST	1/1	2/2
Washougal (106) & East Fork Lewis (205) rivers	CK/CM/ST	1/1/1	2/1/2
Upper Cowlitz (402) & Tilton rivers (501) & Cowlitz Valley Frontal (403)	CK/ST	1/1	2/1
Clatskanie (303) & Young rivers (601)	CK	1	2
Rifle Reservoir (502)	CK/ST	1	1

[44] On January 14, 2013, NMFS published a proposed rule for the designation of critical habitat for LCR coho salmon and Puget Sound steelhead (USDC 2013). A draft biological report, which includes a CHART assessment for LCR coho salmon, was also completed (NMFS 2012c). Habitat quality assessments for LCR coho salmon are out for review; therefore, they are not included on this table.

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name(s) and HUC$_5$ Code(s)	Listed Species	Current quality	Restoration Potential
Beaver Creek (302)	CK	0	1
Unoccupied Habitat: Upper Lewis (201) & Muddy (202) rivers; Swift (203) & Yale (204) reservoirs	CK & ST Conservation Value "Possibly High"		
Willamette River #1709000xxx			
Upper (401) & South Fork (403) McKenzie rivers; Horse Creek (402); & McKenzie River/Quartz Creek (405)	CK	3	3
Lower McKenzie River (407)	CK	2	3
South Santiam River (606)	CK/ST	2/2	1/3
South Santiam River/Foster Reservoir (607)	CK/ST	2/2	1/2
North Fork of Middle Fork Willamette (106) & Blue (404) rivers	CK	2	1
Upper South Yamhill River (801)	ST	2	1
Little North Santiam River (505)	CK/ST	1/2	3/3
Upper Molalla River (905)	CK/ST	1/2	1/1
Abernethy Creek (704)	CK/ST	1/1	1/2
Luckiamute River (306) & Yamhill (807) Lower Molalla (906) rivers; Middle (504) & Lower (506) North Santiam rivers; Hamilton Creek/South Santiam River (601); Wiley Creek (608); Mill Creek/Willamette River (701); & Willamette River/Chehalem Creek (703); Lower South (804) & North (806) Yamhill rivers; & Salt Creek/South Yamhill River (805)	CK/ST	1	1
Hills (102) & Salmon (104) creeks; Salt Creek/Willamette River (103), Hills Creek Reservoir (105), Middle Fork Willamette/Lookout Point (107); Little Fall (108) & Fall (109) creeks; Lower Middle Fork of Willamette (110), Long Tom (301), Marys (305) & Mohawk (406) rivers	CK	1	1
Willamina Creek (802) & Mill Creek/South Yamhill River (803)	ST	1	1
Calapooia River (303); Oak (304) Crabtree (602), Thomas (603) & Rickreall (702) creeks; Abiqua (901), Butte (902) & Rock (903) creeks/Pudding River; & Senecal Creek/Mill Creek (904)	CK/ST	1/1	0/1
Row River (201), Mosby (202) & Muddy (302) creeks, Upper (203) & Lower (205) Coast Fork Willamette River	CK	1	0
Unoccupied habitat in North Santiam (501) & North Fork Breitenbush (502) rivers; Quartzville Creek (604) and Middle Santiam River (605)	CK & ST Conservation Value "Possibly High"		
Unoccupied habitat in Detroit Reservoir/Blowout Divide Creek (503)	Conservation Value: CK "Possibly Medium"; ST Possibly High"		
Lower Willamette #1709001xxx			
Collawash (101), Upper Clackamas (102), & Oak Grove Fork (103) Clackamas rivers	CK/ST	2/2	3/2
Middle Clackamas River (104)	CK/ST	2/1	3/2
Eagle Creek (105)	CK/ST	2/2	1/2
Gales Creek (002)	ST	2	1
Lower Clackamas River (106) & Scappoose Creek (202)	CK/ST	1	2
Dairy (001) & Scoggins (003) creeks; Rock Creek/Tualatin River	ST	1	1

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name(s) and HUC_5 Code(s)	Listed Species	Current quality	Restoration Potential
(004); & Tualatin River (005)			
Johnson Creek (201)	CK/ST	0/1	2/2
Lower Willamette/Columbia Slough (203)	CK/ST	0	2

Interior Columbia Recovery Domain. Critical habitat has been designated in the IC recovery domain, which includes the Snake River Basin, for SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, UCR spring-run Chinook salmon, SR sockeye salmon, MCR steelhead, UCR steelhead, and SRB steelhead. Major tributaries in the Oregon portion of the IC recovery domain include the Deschutes, John Day, Umatilla, Walla Walla, Grande Ronde, and Imnaha rivers.

Habitat quality in tributary streams in the IC recovery domain varies from excellent in wilderness and roadless areas to poor in areas subject to heavy agricultural and urban development (NMFS 2009; Wissmar *et al.* 1994). Critical habitat throughout much of the IC recovery domain has been degraded by intense agriculture, alteration of stream morphology (*i.e.*, channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, livestock grazing, dredging, road construction and maintenance, logging, mining, and urbanization. Reduced summer stream flows, impaired water quality, and reduction of habitat complexity are common problems for critical habitat in developed areas.

Migratory habitat quality in this area has been severely affected by the development and operation of the FCRPS dams and reservoirs in the mainstem Columbia River, Bureau of Reclamation tributary projects, and privately owned dams in the Snake and Upper Columbia River basins. For example, construction of Hells Canyon Dam eliminated access to several likely production areas in Oregon and Idaho, including the Burnt, Powder, Weiser, Payette, Malheur, Owyhee, and Boise river basins (Good *et al.* 2005), and Grand Coulee and Chief Joseph dams completely block anadromous fish passage on the upper mainstem Columbia River.

Hydroelectric development modified natural flow regimes, resulting in higher water temperatures, changes in fish community structure leading to increased rates of piscivorous and avian predation on juvenile salmon and steelhead, and delayed migration for both adult and juveniles. Physical features of dams such as turbines also kill migrating fish. In-river survival is inversely related to the number of hydropower projects encountered by emigrating juveniles.

Similarly, development and operation of extensive irrigation systems and dams for water withdrawal and storage in tributaries have altered hydrological cycles. A series of large regulating dams on the middle and upper Deschutes River affect flow and block access to upstream habitat, and have extirpated one or more populations from the Cascades Eastern Slope major population (IC-TRT 2003). Similarly, operation and maintenance of large water reclamation systems such as the Umatilla Basin and Yakima Projects have significantly reduced flows and degraded water quality and physical habitat in this domain.

Many stream reaches designated as critical habitat in the IC recovery domain are over-allocated under state water law, with more allocated water rights than existing streamflow. Withdrawal of water, particularly during low-flow periods that commonly overlap with agricultural withdrawals, often increases summer stream temperatures, blocks fish migration, strands fish, and alters sediment transport (Spence *et al.* 1996). Reduced tributary stream flow has been identified as a major limiting factor for all listed salmon and steelhead species in this recovery domain except SR fall-run Chinook salmon and SR sockeye salmon (NMFS 2007; NOAA Fisheries 2011).

Many stream reaches designated as critical habitat are listed on the state of Oregon's Clean Water Act section 303(d) list for water temperature. Many areas that were historically suitable rearing and spawning habitat are now unsuitable due to high summer stream temperatures. Removal of riparian vegetation, alteration of natural stream morphology, and withdrawal of water for agricultural or municipal use all contribute to elevated stream temperatures. Contaminants such as insecticides and herbicides from agricultural runoff and heavy metals from mine waste are common in some areas of critical habitat.

The IC recovery domain is a very large and diverse area. The CHART determined that few watersheds with PCEs for Chinook salmon or steelhead are in good to excellent condition with no potential for improvement. Overall, most IC recovery domain watersheds are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some or high potential for improvement. In Washington, the Upper Methow, Lost, White, and Chiwawa watersheds are in good-to-excellent condition with no potential for improvement. In Oregon, only the Lower Deschutes, Minam, Wenaha, and Upper and Lower Imnaha Rivers HUC_5 watersheds are in good-to-excellent condition with no potential for improvement. In Idaho, a number of watersheds with PCEs for steelhead (Upper Middle Salmon, Upper Salmon/Pahsimeroi, Middle Fork Salmon, Little Salmon, Selway, and Lochsa rivers) are in good-to-excellent condition with no potential for improvement. Additionally, several Lower Snake River HUC_5 watersheds in the Hells Canyon area, straddling Oregon and Idaho, are in good-to-excellent condition with no potential for improvement (Table 26).

Table 26. **Interior Columbia Recovery Domain:** Current and potential quality of HUC_5 watersheds identified as supporting historically independent populations of ESA-listed Chinook salmon (CK) and steelhead (ST) (NOAA Fisheries 2005). Watersheds are ranked primarily by "current quality" and secondly by their "potential for restoration."

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name and HUC_5 Code(s)	Listed Species	Current Quality	Restoration Potential
Upper Columbia # 1702000xxx			
White (101), Chiwawa (102), Lost (801) & Upper Methow (802) rivers	CK/ST	3	3
Upper Chewuch (803) & Twisp rivers (805)	CK/ST	3	2
Lower Chewuch River (804); Middle (806) & Lower (807) Methow rivers	CK/ST	2	2
Salmon Creek (603) & Okanogan River/Omak Creek (604)	ST	2	2
Upper Columbia/Swamp Creek (505)	CK/ST	2	1
Foster Creek (503) & Jordan/Tumwater (504)	CK/ST	1	1
Upper (601) & Lower (602) Okanogan River; Okanogan River/Bonaparte Creek (605); Lower Similkameen River (704); & Lower Lake Chelan (903)	ST	1	1
Unoccupied habitat in Sinlahekin Creek (703)	ST Conservation Value "Possibly High"		
Upper Columbia #1702001xxx			
Entiat River (001); Nason/Tumwater (103); & Lower Wenatchee River (105)	CK/ST	2	2
Lake Entiat (002)	CK/ST	2	1
Columbia River/Lynch Coulee (003); Sand Hollow (004); Yakima/Hansen Creek (604), Middle Columbia/Priest Rapids (605), & Columbia River/Zintel Canyon (606)	ST	2	1
Icicle/Chumstick (104)	CK/ST	1	2
Lower Crab Creek (509)	ST	1	2
Rattlesnake Creek (204)	ST	0	1
Yakima #1703000xxx			
Upper (101) & Middle (102) Yakima rivers; Teanaway (103) & Little Naches (201) rivers; Naches River/Rattlesnake Creek (202); & Ahtanum (301) & Upper Toppenish (303) & Satus (305) creeks	ST	2	2
Umtanum/Wenas (104); Naches River/Tieton River (203); Upper Lower Yakima River (302); & Lower Toppenish Creek (304)	ST	1	2
Yakima River/Spring Creek (306)	ST	1	1
Lower Snake River #1706010xxx			
Snake River/Granite (101), Getta (102), & Divide (104) creeks; Upper (201) & Lower (205) Imnaha River; Snake River/Rogersburg (301); Minam (505) & Wenaha (603) rivers	ST	3	3
Grande Ronde River/Rondowa (601)	ST	3	2
Big (203) & Little (204) Sheep creeks; Asotin River (302); Catherine	ST	2	3

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name and HUC$_5$ Code(s)	Listed Species	Current Quality	Restoration Potential
Creek (405); Lostine River (502); Bear Creek (504); & Upper (706) & Lower (707) Tucannon River			
Middle Imnaha River (202); Snake River/Captain John Creek (303); Upper Grande Ronde River (401); Meadow (402); Beaver (403); Indian (409), Lookingglass (410) & Cabin (411) creeks; Lower Wallowa River (506); Mud (602), Chesnimnus (604) & Upper Joseph (605) creeks	ST	2	2
Ladd Creek (406); Phillips/Willow Creek (408); Upper (501) & Middle (503) Wallowa rivers; & Lower Grande Ronde River/Menatche Creek (607)	ST	1	3
Five Points (404); Lower Joseph (606) & Deadman (703) creeks	ST	1	2
Tucannon/Alpowa Creek (701)	ST	1	1
Mill Creek (407)	ST	0	3
Pataha Creek (705)	ST	0	2
Snake River/Steptoe Canyon (702) & Penawawa Creek (708)	ST	0	1
Flat Creek (704) & Lower Palouse River (808)	ST	0	0
Upper Salmon and Pahsimeroi #1706020xxx			
Germania (111) & Warm Springs (114) creeks; Lower Pahsimeroi River (201); Alturas Lake (120), Redfish Lake (121), Upper Valley (123) & West Fork Yankee (126) creeks	ST	3	3
Basin Creek (124)	ST	3	2
Salmon River/Challis (101); East Fork Salmon River/McDonald Creek (105); Herd Creek (108); Upper East Fork Salmon River (110); Salmon River/Big Casino (115), Fisher (117) & Fourth of July (118) creeks; Upper Salmon River (119); Valley Creek/Iron Creek (122); & Morgan Creek (132)	ST	2	3
Salmon River/Bayhorse Creek (104); Salmon River/Slate Creek (113); Upper Yankee Fork (127) & Squaw Creek (128); Pahsimeroi River/Falls Creek (202)	ST	2	2
Yankee Fork/Jordan Creek (125)	ST	1	3
Salmon River/Kinnikinnick Creek (112); Garden Creek (129); Challis Creek/Mill Creek (130); & Patterson Creek (203)	ST	1	2
Road Creek (107)	ST	1	1
Unoccupied habitat in Hawley (410), Eighteenmile (411) & Big Timber (413) creeks	Conservation Value for ST "Possibly High"		
Middle Salmon, Panther and Lemhi #1706020xxx			
Salmon River/Colson (301), Pine (303) & Moose (305) creeks; Indian (304) & Carmen (308) creeks, North Fork Salmon River (306); & Texas Creek (412)	ST	3	3
Deep Creek (318)	ST	3	2
Salmon River/Cow Creek (312) & Hat (313), Iron (314), Upper Panther (315), Moyer (316) & Woodtick (317) creeks; Lemhi River/Whimpey Creek (402); Hayden (414), Big Eight Mile (408), & Canyon (408) creeks	ST	2	3

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name and HUC_5 Code(s)	Listed Species	Current Quality	Restoration Potential
Salmon River/Tower (307) & Twelvemile (311) creeks; Lemhi River/Kenney Creek (403); Lemhi River/McDevitt (405), Lemhi River/Yearian Creek (406); & Peterson Creek (407)	ST	2	2
Owl (302) & Napias (319) creeks	ST	2	1
Salmon River/Jesse Creek (309); Panther Creek/Trail Creek (322); & Lemhi River/Bohannon Creek (401)	ST	1	3
Salmon River/Williams Creek (310)	ST	1	2
Agency Creek (404)	ST	1	1
Panther Creek/Spring Creek (320) & Clear Creek (323)	ST	0	3
Big Deer Creek (321)	ST	0	1
Mid-Salmon-Chamberlain, South Fork, Lower, and Middle Fork Salmon #1706020xxx			
Lower (501), Upper (503) & Little (504) Loon creeks; Warm Springs (502); Rapid River (505); Middle Fork Salmon River/Soldier (507) & Lower Marble Creek (513); & Sulphur (509), Pistol (510), Indian (511) & Upper Marble (512) creeks; Lower Middle Fork Salmon River (601); Wilson (602), Upper Camas (604), Rush (610), Monumental (611), Beaver (614), Big Ramey (615) & Lower Big (617) creeks; Middle Fork Salmon River/Brush (603) & Sheep (609) creeks; Big Creek/Little Marble (612); Crooked (616), Sheep (704), Bargamin (709), Sabe (711), Horse (714), Cottonwood (716) & Upper Chamberlain Creek (718); Salmon River/Hot Springs (712); Salmon River/Kitchen Creek (715); Lower Chamberlain/McCalla Creek (717); & Slate Creek (911)	ST	3	3
Marsh (506); Bear Valley (508) Yellow Jacket (604); West Fork Camas (607) & Lower Camas (608) creeks; & Salmon River/Disappointment Creek (713) & White Bird Creek (908)	ST	2	3
Upper Big Creek (613); Salmon River/Fall (701), California (703), Trout (708), Crooked (705) & Warren (719) creeks; Lower South Fork Salmon River (801); South Fork Salmon River/Cabin (809), Blackmare (810) & Fitsum (812) creeks; Lower Johnson Creek (805); & Lower (813), Middle (814) & Upper Secesh (815) rivers; Salmon River/China (901), Cottonwood (904), McKenzie (909), John Day (912) & Lake (913) creeks; Eagle (902), Deer (903), Skookumchuck (910), French (915) & Partridge (916) creeks	ST	2	2
Wind River (702), Salmon River/Rabbit (706) & Rattlesnake (710) creeks; & Big Mallard Creek (707); Burnt Log (806), Upper Johnson (807) & Buckhorn (811) creeks; Salmon River/Deep (905), Hammer (907) & Van (914) creeks	ST	2	1
Silver Creek (605)	ST	1	3
Lower (803) & Upper (804) East Fork South Fork Salmon River; Rock (906) & Rice (917) creeks	ST	1	2
Little Salmon #176021xxx			
Rapid River (005)	ST	3	3
Hazard Creek (003	ST	3	2

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name and HUC_5 Code(s)	Listed Species	Current Quality	Restoration Potential
Boulder Creek (004)	ST	2	3
Lower Little Salmon River (001) & Little Salmon River/Hard Creek (002)	ST	2	2
Selway, Lochsa and Clearwater #1706030xxx			
Selway River/Pettibone (101) & Gardner (103) creeks; Bear (102), White Cap (104), Indian (105), Burnt Knob (107), Running (108) & Goat (109) creeks; & Upper Selway River (106); Gedney (202), Upper Three Links (204), Rhoda (205), North Fork Moose (207), Upper East Fork Moose (209) & Martin (210) creeks; Upper (211), Middle (212) & Lower Meadow (213) creeks; Selway River/Three Links Creek (203); & East Fork Moose Creek/Trout Creek (208); Fish (302), Storm (309), Warm Springs (311), Fish Lake (312), Boulder (313) & Old Man (314) creeks; Lochsa River/Stanley (303) & Squaw (304) creeks; Lower Crooked (305), Upper Crooked (306) & Brushy (307) forks; Lower (308), Upper (310) White Sands, Ten Mile (509) & John's (510) creeks	ST	3	3
Selway River/Goddard Creek (201); O'Hara Creek (214) Newsome (505) creeks; American (506), Red (507) & Crooked (508) rivers	ST	2	3
Lower Lochsa River (301); Middle Fork Clearwater River/Maggie Creek (401); South Fork Clearwater River/Meadow (502) & Leggett creeks; Mill (511), Big Bear (604), Upper Big Bear (605), Musselshell (617), Eldorado (619) & Mission (629) creeks, Potlatch River/Pine Creek (606); & Upper Potlatch River (607); Lower (615), Middle (616) & Upper (618) Lolo creeks	ST	2	2
South Fork Clearwater River/Peasley Creek (502)	ST	2	1
Upper Orofino Creek (613)	ST	2	0
Clear Creek (402)	ST	1	3
Three Mile (512), Cottonwood (513), Big Canyon (610), Little Canyon (611) & Jim Ford (614) creeks; Potlatch River/Middle Potlatch Creek (603); Clearwater River/Bedrock (608), Jack's (609) Lower Lawyer (623), Middle Lawyer (624), Cottonwood (627) & Upper Lapwai (628) creeks; & Upper (630) & Lower (631) Sweetwater creeks	ST	1	2
Lower Clearwater River (601) & Clearwater River/Lower Potlatch River (602), Fivemile Creek (620), Sixmile Creek (621) and Tom Taha (622) creeks	ST	1	1
Mid-Columbia #1707010xxx			
Wood Gulch (112); Rock Creek (113); Upper Walla Walla (201), Upper Touchet (203), & Upper Umatilla (301) rivers; Meacham (302) & Birch (306) creeks; Upper (601) & Middle (602) Klickitat River	ST	2	2
Glade (105) & Mill (202) creeks; Lower Klickitat River (604); Mosier Creek (505); White Salmon River (509); Middle Columbia/Grays Creek (512)	ST	2	1
Little White Salmon River (510)	ST	2	0

Current PCE Condition	**Potential PCE Condition**
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name and HUC_5 Code(s)	Listed Species	Current Quality	Restoration Potential
Middle Touchet River (204); McKay Creek (305); Little Klickitat River (603);Fifteenmile (502) & Fivemile (503) creeks	ST	1	2
Alder (110) & Pine (111) creeks; Lower Touchet River (207), Cottonwood (208), Pine (209) & Dry (210) creeks; Lower Walla Walla River (211); Umatilla River/Mission Creek (303) Wildhorse Creek (304); Umatilla River/Alkali Canyon (307); Lower Butter Creek (310); Upper Middle Columbia/Hood (501); Middle Columbia/Mill Creek (504)	ST	1	1
Stage Gulch (308) & Lower Umatilla River (313)	ST	0	1
John Day #170702xxx			
Middle (103) & Lower (105) South Fork John Day rivers; Murderers (104) & Canyon (107) creeks; Upper John Day (106) & Upper North Fork John Day (201) rivers; & Desolation Creek (204)	ST	2	2
North Fork John Day/Big Creek (203); Cottonwood Creek (209) & Lower NF John Day River (210)	ST	2	1
Strawberry (108), Beech (109), Laycock (110), Fields (111), Mountain (113) & Rock (114) creeks; Upper Middle John Day River (112); Granite (202) & Wall (208) creeks; Upper (205) & Lower (206) Camas creeks; North Fork John Day/Potamus Creek (207); Upper Middle Fork John Day River (301) & Camp (302), Big (303) & Long (304) creeks; Bridge (403) & Upper Rock (411) creeks; & Pine Hollow (407)	ST	1	2
John Day/Johnson Creek (115); Lower Middle Fork John Day River (305); Lower John Day River/Kahler Creek (401), Service (402) & Muddy (404) creeks; Lower John Day River/Clarno (405); Butte (406), Thirtymile (408) & Lower Rock (412) creeks; Lower John Day River/Ferry (409) & Scott (410) canyons; & Lower John Day River/McDonald Ferry (414)	ST	1	1
Deschutes #1707030xxx			
Lower Deschutes River (612)	ST	3	3
Middle Deschutes River (607)	ST	3	2
Upper Deschutes River (603)	ST	2	1
Mill Creek (605) & Warm Springs River (606)	ST	2	1
Bakeoven (608) & Buck Hollow (611) creeks; Upper (701) & Lower (705) Trout Creek	ST	1	2
Beaver (605) & Antelope (702) creeks	ST	1	1
White River (610) & Mud Springs Creek (704)	ST	1	0
Unoccupied habitat in Deschutes River/McKenzie Canyon (107) & Haystack (311); Squaw Creek (108); Lower Metolius River (110), Headwaters Deschutes River (601)	ST Conservation Value "Possibly High"		

Oregon Coast Recovery Domain. In this recovery domain, critical habitat has been designated for OC coho salmon. Many large and small rivers supporting significant populations of coho salmon flow through this domain, including the Nehalem, Nestucca, Siletz, Yaquina, Alsea, Siuslaw, Umpqua, Coos, and Coquille.

The historical disturbance regime in the central Oregon Coast Range was dominated by a mixture of high and low-severity fires, with a natural rotation of approximately 271 years. Old-growth forest coverage in the Oregon Coast Range varied from 25 to 75% during the past 3,000 years, with a mean of 47%, and never fell below 5% (Wimberly *et al.* 2000). Currently, the Coast Range has approximately 5% old-growth, almost all of it on Federal lands. The dominant disturbance now is logging on a cycle of 30 to 100 years, with fires suppressed.

Oregon's assessment of OC coho salmon (Nicholas *et al.* 2005) mapped how streams with high intrinsic potential for rearing are distributed by land ownership categories. Agricultural lands and private industrial forests have by far the highest percentage of land ownership in high intrinsic potential areas and along all coho salmon stream miles. Federal lands have only about 20% of coho salmon stream miles and 10% of high intrinsic potential stream reaches. Because of this distribution, activities in lowland agricultural areas are particularly important to the conservation of OC coho salmon.

The OC coho salmon assessment concluded that at the scale of the entire domain, pools are generally abundant, although slow-water and off-channel habitat (which are important refugia for coho salmon during high winter flows) are limited in the majority of streams when compared to reference streams in minimally-disturbed areas. Amounts of LW in streams are low in all four ODFW monitoring areas and land-use types relative to reference conditions. Amounts of fine sediment are high in three of the four monitoring areas, and were comparable to reference conditions only on public lands. Approximately 62 to 91% of tidal wetland acres (depending on estimation procedures) have been lost for functionally and potentially independent populations of coho salmon.

As part of the coastal coho salmon assessment, ODEQ analyzed the status and trends of water quality in the range of OC coho salmon using the Oregon water quality index, which is based on a combination of temperature, dissolved oxygen, biological oxygen demand, pH, total solids, nitrogen, total phosphates, and bacteria. Using the index at the species scale, 42% of monitored sites had excellent to good water quality, and 29% show poor to very poor water quality (ODEQ 2005). Within the four monitoring areas, the North Coast had the best overall conditions (6 sites in excellent or good condition out of 9 sites), and the Mid-South coast had the poorest conditions (no excellent condition sites, and only 2 out of 8 sites in good condition). For the 10-year period monitored between 1992 and 2002, no sites showed a declining trend in water quality. The area with the most improving trends was the North Coast, where 66% of the sites (6 out of 9) had a significant improvement in index scores. The Umpqua River basin, with one out of 9 sites (11%) showing an improving trend, had the lowest number of improving sites.

Southern Oregon/Northern California Coasts Recovery Domain. In this recovery domain critical habitat has been designated for SONCC coho salmon. Many large and small rivers supporting significant populations of coho salmon flow through this area, including the Elk, Rogue, Chetco, Smith and Klamath. The following summary of critical habitat information in the Elk, Rogue, and Chetco rivers is also applicable to habitat characteristics and limiting factors in other basins in this area.

The Elk River flows through Curry County, and drains approximately 92 square miles (or 58,678 acres) (Maguire 2001). Historical logging, mining, and road building have degraded stream and riparian habitats in the Elk River basin. Limiting factors identified for salmon and steelhead production in this basin include sparse riparian cover, especially in the lower reaches, excessive fine sediment, high water temperatures, and noxious weed invasions (Maguire 2001).

The Rogue River drains approximately 5,160 square miles within Curry, Jackson and Josephine counties in southwest Oregon. The mainstem is about 200 miles long and traverses the coastal mountain range into the Cascades. The Rogue River estuary has been modified from its historical condition. Jetties were built by the ACOE in 1960, which stabilized and deepened the mouth of the river. A dike that extends from the south shore near Highway 101 to the south jetty was completed in 1973. This dike created a backwater for the large shallow area that existed here, which has been developed into a boat basin and marina, eliminating most of the tidal marsh.

The quantity of estuary habitat is naturally limited in the Rogue River. The Rogue River has a drainage area of 5,160 square miles, but the estuary at 1,880 acres is one of the smallest in Oregon. Between 1960 and 1972, approximately 13 acres of intertidal and 14 acres of subtidal land were filled in to build the boat basin dike, the marina, north shore riprap and the other north shore developments (Hicks 2005). Jetties constructed in 1960 to stabilize the mouth of the river and prevent shoaling have altered the Rogue River, which historically formed a sill during summer months (Hicks 2005).

The Lower Rogue Watershed Council's watershed analysis (Hicks 2005) lists factors limiting fish production in tributaries to Lower Rogue River watershed. The list includes water temperatures, low stream flows, riparian forest conditions, fish passage and over-wintering habitat. Limiting factors identified for the Upper Rogue River basin include fish passage barriers, high water temperatures, insufficient water quantity, lack of LW, low habitat complexity, and excessive fine sediment (Rogue Basin Coordinating Council 2006).

The Chetco River estuary has been significantly modified from its historical condition. Jetties were erected by the ACOE in 1957, which stabilized and deepened the mouth of the river. These jetties have greatly altered the mouth of the Chetco River and how the estuary functions as habitat for salmon migrating to the ocean. A boat basin and marina were built in the late 1950s and eliminated most of the functional tidal marsh. The structures eliminated shallow water habitats and vegetation in favor of banks stabilized with riprap. Since then, nearly all remaining bank habitat in the estuary has been stabilized with riprap. The factors limiting fish production in the Chetco River appear to be high water temperature caused by lack of shade, especially in tributaries, high rates of sedimentation due to roads, poor over-wintering habitat due to a lack of LW in tributaries and the mainstem, and poor quality estuary habitat (Maguire 2001).

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 action area, the anticipated impacts of all proposed Federal projects in the 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 private, state, and Federal lands. Within the program-level 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 a myriad of interrelated factors for the decline of species considered in this opinion. 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.

Anadromous salmonids have been affected by the development and operation of dams. Dams, without adequate fish passage systems, have extirpated anadromous fish from their pre-development spawning and rearing habitats. Dams and reservoirs, within the currently accessible migratory corridor, have greatly altered the river environment and have affected fish passage. The operation of water storage projects has altered the natural hydrograph of many 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 is being restored where it did not previously exist, either through improvements to existing fish passage facilities or through dam removal (*e.g.*, Marmot Dam on the Sandy River and Powerdale Dam on the Hood River).

Within the habitat currently accessible by species considered in this opinion, dams have negatively affected spawning and rearing habitat. Floodplains have been reduced, off-channel habitat features have been eliminated or disconnected from the main channel, and the amount of LW in mainstem rivers has been greatly reduced. Remaining habitats often are affected by flow fluctuations associated with reservoir water management for power peaking, flood control, and other operations.

The development of hydropower and water storage projects within the Columbia River basin have resulted in the inundation of many mainstem spawning and shallow-water rearing areas (loss of spawning gravels and access to spawning and 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, including harbor seals, sea lions, and killer whales all prey on juvenile and adult salmon. The Columbia River Basin has a diverse assemblage of native and introduced fish species, some of which prey on salmon, steelhead, and eulachon. 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), Pacific lamprey (native), yellow perch (introduced), largemouth bass (introduced), and bull trout (native). Increased predation by non-native predators has and continues to decrease population abundance and productivity.

Avian predation is another factor limiting salmonid recovery in the Columbia River Basin. Throughout the basin, piscivorous birds congregate near hydroelectric dams and 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 (a 39% decrease from 2003) and another 91.7 million pounds were discharged in the air and on land in 2011 (U.S. EPA 2011b). This reduction can be attributed, in part, to significant state, local and private efforts to modernize and strengthen tools available to treat and manage stormwater runoff (U.S. EPA 2009; U.S. EPA 2011b).

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). In the lower Clackamas River basin, Oregon (2000–2005), USGS detected 63 pesticide compounds, including 33 herbicides. 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.

Whenever a contaminant is in an aqueous phase or associated with suspended sediments, it is subject to the processes of advection and dispersion toward the Pacific Ocean. However, once soluble metal releases are reduced or terminated, the solute half-time in Columbia River water is months versus about 20 years for adsorbed metals on surficial (or resuspended) bed sediments. The much slower rate of decline for sediment, as compared to the solute phase, is attributed to resuspension, transport and redeposition of irreversibly bound metals from upstream sedimentary deposits. This implies downstream exposure of benthic or particle-ingesting biota can continue for years following source remediation and/or termination of soluble metal releases (Johnson *et al.* 2005). Adsorbed contaminants are highest in clay and silt, which can only be deposited in areas of reduced water velocity, such as behind dams and the backwater or off-channel areas preferred as rearing habitat by juveniles of some Pacific salmon (Johnson *et al.* 2005; ODEQ 2012). Similar estimates for the residence time of contaminants in the freshwater plume are unavailable, although the plume itself has been tracked as a distinct coastal water mass that may extend up to 50 miles beyond the mouth of the Columbia River, where the dynamic interaction of tides, river discharge, and winds can cause significant variability in the plume's location at the interannual, seasonal scale, and even at the event scale of hours (Burla *et al.* 2010; Kilcher *et al.* 2012; Thomas and Weatherbee 2006).

The existing highway system contributes to a poor environmental baseline condition in several significant ways. 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 action area that have already undergone formal consultation. For example, from 2007 through 2012, the Corps authorized 280 restoration actions in Oregon under the SLOPES programmatic consultation and another 397 actions for construction, minor discharge, over- and in-water structures, transportation, streambank stabilization, surveys, and utility lines in habitat affecting ESA-listed fish species. 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 BPA, NOAA Restoration Center, and USFWS 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.

NMFS also made the following assumptions regarding the environmental baseline conditions in specific areas where projects will be carried out consistent with the proposed action:

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, floodplain fill, 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

"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 are still reasonably certain to occur.

This analysis begins with an overview of the scope of the SLOPES Stormwater, Transportation or Utility program, deconstructs the program and individual types of actions, then examines the general environmental impacts of each of those elements in detail before analyzing their combined impact on species and designated critical habitats.

Under the administrative portion of this action, the Corps will evaluate each individual action to ensure that the following conditions are complied with: (a) The PDC and this opinion are applied where ESA-listed salmon, steelhead, green sturgeon, or eulachon, or their designated critical habitats, or both, are present; (b) the anticipated range of effects is within the range considered in this opinion; (c) the action is carried out consistent with the PDC; and (d) action and program level monitoring and reporting requirements are met. These procedures are a central part of the SLOPES program and function to ensure that individual projects covered by SLOPES and 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 SLOPES proposed action, and otherwise comply with this opinion and Incidental Take Statement 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.

Construction of each action will begin after the Corps' approval. The discussion of the direct physical and chemical effects of this part of the action on the environment will vary depending on the type of action being performed, but will all be based on a common set of effects related to construction. Actions as described in this opinion and involving natural hazard response; streambank and channel stabilization; maintenance, rehabilitation, or replacement of roads, culverts, bridges, stormwater facilities, and utility line crossings are likely to have all of the following effects. Actions that only involve placement of boulders, gravel or wood will only have a subset of those effects, or will express those effects to a lesser degree.

Construction will have direct physical and chemical effects on the environment that commonly begin with pre-construction activity, such as surveying, minor vegetation clearing, and placement of stakes and flagging guides. This requires movement of personnel and sometimes machines over the action area. The next stage, site preparation, may require development of access roads, construction staging areas, and materials storage areas that affect more of the action area. If additional earthwork is necessary to clear, excavate, fill, or shape the site, more vegetation and topsoil may be removed, deeper soil layers exposed, and operations extended into the active channel. The final stage of construction is site restoration. This stage consists of any action necessary to undo disturbance caused by the action, may include replacement of LW, native vegetation, topsoil, and native channel material displaced by construction, and otherwise restoring ecosystem processes that form and maintain productive fish habitats.

The physical, chemical, and biotic effects of each individual project the Corps authorizes under SLOPES for Stormwater, Transportation or Utilities will vary according to the number and type of elements present, although each element will share, in relevant part, 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. NMFS assumes that every individual project will share some of the effects described here in proportion to the project's complexity, footprint, and proximity to species and critical habitat, but that no action will have effects that are greater than the full range of effects described here, because every action is based on the same set of underlying construction activities or elements, and each element is limited by the same PDC. The duration of construction required to complete most projects will normally be less than one year, although significant fish passage projects may require additional in-water work or upland work to complete. Projects requiring an EIS pursuant to NEPA that evaluate alternatives affecting listed species are ineligible for coverage under this consultation due to the potentially large and unpredictable effects caused by projects of this scale.

Program administration. The Corps will provide initial PDC for likely users of this opinion to ensure they are incorporated into all phases of design for each authorized project, and that any unique project or site constraint related to site suitability, right-of-way, special maintenance needs, compensatory mitigation, or cost is resolved early on. Then, the Corps will review each proposed project to ensure that the opinion is being used as intended. The Corps will also obtain an additional approval from NMFS for projects that will have a substantial effect on fish passage or stream geometry, or other characteristics that require NMFS's special expertise to determine whether the proposal is consistent with the opinion. The Corps will also retain the right of reasonable access to each project site so that the use and effectiveness of these PDC can be monitored if necessary. Furthermore, the Corps will notify NMFS before each project begins construction. Shortly (within 60 days) after inwater work for a project is completed, the Corps or the applicant will submit the completion report portion of the implementation form, along with any pertinent information needed, to ensure that a completed project matches its proposed design.

As an additional program-level check on the continuing effects of the action, the Corps 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 PDC 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.

Preconstruction. Preconstruction activities for restoration projects typically include surveying, mapping, placement of stakes and flagging guides, exploratory drilling, minor vegetation clearing, opening access roads, and establishing vehicle and material staging areas. 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. 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 to have long-term adverse effects due to the impact of maintaining the built environment's encroachment on aquatic habitats. Conversely, under the action as proposed, each project is also likely to have long-term positive effects through application of PDC that reduce pre-existing impacts by, for example, improving floodplain connectivity, streambank function, water quality, or fish passage.

Surveying, mapping, and the placement of stakes and flagging entail minor movements of machines and personnel over the action area with minimal direct effects but important indirect effects by establishing geographic boundaries that will limit the environmental impact of subsequent activities. The Corps 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 actions.

Erosion and pollution control. The Corps will ensure that a suite of 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. NMFS review and approval is required for earthwork at an 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 the Corps' best professional judgment.

During and after wet weather, increased runoff resulting from soil and vegetation disturbance at a construction site during both preconstruction and construction phases is likely to suspend and transport more sediment to receiving waters as long as construction continues so that multiyear projects are likely to cause more sedimentation. This increases total suspended solids and, in some cases, stream fertility. Increased runoff also increases the frequency and duration of high stream flows and wetland inundation in construction areas. Higher stream flow increases stream energy that scours stream bottoms and transports greater sediment loads farther downstream than would otherwise occur. Sediments in the water column reduce light penetration, increase water temperature, and modify water chemistry. Redeposited sediments partly or completely fill pools, reduce the width to depth ratio of streams, and change the distribution of pools, riffles, and glides. Increased fine sediments in substrate also reduce survival of eggs and fry, reducing spawning success of salmon, steelhead, and eulachon.

During dry weather, the physical effects of increased runoff appear as reduced ground water storage, lowered stream flows, and lowered wetland water levels. The combination of erosion and mineral loss reduce soil quality and site fertility in upland and riparian areas. Concurrent in-water work compacts or dislodges channel sediments, thus increasing total suspended solids and allowing currents to transport sediment downstream where it is eventually re-deposited. Continued operations when the construction site is inundated significantly increase the likelihood of severe erosion and contamination. However, the Corps proposes to cease work when high flows may inundate the project area, except for efforts to avoid or minimize resource damage, so significant erosion and contamination is unlikely.

Establishing access roads and staging areas requires disturbance of vegetation and soils that support floodplain and riparian function, such as delivery of LW 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). Although the size of areas likely to be adversely affected by actions proposed to be authorized or carried out under this opinion are small, and those effects are likely to be short-term (weeks or months), even small denuded areas will lose organic matter and dissolved minerals, such as nitrates and phosphates. The microclimate at each action 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.

Whenever possible, 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. All temporary access roads will be obliterated when the action 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.

Excavating test pits removes vegetation in the excavated area and may cause soil compaction along wheel tracks and in excavated spoils placement areas. Typically, spoils do not erode into streams or wetlands since this material is placed back into the test pit once the investigation or sampling has been completed, usually within a 2-hour time period, and the disturbed area is stabilized by seeding and mulching to prevent rainfall from washing sediment from the spoils piles into nearby streams or wetlands.

Exploratory drilling with an auger typically produces 1.5 to 11.5 cubic meters of spoil that will be stabilized or removed from the site. Erosion control berms and ditching that are sometimes used to manage runoff from an active drill site may themselves cause erosion, sedimentation from drilling mud, or other temporary site disturbances. Similarly, untreated drilling fluids sometimes travel along a subsurface soil layer and exit in a stream or wetland and degrade water quality.

Effects from soils testing are similar to those described above for drilling operations. Air rotary drilling produces dust, flying sand-sized rock particles, foaming additives, and fine water spray that will be collected to prevent deposition in a stream or wetland. The distances that cuttings and liquids (*e.g.*, water, foaming additives) are ejected out of the boring depend on the size of the drilling equipment. Unrestrained, larger equipment will disperse particles up to 6.1 meters, while smaller equipment will typically expel particles up to 3 meters. As with any heavy equipment, drilling rigs are subject to accidental spills of fuel, lubricants, hydraulic fluid and other contaminants that, if unconfined, may harm the riparian zone or aquatic habitats.

When borings are abandoned near streams or wetlands, excess grout will be contained to prevent pollution, especially during rainy periods. In some cases, boring abandonment may not occur for months or even years after the drilling has been completed. Then, soils and vegetation are subjected to additional disturbance when workers re-enter the site. Sometimes, instruments will be drilled out. When this occurs, effects are similar to those described above for drilling.

Construction. Use of heavy equipment for vegetation removal and earthwork compact the soil, thus reducing permeability and infiltration. 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). It is likely that petroleum-based contaminants have similar effects on eulachon. To minimize the risk of contamination from accidental spills that result from leaks and ruptured hydraulic hoses, equipment, vehicles, and power tools, operators will replace petroleum-based hydraulic fluids with biodegradable products when working within wetlands or within 150 feet of a water body.

The Corps will also require that 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), use of staging areas at least 150 feet from surface waters, and regular inspection and cleaning before operation to ensure that vehicles remain free of external oil, grease, mud, and other visible contaminants. Also, as noted above, to reduce the likelihood that sediment or pollutants will be carried away from project construction sites, the Corps 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.

Work involving the presence of equipment or vehicles in the active channel when ESA-listed fish are present is likely to result in injury or death of some individuals. The Corps will avoid or reduce that risk by limiting the timing of that work to avoid vulnerable life stages of ESA-listed fish, including migration, spawning and rearing. Further, when work in the active channel involves substantial excavation, backfilling, embankment construction, or similar work below OHW where adult or juvenile fish are reasonably certain to be present, or 300 feet or less upstream from spawning habitats, the Corps will require that the work area be effectively isolated from the active channel to reduce the likelihood of direct, mechanical interactions with fish, or indirect interactions through environmental effects. Regardless of whether a work area is isolated or not, and with few exceptions, the Corps will require that passage for adult and juvenile fish that meets NMFS's (2011a) criteria, or most recent version, will be provided around the project area during and after construction.

Work area isolation. If work area isolation is necessary, any juvenile salmon or steelhead present in the work isolation area will be captured and released. It is unlikely that any adult fish, including salmon, steelhead, green sturgeon, or eulachon will be affected by this procedure because it will occur when adults are unlikely to be present and, if any are present, their size allows them to easily escape from the containment area. Capturing and handling fish causes them stress though they typically recover fairly rapidly from the process and therefore the overall effects of the procedure are generally short-lived (NMFS 2002).

The primary contributing factors to stress and death from handling are differences in water temperature between the river where the fish are captured and wherever the fish are held, dissolved oxygen conditions, the amount of time that fish are held out of the water, and physical trauma. Stress on fish increases rapidly from handling if the water temperature exceeds 64°F or dissolved oxygen is below saturation. The Corps' conservation measures regarding fish capture and release, use of pump-intake screens during the de-watering phase, and fish passage around the isolation area are based on standard NMFS guidance to reduce the adverse effects of these activities (NMFS 2011a). If it is determined that carrying out the project had any unanticipated role in the death of an ESA-listed fish, that information will be reviewed by the Corps and NMFS to decide whether it is necessary to modify the project or the program to further reduce impacts.

Rock and other hard structures. Many actions authorized or carried out under this opinion will seek to install rock or other hard structures within a functional floodplain to stabilize a streambank or channel and reduce erosion of the approach to, or foundation of, a road, culvert, or bridge. In addition to the construction impacts described above, the adverse impacts of hardening the functional floodplain include direct habitat loss, reduced water quality, upstream and downstream channel impacts, reduced ecological connectivity, and the risk of structural failure (Barnard *et al.* 2013; Cramer 2012; Fischenich 2003; NMFS 2011a; Schmetterling *et al.* 2001). The habitat features of concern include water velocity, depth, substrate size, gradient, accessibility and space that are suitable for salmon and steelhead rearing. In spawning areas, rock and other hard structures are often used to replace spawning gravels, and realign channels to eliminate natural meanders, bends, spawning riffles and other habitat elements. Riffles and gravel bars downstream are scoured when flow velocity is increased. For eulachon, the important habitat features are flow, water quality and substrate conditions. For sturgeon, the habitat features of concern include bays, estuaries, and sometimes the deep riverine mainstem in lower elevations where sturgeons congregate.

The Corps proposes to avoid or minimize the adverse impacts of installing rock or other hard structures by ensuring that existing rock or hard structures will be maintained in a way that reduces their on-going adverse effects (*e.g.*, requirements to move existing structures and structural fill out of the functional floodplain whenever possible, and for erosion protection measures to incorporate vegetation, planting terraces, large wood, irregular faces, toe roughness), or else avoids or minimizes the adverse effects of altering the functional floodplain through compensatory mitigation (*e.g.*, remove or retrofit existing riprap, hard structures, or other fill elsewhere in the functional floodplain).

Treated wood. The only projects that fall within the proposed action and use treated wood in or near water are the repair or maintenance of existing wood bridges. If the Corps or an applicant would like to use treated wood for other purposes, then individual consultation would be required.

Examples of pesticide-treated wood preservatives include water-based wood preservatives, such as chromated copper arsenate (CCA), ammoniacal copper zinc arsenate (ACZA), alkaline copper quaternary (ACQ-B and ACQ-D), ammoniacal copper citrate (CC), copper azoles (CBA-A and CA-B), copper dimethyldithiocarbamate (CDDC), borate preservatives, and oil-type wood preservatives, such as creosote, pentachlorophenol, and copper naphthenate (FPL 2000). Acid copper chromate (ACC) and copper HDO (CX-A) are more recent compounds not yet in wide use (Lebow 2004). Withdrawal of CCA from most residential applications has increased interest in arsenic-free preservative systems that all rely on copper as their primary active ingredient (FPL 2004; Lebow 2004) with the proportion of preservative component ranging from 17% copper oxide in some CDDC formulations, to 96% copper oxide in CA-B (Lebow 2004).

A pesticide-treated wood structure placed in or over flowing water will leach copper and a variety of other toxic compounds directly into the stream (Hingston *et al.* 2001; Kelly and Bliven 2003; Poston 2001; Weis and Weis 1996). Although the likelihood of leaching pesticides, including copper, from wood used above or over the water is different than splash zone or in-water applications (Western Wood Preservers Institute *et al.* 2011), these accumulated materials add to the background loads of receiving streams. Movement of leached preservative components is generally limited in soil but is greater in soils with high permeability and low organic content. Mass flow with a water front is probably most responsible for moving metals appreciable distances in soil, especially in permeable, porous soils. Preservatives leached into water are more likely to migrate downstream compared with preservatives leached into soil, with much of the mobility occurring in the form of suspended sediment. If shavings, sawdust, or smaller particles of pesticide-treated wood generated during construction, use, or maintenance of a structure are allowed to enter soil or water below, they make a disproportionately large contribution to environmental contamination because the rate of leaching from smaller particles is 30 to 100 times greater than from solid wood (FPL 2001; Lebow 2004; Lebow and Tippie 2001).

Copper and other toxic chemicals, such as zinc, arsenic, chromium, and PAHs, that leach from pesticide-treated wood used to construct roads, culverts or bridges are likely to adversely affect salmon, steelhead, green sturgeon, and eulachon that spawn, rear, or migrate by those structures, and when they ingest contaminated prey (Poston 2001). Early efforts by NMFS to analyze the science applicable to treated wood impacts on anadromous fish (NMFS 1998, cited in NOAA Fisheries 2009) assumed that certain thresholds for exposure were protective of fish, including juvenile salmon, for example a water column concentration of 7 ppb for copper as a threshold for behavioral avoidance by salmon and 0.018 toxic units for PAH as adequately protective against toxic effects or bioaccumulation. NMFS relied on the 1998 document when developing the 2004 SLOPES biological opinion (NMFS 2004).

More recently, copper has been shown to impair the olfactory nervous system and olfactory-mediated behaviors in salmon and steelhead at levels as low as 0.6 ppb, with a range from 0.3 to 3.2 pbb (Baldwin *et al.* 2003; Baldwin and Scholz 2005; Hecht *et al.* 2007; Linbo *et al.* 2006; McIntyre *et al.* 2008; Feist et al. 2011, Scholz et al. 2011, Spromberg and Scholz 2011). Similarly, more recent science analyzes the effects of dietary exposure to PAHs, which leach from wood treated with creosote, and may cause cancer, reproductive anomalies, immune dysfunction, growth and development impairment, and other impairments to exposed fish (Carls *et al.* 2008; Collier *et al.* 2002; Incardona *et al.* 2005; Incardona *et al.* 2004; Incardona *et al.* 2006; Johnson 2000; Johnson *et al.* 2002; Johnson *et al.* 1999; Stehr *et al.* 2009, Brette et al. 2014).

Moreover, we now have more sophisticated understandings of the synergistic impacts of copper and PAH when combined with other contaminant and stressors, as well as a greater appreciation for the repeated exposures of anadromous fish during the life cycle. Specifically, all life history stages of salmon are typically exposed to complex environmental mixtures of other toxic compounds (e.g., other metals, pesticides, weathered PAHs) in conjunction with other stressors (e.g., elevated temperatures, low dissolved oxygen) through a variety of exposure routes other than the water column, including consumption of contaminated prey items (dietary) or direct contact with contaminated sediments (Sandahl et al. 2007, Macneale et al. 2010, Scholz et al. 2011, Feist et al. 2011, Laetz et al. 2014). No stand alone thresholds take into account these multiple routes of exposure or the potential impacts of complex mixtures of contaminants on olfaction or other physiological functions. Interactions among multiple stressors, including contaminant mixtures, were far beyond the scope of the NMFS 1998 guidelines, or any other current guidelines, and warrant careful consideration in site-specific assessments.

The proposed action significantly limits exposure of fish to the adverse effects of treated wood by prohibiting the use of treated wood in a structure that will be in or over water or permanently or seasonally flooded wetlands, *except to maintain or repair an existing wood bridges*. In addition, for bridge maintenance and repair, treated wood is subject to strict conditions. Those limits include requirements that any treated wood will first be inspected to ensure that no visible residue, bleeding of preservative, preservative-saturated sawdust, contaminated soil, or other matter is present, then stored out of contact with standing water and wet soil and protected from precipitation. The use of prefabrication is required whenever possible to ensure that cutting, drilling and field preservative treatments are minimized. When field fabrication is necessary, all cutting and drilling of pesticide-treated wood, and field preservative treatment of wood exposed by cutting and drilling, will occur above OHW to minimize discharge of sawdust, drill shavings, excess preservative and other debris in riparian or aquatic habitats. Tarps, plastic tubs or similar devices will be used to contain the bulk of any fabrication debris, and any excess field preservative will be wiped off. Any structure built of pesticide-treated wood, including pilings, will have design features to avoid or minimize impacts and abrasion that would deposit pesticide-treated wood debris and dust in riparian or aquatic habitats.

Moreover, any project that requires removal of pesticide-treated wood will ensure that, to the extent possible, no wood debris falls into the water. If wood debris does fall into the water, it will be removed immediately. After treated wood is removed, it will be placed in an appropriate dry storage site until it can be removed from the project area. When these measures are considered collectively, they will significantly reduce the amount of toxic preservatives reaching water bodies occupied by ESA-listed fish.

Additionally, the total amount of treated wood used in projects authorized under this opinion is expected to be low. This is because: (1) the only authorized use of treated wood is for repair and maintenance of existing wood bridges, (2) the number of wood bridges in the program action area is relatively small and decreasing over time, (3) the number of bridge maintenance and repair projects authorized under this opinion in any given year is only a small fraction of the total number of project authorized.

Because of these limitations and conditions, the actual area where we expect juvenile fish to experience sublethal effects, such as reduced foraging success and reduced growth, is so small relative to the total area occupied by juvenile fish, and the total area of designated critical habitat, we do not expect the impacts of treated wood use to alter population growth rate, abundance, or any other demographic characteristic.

Alternatives to treated wood that are used could also have some adverse effects. Materials such as wood that is not treated with pesticides (e.g., redwood, cedar, cypress, or exotic hardwoods) or less toxic preservatives (e.g., sodium silicate), galvanized steel, concrete, recycled plastic lumber, rubber, or composite materials are increasingly being used in aquatic construction projects due to expected longevity, increased strength, and minimal leaching characteristics (EPA 2014, Hutton and Samis 2000, Stratus 2005, USFS 2014). Those materials are all likely to contain little, if any, copper or PAH, but may include other metal or synthetic materials that cannot be considered entirely non-toxic (EPA 2014, Hutton and Samis 2000, Stratus 2005, USFS 2014).

The installation and removal of piling with a vibratory or impact hammer is likely to result in adverse effects to salmon, steelhead, green sturgeon, and eulachon due to high levels of underwater sound that will be produced. Although there is little information regarding the effects on fish from underwater sound pressure waves generated during the piling installation (Anderson and Reyff 2006; Laughlin 2006), laboratory research on the effects of sound on fish has used a variety of species and sounds (Hastings *et al.* 1996; Popper and Clarke 1976; Scholik and Yan 2002).

Because those data are not reported in a consistent manner and most studies did not examine the type of sound generated by pile driving, it is difficult to directly apply the results of those studies to pile driving effects on salmon, steelhead, green sturgeon and eulachon. However, it is well established that elevated sound can cause injuries to fish swim bladders and internal organs or temporary and permanent hearing damage. The degree to which normal behavior patterns are altered is less known, although it is likely that salmon, steelhead, green sturgeon, and eulachon that are resident within the action area are more likely to sustain an injury than fish that are migrating up or downstream. Removal of pilings within the wetted perimeter that are at the end of their service life will disturb sediments that become suspended in the water, often along with contaminants that may have been pulled up with, or attached to, the pile. A major release of PAHs into the water is likely to occur if creosote-treated pilings are damaged during removal, or if debris is allowed to re-enter or remain in the water.

The proposed action includes a PDC to minimize exposure of fish to high levels of underwater sound during pile driving and to reduce releases of suspended solids and contaminants during pile removal. PDC include requirements that pilings will be 24 inches in diameter or smaller, steel H-pile will be designated as HP24 or smaller, a vibratory hammer will be used whenever possible for piling installation and full or partial (bubble curtain) isolation of the pile while it is being driven will occur. During pile extraction, care will be taken to ensure that sediment disturbance is minimized. Measures for broken or intractable piles include properly disposing all residue and containing floating debris and sediment that adheres to piles. Nonetheless, a small contaminant release will occur when a creosote pile is removed, and total suspended sediment will increase with every pile removal. It is still likely that sound energy will radiate directly or indirectly into the water as a result of pile driving, although, due to the proposed PDC, widespread propagation of sounds injurious to fish is not expected to occur.

Water withdrawal. Any temporary water withdrawal will have a fish screen installed, operated, and maintained as described in NMFS (2011a). The Corps will require that all discharge water created by concrete washout, pumping for work area isolation, vehicle wash water, drilling fluids, or other construction work will be treated using the BMPs applicable to site conditions for removal of 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.

Non-native and Invasive Plant Control. Manual, mechanical, biological and herbicidal treatments of invasive and non-native plants are often conducted as part of an action to restore native riparian vegetation on streambank stabilization, culvert, and bridge projects. NMFS has recently analyzed the effects of these activities using the similar active ingredients and PDC for proposed USDA Forest Service and USDI Bureau of Land Management invasive plant control programs (NMFS 2010; NMFS 2012a; NMFS 2013c). The types of plant control actions analyzed here are a conservative (*i.e.*, less aggressive) subset of the types of actions 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 27).

Table 27. 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

*Stepping on redds, displacing 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 the proposed PDC, 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 and blackberry monocultures, and possibly from cutting streamside woody species (tree of heaven, scotch broom, *etc.*). Most invasive plants are understory species of streamside vegetation that do not provide the majority of streamside shade and furthermore will be replaced by planted native vegetation. 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 that is likely to occur due to removal of riparian weeds could slightly affect stream temperatures or dissolved oxygen levels, which could cause short-term stress to fish adults, juveniles and eggs. NMFS did not identify adverse effects to macroinvertebrates from herbicide applications that follow these proposed PDC. Effects pathways are described in detail below.

Manual and mechanical treatments are likely to result in mild construction effects (discussed above). Hand pulling of emergent vegetation is likely to result in a localized mobilization of suspended sediments. Treatment of knotweed and other streamside invasive species with herbicides (by stem injection or spot spray) or 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 definite, broad area, and to 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 invasive plant monoculture that encompasses a small stream channel. This effect would vary depending on site aspect, elevation, and amount of topographic shading, but is likely to decrease over time at all sites as shade from 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. Biological controls typically work slowly over a period of years, and only on target species, and result in minimal impact to soils and vegetation from the actual release. 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.

Herbicide applications. Stream margins often provide shallow, low-flow conditions, have a slow mixing rate with mainstem waters, and are the site at which runoff and subsurface flows are introduced. Juvenile salmon and steelhead, particularly recently emerged fry, often use low-flow areas along stream margins. For example, wild Chinook salmon rear near stream margins until they reach about 60 mm in length. 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. NMFS identified three scenarios for the analysis of herbicide application effects: (1) Runoff from riparian application; (2) application within perennial stream channels; and (3) runoff from intermittent stream channels and ditches.

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, which is proposed, as well as many other herbicides and pesticides, are detected frequently in freshwater habitats within the four western states where listed Pacific salmonids are distributed (NMFS 2011e).

Several proposed PDC 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.

Surface water contamination with herbicides 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 action, 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 is another important pathway. Most herbicide groundwater contamination is caused 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 (DiTomaso1997). 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 2011e). Proposed PDC minimize these concerns by ensuing proper calibration, mixing, and cleaning of equipment. Non-point source groundwater contamination of herbicides can occur when a mobile herbicide is applied in areas with a shallow water table. Proposed PDC minimize this danger by restricting the formulas used, and the time, place and manner of their application to minimize offsite movement.

Herbicide toxicity. Herbicides included in this invasive plant programmatic activity 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 in this programmatic activity 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, direct and indirect exposure and toxicity risks are inherent in some application scenarios.

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. This leads to uncertainty in risk assessment analyses. 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.

The effects of the herbicide applications 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 (above the OHW mark) application along streams, lakes and ponds, (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. Risks associated with exposure and associated effects were also evaluated for terrestrial species.

Although the PDC would minimize drift and contamination of surface and ground water, herbicides reaching surface waters will likely result in mortality to fish during incubation, or lead to altered development of embryos. Stehr *et al.* (2009) found that the low levels of herbicide delivered to surface waters are unlikely to be toxic to the embryos of ESA-listed salmon, steelhead and trout. However, mortality or sub-lethal effects such as reduced growth and development, decreased predator avoidance, or modified behavior are likely to occur. Herbicides are likely to also adversely affect the food base for listed salmonids and other fish, which includes terrestrial organisms of riparian origin, aquatic macroinvertebrates and forage fish.

Adverse effect threshold values for each species group were defined as either 1/20th of the LC50 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 2004c), imazapic (SERA 2004a), chlorsulfuron (SERA 2004b), imazapyr (SERA 2011a), glyphosate (SERA 2011c), and triclopyr (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.

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 herbicides on salmonids are fully described by NMFS in other recent opinions with the EPA, USFS, BPA, and USACE (NMFS 2010; NMFS 2011e; NMFS 2011g; NMFS 2012a; NMFS 2013b; NMFS 2013d; NMFS 2013c) 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 2008c).

HQ evaluations form the 2008 ARBO (NMFS 2008c) 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.

For imazapic, picloram, and triclopyr, we referred to NMFS's opinions, SERA reports, various other literature sources, and the 2013 BA for ARBO II (USDA-Forest Service *et al.* 2013) to characterize risk to listed fish species.

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 adversely affect algal production when occurring on soils with poor infiltration.

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 not likely to adversely affect listed salmonids or their habitat 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 adversely affect listed salmonids. 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 mg/L for both acute toxicity and reproductive effects. Aquatic macrophytes may be much more sensitive, with an acute EC50 of 6.1 μg/L in duck weed (*Lemna gibba*). Aquatic algae appear to be much less sensitive, with EC50 values of greater than 45 μg/L. 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.

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 juvenile salmonids. Consequently, adverse effects on algae and aquatic macrophyte production may cause a reduction in availability of forage for juvenile salmonids. Over time, juvenile salmonids that receive less food have lower body condition and smaller size at smoltification. However, the small amount of imazapyr expected to reach the water should not result in effects this severe.

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 forage availability for juvenile salmonids 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 will be likely in both sensitive species of fish and sensitive species of algae (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). PDC 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 adversely affect listed salmonids or their habitat.

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 adversely affect 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 mg/L or less for purified triclopyr alone or for the TEA formulations Garlon 3A and Renovate.

Adjuvants. Washington State Departments of Agriculture and Ecology have the following criteria for the registration of spray adjuvants for aquatic use in Washington:

- The adjuvant must fulfill all requirements for registration of a food / feed use spray adjuvant in Washington.
- The adjuvant must be either slightly toxic or practically non-toxic to freshwater fish. Rainbow trout (Oncorhynchus mykiss) is the preferred test species.
- The adjuvant must be moderately toxic, slightly toxic or practically non-toxic to aquatic invertebrates. Either *Daphnia magna* or *Daphnia pulex* are acceptable test species.

- The adjuvant formulation must contain less than 10% alkyl phenol ethoxylates (including alkyl phenol ethoxylate phosphate esters).
- The adjuvant formulation must not contain any alkyl amine ethoxylates (including tallow amine ethoxylates).

Several of these compounds were not proposed in this consultation because they do contain alkyl phenol ethoxylates (APEOs). Alkylphenols, including nonylphenol (NP) and nonylphenol ethoxylates (NPE), have been detected in the natural environment, including ambient air, sewage treatment plant effluent, sediment, soil, and surface waters, in wildlife, household dust, and human tissues. NP and NPE are toxic to aquatic organisms, and the breakdown products of nonylphenol ethoxylates (NP and shorter-chained ethoxylates) are more toxic and more persistent than their parent chemicals. NP has been shown to have estrogenic effects in a number of aquatic organisms (Environment Canada and Health Canada 2001; Lani 2010; Servos 1999). Environment Canada and Health Canada (2001) concluded that nonylphenol and its ethoxylates are entering the environment in a quantity or concentration or under conditions that have or may have an immediate or long-term harmful effect on the environment or its biological diversity. Zoller (2006) reported that egg production by zebrafish, exposed to 75, 25 and 10 µg/L of a typical industrial APEO was reduced up to 89.6%, 84.7% and 76.9%, respectively, between the 8th and 28th days of exposure.

Stehr *et al.* (2009) studied developmental toxicity in zebrafish *(Danio rerio)*, which involved conducting rapid and sensitive phenotypic screens for potential developmental defects resulting from exposure to six herbicides (picloram, clopyralid, imazapic, glyphosate, imazapyr, and triclopyr) and several technical formulations. Available evidence indicates that zebrafish embryos are reasonable and appropriate surrogates for embryos of other fish, including salmonids. The absence of detectable toxicity in zebrafish screens is unlikely to represent a false negative in terms of toxicity to early developmental stages of threatened or endangered salmonids. Their results indicate that low levels of noxious weed control herbicides are unlikely to be toxic to the embryos of ESA-listed salmon, steelhead, and trout. Those findings do not necessarily extend to other life stages or other physiological processes (*e.g.*, smoltification, disease susceptibility, behavior).

The proposed PDC include limitations on the herbicides, adjuvants, carriers, handling procedures, application methods, drift minimization measures, and riparian buffers. The PCD 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 key limiting factor that, together with the other limitations, will greatly reduce the likelihood that significant amounts of herbicide will be transported to aquatic habitats, although some herbicides are still likely to enter streams through aerial drift, in association with eroded sediment in runoff, and dissolved in runoff, including runoff from intermittent streams and ditches. 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 action area, provide early detection and rapid response before such species establish a secure position in the plant community, eradicate incipient populations, and control existing populations.

Site restoration. After each project is complete, the Corps will require any significant disturbance of riparian vegetation, soils, streambanks, or stream channel that was caused by the construction to be cleaned up and restored to reestablish those features within reasonable limits of natural and management variation. Thus, site restoration will typically include replacement of natural materials or other geomorphic characteristics that were previously altered or degraded there in some way, so that ecosystem processes that form and maintain productive fish habitats are replaced and can function at those sites.

Some of the adverse effects of construction will abate almost immediately, such as increased total suspended solids or vibration caused by pile driving. Others will be long-term conditions that may decline quickly but persist at some level for weeks, months, or years, until riparian and floodplain vegetation are fully reestablished. Failure to complete site restoration, or to prevent disturbance of newly restored areas by livestock or unauthorized persons will delay or prevent recovery of processes that form and maintain productive fish habitats. The time necessary for recovery of functional habitat attributes sufficient to support species recovery following any disturbance 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 (*i.e.*, months to years) after completion of the project. Recovery of functions related to LW 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. The rate and extent of functional recovery is also controlled in part by watershed context. Proposed actions will likely occur in areas where productive habitat functions and recovery mechanisms are absent or degraded. Failure to complete site restoration, or to prevent disturbance of newly restored areas by livestock or unauthorized persons will delay or prevent recovery of processes that form and maintain productive fish habitats.

For actions that include a construction phase, 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 the delivery of LW to the riparian area and aquatic system, 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. Whether recovery occurs over weeks or years, the disturbance frequency, considered as the number of actions funded per year within a given recovery domain, is likely to be extremely low, as is the intensity of the disturbance, considered as a function of the total number of miles of critical habitat present within each watershed.

Activity Category-Specific Effects

Natural Hazard Response. In the case of a natural hazard response, the effects of the action will be complicated by the initial conditions of the action area which will include imminent or recent failure of an existing road, culvert, bridge, or utility line. Such failures are likely to include a significant amount of structural debris plus disturbance and erosion of riparian vegetation and soils, stream banks, and stream substrates that will be stabilized, and then restored to the same standard as other parts of the proposed action. For purposes of this opinion, the effects of the proposed action, including natural hazard response, will be analyzed using a common set of effects related to construction, site restoration, and operation and maintenance. The NMFS assumes that no action will have effects that are greater than the full range of effects described here because each action is based on a similar set of underlying construction activities, is limited by the same PDC, and, except where noted, the species that will be affected have similar biological requirements and behaviors.

Streambank and channel stabilization. In this SLOPES programmatic opinion, the primary streambank stabilization method proposed is vegetated riprap with large woody debris. Other proposed methods, to be used alone or in combination, include a log or roughened rock toe, a partially spanning porous weir, woody plantings, herbaceous cover, deformable soil reinforcement, coir logs, bank reshaping and slope grading, floodplain flow spreaders, floodplain roughness, and engineered log jams. Damaged streambanks will be restored to a natural slope, pattern, and profile suitable for establishment of permanent woody vegetation, without changing the location of the bank toe. Rock and other hard structures within the functional floodplain reduce water quality by reducing or eliminating riparian vegetation that regulates the quantity and quality of runoff and, together with channel complexity, help to maintain and reduce stream temperatures. The benefits of using rock or other hard structures for this purpose are often speculative or minimal, at best, particularly in contrast to the multiple habitat benefits provided by other erosion control methods that do not require hardening of the stream bank or bed (Cramer *et al.* 2003; Cramer 2012).

The effects of stream bank restoration are likely to include construction effects discussed above, and reestablishment of native riparian forests or other appropriate native riparian plant communities, provide increased cover (LW, boulders, vegetation, and bank protection structures) and a long-term source of all sizes of instream wood, reduce fine sediment supply, increase shade, moderate microclimate effects, and provide more normative channel migration over time.

Upstream and downstream channel effects occur when bank and channel hardening and channel narrowing alter stream velocity. Downstream, loss of stream roughness and channel narrowing causes water velocity and erosion to increase. Upstream, channel narrowing reduces water velocity and leads to backwater effects during high flows that typically result in upstream deposition (Legasse, Schall and Richardson, 2001). Then, when flows recede, erosion occurs around or through the new deposition. Thus, a hardened bank or channel creates chronically unstable conditions that increase bed and bank erosion upstream and downstream, and often affect either the subject structure or an unrelated structure in a way that applicants prefer to address by further hardening. This sets in motion another round of upstream and downstream channel effects that perpetuates and extends the extent of aquatic habitat damage.

Channel maintenance is another very serious source of upstream and downstream channel effects. Channel maintenance refers to the periodic (sometimes annual) dredging necessary to counteract natural deposition which occurs around structures where they impinge on the edge of a functional floodplain, particularly where a smaller tributary enters the floodplain and creates an alluvial fan. These areas tend to fill with alluvial material that will be dredged to prevent a road, culvert, or other structure from being overtopped during high flow events. This chronic source of bed removal is a major cause of channel instability and loss of spawning and rearing habitat for long distances upstream and downstream, and is a source of mechanical disturbance in bays, estuaries, and lower elevation mainstem reaches where sturgeon occur.

Ecological connectivity refers to the capacity of the landscape to support the movement of energy, water, sediment, organisms, and other material. Ecological connectivity is adversely affected by rock or other hard structures in the functional floodplain when bed material and aggrading channel processes cannot cycle throughout the reach, and when the upstream or downstream movements of organisms are restricted. The conservation of salmon, steelhead, green sturgeon, and eulachon is intimately linked to the health of their underlying ecosystems. This, in turn, depends on more than just the ability of these fish to move upstream and downstream during different life history stages and under a wide variety of different stream conditions. Ecological health also requires ecological connectivity for a wide range of physical and biotic processes that are more difficult to quantify than fish passage, such as seasonally shifting channel patterns, the upstream flight and downstream drift of insects, and delivery of large wood from terrestrial sources to the stream, estuary and coastal ocean (Maser *et al.* 1988). Installation of rock or structures that require channel maintenance captures large wood, accelerates or delays fish movements, or otherwise inhibits the movement of energy and material also reduces ecological connectivity.

Maintenance, rehabilitation, and replacement of roads, culverts, and bridges. The effects of these projects includes all of the preconstruction, construction, and site restoration effects described above. This includes actions necessary to complete geotechnical surveys, such as access road construction, drill pad preparation, mobilization and set up, drilling and sampling operations, demobilization, boring abandonment, and access road and drill pad reclamation. Excavation, grading, and filling necessary to maintain, rehabilitate, or replace existing roads, culverts, and bridges, and to construct and maintain stormwater facilities are also included.

Stormwater runoff from the highway system, including roads, culverts, and bridges, delivers a wide variety of pollutants to aquatic ecosystems, such as nutrients, metals, petroleum-related compounds, sediment washed off the road surface, and agricultural chemicals used in highway maintenance (Buckler and Granato 1999; Colman *et al.* 2001; Driscoll *et al.* 1990; Kayhanian *et al.* 2003). These ubiquitous pollutants are a source of potent adverse effects to salmon and steelhead, even at ambient levels (Hecht *et al.* 2007; Johnson *et al.* 2007; Loge *et al.* 2006; Sandahl *et al.* 2007; Spromberg and Meador 2006), and are among the identified threats to sturgeon. Aquatic contaminants often travel long distances in solution or attached to suspended sediments, or gather in sediments until they are mobilized and transported by the next high flow (Alpers *et al.* 2000b; Alpers *et al.* 2000a; Anderson *et al.* 1996). These contaminants also accumulate in the prey and tissues of juvenile salmon where, depending on the level of exposure, they cause a variety of lethal and sublethal effects on salmon and steelhead, including disrupted behavior, reduced olfactory function, immune suppression, reduced growth, disrupted smoltification, hormone disruption, disrupted reproduction, cellular damage, and physical and developmental abnormalities (Fresh *et al.* 2005; Hecht *et al.* 2007; Lower Columbia River Estuary Partnership 2007). The proposed design criterion for stormwater management will treat stormwater flows associated with more than 95% of the annual average rainfall. 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 that have been identified as excellent treatments to reduce or eliminate contaminants for highway runoff (Barrett *et al.* 1993; Center for Watershed Protection and Maryland Department of the Environment 2000 (revised 2009); Herrera Environmental Consultants 2006; Hirschman *et al.* 2008; National Cooperative Highway Research Program 2006).[45]

Stormwater treatment practices, such as bioretention, bioslopes, infiltration ponds, and porous pavement, supplemented with appropriate soil amendments as needed,[46] 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 2012). Stormwater treatment may also include source control BMPs, which prevent pollution, or other adverse effects of stormwater, from occurring. Source control BMPs include methods as various as using mulches and covers on disturbed soil, putting roofs over outside storage areas, and berming areas to prevent stormwater run-on and pollutant runoff.

Flow control BMPs typically control the volume rate, frequency, and flow duration of stormwater surface runoff. The need to provide flow control BMPs depends on whether a development site discharges to a stream system or wetland, either directly or indirectly. Stream channel erosion control can be accomplished by BMPs that detain runoff flows and also by those which physically stabilize eroding streambanks. Both types of measures may be necessary in urban watersheds. Construction of a detention pond is the most common means of meeting flow control requirements. Construction of an infiltration facility is the preferred option but is feasible only where more porous soils are available.

Although the Corps proposes that actions will capture, manage, and treat runoff up to the design storm level from most proposed projects, treatment will not eliminate and may not even significantly reduce all pollutants in the runoff currently produced at project sites. Thus, adverse effects of non-point source pollution will persist for the design life of the proposed action.

Roads, culverts, and bridges require routine maintenance to remain serviceable with a minimum of adverse effects to species and designated critical habitats. Most of these actions will be completed in accordance with the most recent version approved by NMFS of ODOT (2006) best

[45] 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).

[46] 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 2008; Igloria 2008).

management practices for routine road maintenance, unless those practices conflict with PDC in this opinion.

Unlike routine road maintenance, structural failure of road, culvert, or bridge infrastructure causes extensive and long-lasting damage to aquatic habitats. Consequences of infrastructure failure include erosion and sedimentation, release of toxic materials or structural debris into the water, rerouting of flows into neighboring drainages that may be unable to adjust to the increase in peak flow, or onto unchanneled slopes. Structural failure may be caused by inadequate design, poor construction, damage accumulated from vehicles, inadequate maintenance, or extreme natural events, but most often is a result of flooding and improper or inadequate engineering and design, particularly at stream crossings but also where roads cross headwater swales and other areas of convergent groundwater. A typical failure occurs when culverts that are sized only to accommodate the flow of water, but not the additional sediment and wood typically transported during higher flows, becomes obstructed, thus causing water and debris to overflow. In more serious cases, diversion and concentration of overflow then leads to a "cascading failure," a series of adverse events that end with loss of the structure or initiation of landslides and debris flows (Furniss *et al.* 1998; Gucinski *et al.* 2001).

Although flooding will always be a threat to this type of infrastructure, the Corps' proposed action will minimize this danger by requiring road, culvert, and bridge designs that anticipate and accommodate the movement of water, sediment and debris during infrequent but major storms and reduce stormwater runoff. Reduced maintenance costs will be a significant ancillary benefit for applicants. Moreover, the proposed action will allow the Corps to authorize or carry out a "natural hazard response" when road, culvert, bridge, or utility line infrastructure fails, or is about to fail. This will allow a public transportation manager to act immediately, or before the next appropriate in-water work window, as necessary to repair or prevent infrastructure failure that poses an imminent threat to human life, property, or natural resources. Part of the response includes contacting NMFS as soon as possible to review PDC 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 response action on listed species or their critical habitat. Later, a report on the incident will provide an assessment of the effects to listed species and critical habitats and a plan to bring the response into conformance with all other applicable PDC in this opinion.

Utility line stream crossings. Proposed utility line actions consist of stream crossings for pipes, pipelines, cables, and wires. Most direct and indirect effects of utility line actions are similar to the effects of general construction discussed above, and will follow the PDC for general construction as applicable. Aerial utility lines hung from an existing bridge are likely to add no additional effects to those of the bridge; drilled lines are likely to have a smaller subset of the construction effects discussed above, including drilling effects, or will express those effects to a lesser degree. However, trenched utility lines are likely to cause additional adverse effects related to erosion.

Excavation and subsequent filling of a trench in a streambank or dry channel is likely to make the area of the trench more or less resistant to erosion, depending on the substrate composition, the type of excavation, and the type of fill. If the trench area is less resistant to erosion, due to loosening of the substrate or through the use of fill with smaller substrate particles than were originally present, then high stream flows are likely to erode the disturbed substrate, thus mobilizing sediment or abruptly altering the bottom contours or bank stability of the stream. If the trench area is more resistant to erosion, through compaction of the substrate or through the use of fill with larger substrate particles than were originally present, then high stream flows may be less likely to erode the disturbed substrate than the remainder of the streambed or bank, possibly creating hydraulic control points and altering fluvial processes. Similarly, pipelines, cables, and materials used to armor them may create hydraulic control points ("jumps") that degrade channel conditions and impede fish passage, if they remain at the same elevation after being exposed by streambed or bank erosion.

2.4.1 Effects of the Action on ESA-Listed Salmon and Steelhead

As noted above, each individual project will be completed as proposed with full application of PDCs. Each action 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 PDC 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 effects of most of the proposed action are also reasonably certain to result in some degree of ecological recovery at each project site due to the requirements for bioengineered bank treatments, fish passage and stormwater treatment where it may have been partial or nonexistent before, site restoration, and compensatory mitigation projects that should provide a high level of ecological function, even when compensating for degraded or low quality resources.

The proximity of spawning adults, eggs, and fry of most salmon and steelhead species to any construction-related effects of projects completed under the proposed program that could injure or kill them will be limited by the PDC that require work within the active channel to be isolated from that channel and completed in accordance with the Oregon guidelines for timing of in-water work to protect fish and wildlife resources. The Oregon guidelines for timing of in-water work are primarily based on the average run timing of salmon and steelhead populations, although 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. It is unlikely that spawning adults, eggs, or fry of endangered UCR spring-run Chinook salmon, SR sockeye salmon, and UCR steelhead will ever occur in proximity to construction-related effects of the projects completed under the proposed program because those species do not spawn in Oregon. Nonetheless, adult and juvenile individuals of these species pass through the Columbia River mainstem and estuary and so are likely to encounter effects of the action during those life history periods. It is unknown whether the Oregon guidelines for timing of in-water work are also protective of eulachon because their migration and rearing times are less well known and were not considered when the guidelines were prepared.

In general, direct effects are ephemeral (instantaneous to hours) or short-term (days to months), and indirect effects are long-term (years to decades, or the life of the project). Effects are described by life history stage in outline form below. Projects with a more significant construction aspect are likely to adversely affect more fish, and to take a longer time to recover, than projects with less construction.

Except for fish that are captured during work area isolation, individual fish whose condition or behavior is impaired by the effects of a project authorized or completed under this opinion are likely to suffer primarily from ephemeral or short-term sublethal effects during construction, including diminished rearing and migration as described below. Projects that will require two or more years to complete are also likely to adversely affect more fish because their duration will be longer, but those effects are also likely to be less intense during each subsequent year as a result of work area isolation that will only be completed once per work area.

Any construction 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, particularly recently emerged fry, 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.

The peak number of projects that were reviewed under the SLOPES-IV Roads, Culverts, Bridges, and Utility Lines programmatic opinion was 88 in 2012. Over the period 2009-2012, the average number of projects per year authorized by the Corps has been about 68 projects, with 54 or fewer projects in any recovery domain. Allowing for a 25% increase over the maximum number of actions over this period in each of the recovery domains, we expect 128 or fewer total stormwater, transportation or utility line projects, with 68 or fewer projects in a single recovery domain, in a single year, under this opinion. Based on past experience, in most domains far fewer projects will likely be implemented (Table 1). Measured as miles of streambank disturbance, the average physical impact of these projects combined is small compared to the total number of miles of critical habitat available in each recovery domain. The likelihood of additive effects on species at the program level due to projects occurring in close proximity within the same watershed, or even within sequential watersheds, is very remote, whether those effects are adverse or beneficial.

Based on our previous experience with SLOPES projects, it is unlikely at the program level, although not impossible, that the action area for two or more projects will occur in proximity to each other in the same watershed, during the same year. Moreover, the total streamside footprint that will be physically disturbed by the full program each year, which corresponds to the area where almost all direct construction impacts will occur, is extremely small compared to the total number of watersheds or critical habitat miles in each recovery domain.

Of the ESA-listed species considered in this opinion, only juvenile salmon and steelhead are likely to be captured during work area isolation. Restrictions on timing and location of projects will not overlap with juvenile eulachon, making their capture extremely unlikely. Adult salmon, steelhead, and eulachon that may be present when the in-water work area is isolated are likely to leave by their own volition, or can otherwise be easily excluded without capture or direct contact before the isolation is complete.

Most direct, lethal effects of authorizing and carrying out the proposed actions are likely be 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. Debris buildup and predation within minnow traps can also kill or injure listed fish if they are not monitored and cleared on a regular basis. 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).

An estimate of the maximum effect that capture and release operations for projects authorized or completed under this opinion will have on the abundance of adult salmon and steelhead in each recovery domain was obtained as follows: A = n(pct), where:

A = number of adult equivalents "killed" each year
n = number of projects likely to occur in a recovery domain each year
p = 31, *i.e.*, number of juveniles to be captured per project, based on ODOT's data for site isolation[47]
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).

[47] In 2007, ODOT completed 36 work area isolation operations involving capture and release using nets and electrofishing; 12 of those operations resulted in capture of 0 Chinook salmon, 345 coho salmon, and 22 steelhead; with an average mortality of 5% Cannon (2008). Cannon (2012) reported a mortality rate of 4.4% for 455 listed salmon and steelhead captures during 30 fish salvage operations in 2012. No sturgeon or eulachon have been captured as a result of ODOT fish salvage operations.

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 very conservative because many juveniles are likely to be captured as fry or parr, life history stages that have a survival rate to adulthood that is exponentially smaller than for smolts.

Thus, the effects of work area isolation on the abundance of juvenile or adult salmon or steelhead in any population is likely to be small, no more than three adult-equivalent per year in any recovery domain (Table 28).

Table 28. Number of salmon and steelhead affected, per year, by recovery domain.

Recovery Domain	Estimated Maximum Number of Projects (per year)	Estimated Maximum Number of Juveniles Captured (per year)	Estimated Maximum Number of Juveniles Injured or Killed (per year)	Estimated Maximum Number of Adult Equivalents "Killed" (per year)
WLC	68	2,108	105	2.1
IC	9	279	14	0.3
OC	40	1,240	62	1.2
SONCC	11	341	17	0.3
Total	128	3,968	198	4.0

Rapid changes and extremes in environmental conditions 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, reduced input of particulate organic matter to streams, the addition of fine sediment to channels, and mechanical disturbance of shallow-water habitats are likely to lead to under use of stream habitats, displacement from or avoidance of preferred rearing areas, or abandonment of preferred spawning grounds, which 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). Restoration actions that affect stream channel widths are also likely to impair local movements of juvenile fish for hours or days, and downstream migration maybe similarly impaired. Moreover, smaller fry are likely to be injured or killed due to in-water interactions with construction activities, including work area isolation, and due to the adverse consequences that displacement and impaired local movement will have on rearing activities, at each restoration site subject to those activities.

Fish may compensate for, and adapt to, some of these perturbing situations so that they continue to perform necessary physiological and behavioral functions, although in a diminished capacity. However, fish that are subject to prolonged, combined, or repeated stress by the effects of the action combined with poor environmental baseline conditions will likely suffer a metabolic cost that will be sufficient to impair their rearing, migrating, feeding, and sheltering behaviors and thereby increase the likelihood of injury or death.

In addition to the general effects of construction on listed species described above, each type of action will also have the following effects on individual fish. Fish passage restoration will increase the quantity of spawning and rearing habitat accessible to affected species. Removal of pilings is likely to decrease predation on juvenile salmon and steelhead by reducing resting areas for piscivorous birds and cover for aquatic predators, and by reducing long-term exposure to toxics.

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).

At the species level, direct 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 effects of any action authorized or completed under this opinion will be too minor, localized and brief to affect the VSP characteristics of any salmon or steelhead population, they also will not have any effects at the species level.

Given the small reduction in the growth and survival of fish that will be directly affected by individual projects, primarily at the fry, parr, and smolt life stages, the relatively low intensity and severity of that reduction at the population level, and the low frequency in a given population, any adverse effects to fish growth and survival are likely to be inconsequential. Moreover, the proposed action is also reasonably certain to lead to some degree of species recovery within each action area, including more normal growth and development, improved survival, and improved spawning success. Projects that improve fish passage through culverts or better longitudinal connectivity (up and downstream), habitat complexity, and ecological connectivity between streams and floodplains will likely have long-term beneficial effects on population structure.

Summary of the effects of the action by fish life history stage:

1. <u>Freshwater spawning</u>
    a. Salmon and steelhead
        i. Adult. *Direct* – Chemical contaminants from machinery impair reproductive behavior. No holding or spawning is likely to occur in the immediate project area due to in-water timing and work restrictions.

However, pre-spawning mortality and less spawning success will occur downstream of long-term project sites due to higher bioenergetic cost, more sublethal effects of contaminants, less adaptive behavior and movement, and an increased likelihood of competition, predation, and disease. The occurrence of these effects is likely to be infrequent and spread over a very large area. Better spawning success will likely occur after spawning gravel supplementation. Long term positive effects on population abundance or productivity are expected. *Indirect* – Better pre-spawning survival and spawning success after the completion of projects due to improved migration conditions and fewer adult fish passage barriers.

ii. Egg. *Direct* – Chemical contaminants and sediment in runoff during construction activities reduce egg survival. Improved incubation success after spawning gravel restoration. *Indirect* – No effect if spawning areas are upstream of construction areas. Survival of eggs may be reduced for some years in some limited areas that are downstream of construction sites if sufficient fine sediment is deposited to reduce the availability of interstitial space and impede delivery of sufficient oxygen to incubating embryos until natural scouring effects restore the preferred sediment distribution size. Where fine sediment is not deposited, or after it is scoured, more normal egg development is likely to occur due to improved water quality.

iii. Alevin. *Direct* – Temporary increase in chemical contaminants and sediment during construction reduces alevin survival. No other direct effects due to in-water timing and work restrictions. *Indirect* – More normal growth and development after site construction due to improved water quality and cover, and less disease and predator induced mortality, and improved conditions for local movements.

2. <u>Freshwater rearing</u>

a. Salmon and steelhead

i. Fry. *Direct* – Temporary increase in chemical contaminants and sediment during construction activities reduces forage and impairs behavior. Capture, with some injury and death, during in-water work isolation and construction of projects, reduced growth and development due to higher bioenergetic cost, more sublethal effects of contaminants, less adaptive behavior and movement, an increased likelihood of competition, predation, and disease, and a degraded biological community. These effects may be stronger when projects take place beside or in small tributaries where aquatic habitat areas are correspondingly small and easily modified. Conversely, fewer individuals are likely to occur in those habitats. In larger tributaries and main stem rivers, aquatic habitat areas are larger and less likely to be modified by construction activities, although more individual fish may be affected. Piling removal projects will improve water quality by eliminating chronic sources of toxic contamination. *Indirect* – More normal growth and development after site restoration due to better forage, less disease and predator induced mortality, more effective migration and distribution due to improved water quality and cover, better forage, more functional floodplain conditions, and fewer juvenile passage barriers.

ii. Parr. Same as for fry, although probably fewer individuals directly affected due to greater swimming ability.

3. <u>Freshwater migration</u>

a. Salmon and steelhead

i. Adult. *Direct* – Temporary increase in chemical contaminants and sediment during construction activities impairs orientation and migratory behavior. Delayed upstream migration and increased pre-spawning mortality during instream activities due to higher bioenergetic cost, more sublethal effects of contaminants, less adaptive behavior and movement, and an increased likelihood of competition, predation, and disease. These effects are likely to occur at a very limited number of sites in any given year. *Indirect* – More normal upstream migration and pre-spawning mortality after site restoration due to less disease induced morality, improved migration conditions, and fewer fish passage barriers.

ii. Kelt (steelhead). *Direct* – Same as for adults, plus delayed seaward migration and increased post-spawning mortality during instream activities due to higher bioenergetic cost, more sublethal effects of contaminants, less adaptive behavior and movement, and an increased likelihood of competition, predation, and disease. *Indirect* – More normal seaward migration and post-spawning mortality after site restoration due to less disease induced mortality, improved migration conditions, and fewer adult fish passage barriers.

iii. Fry. *Direct* – Same as for freshwater rearing, plus capture (with some injury and death) during in-water work isolation, delayed seaward migration and reduced growth and development during instream activities due to higher bioenergetic cost, more sublethal effects of contaminants, less adaptive behavior and movement, and an increased likelihood of competition, predation, and disease. *Indirect* – More normal seaward migration, growth and development after site restoration due to improved water quality and cover, better forage, more functional floodplain conditions, and fewer juvenile passage barriers.

iv. Parr. Same as for fry, although probably fewer individuals affected due to greater swimming ability.

4. <u>Estuary rearing and smoltification</u>

a. Salmon and steelhead

i. Fry. *Direct* – Same as for freshwater rearing and migration.

ii. Parr. Same as for fry.

iii. Smolt. Same as for fry and parr, although probably fewer individuals affected due to greater swimming ability.

5. Nearshore marine growth and migration
   i. Juvenile: Near-shore migration of juvenile salmon is a critical time for feeding and rapid growth before movement toward the open ocean. *Direct* – Pile driving would disrupt migration and feeding. *Indirect* – Piles provide perches for avian predators. Habitat alteration by roads, culverts, bridges will reduce important beach forage habitat. Stormwater from these surfaces will introduce contaminants that may affect survival.
6. Offshore marine growth and migration – These life history stages do not occur in the action area.

2.4.2 Effects on ESA-Listed Green Sturgeon and Eulachon

Less is known about southern DPS of green sturgeon and eulachon although key differences in the distribution and biology of these two species make it reasonable to assume that the effects of the proposed action on them are likely to be within range of effects on salmon and steelhead described above. Both species are broadly distributed in marine areas along the western coast of North America and only enter the action area in a relatively few subtidal and intertidal areas.

In the case of southern green sturgeon, subadult and adult individuals enter the action area for non-breeding, non-rearing purposes. Impacts from construction to green sturgeon are the same as those described above for salmonids. Because of their age, location, and life history, these individuals are relatively distant from, and insensitive to, the effects of a majority of the actions described above, and those effects are unrelated to the principal factor for the decline of this species, *i.e.*, the reduction of its spawning area in the Sacramento River. Adult and subadult green sturgeons are likely to be far less sensitive to turbidity and suspended solids than salmonids. The NMFS is also reasonably certain 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.

Eulachon are also limited to a relatively few subtidal and intertidal areas and the mainstem Columbia River below Bonneville Dam, but they return to those areas with a presumed fidelity that indicates close association between a particular stock and its spawning environment (Gustafson *et al.* 2011; Gustafson *et al.* 2010). Moreover, eulachon face numerous potential threats throughout every stage of their life cycle, although the severity of shoreline construction effects and water quality, the most significant effects described above, have been ranked as "very low" and "low," respectively (Gustafson *et al.* 2011; Gustafson *et al.* 2010).

Summary of Effects to Green Sturgeon and Eulachon. Some individual green sturgeon are likely to be adversely affected by the activities covered under the SLOPES for Stormwater, Transportation or Utilities program described in this opinion. However, there should be few green sturgeon in the vicinity of most of the actions. Pile driving would be the most likely activity to affect individuals. The restrictions on pile driving and dredging should minimize those impacts. The impacts from these activities are not expected to result in a change at the population level.

Although eulachon do not have a swim bladder that is subject to risk of damage during pile driving, they are nonetheless still highly vulnerable other types of tissue damage and adverse effects to eulachon as a result of actions under this program would primarily occur as a result of pile driving activities. Work window restrictions should limit impacts to this species as a result of these activities. The impacts from these activities are not expected to result in any measurable population level effects.

2.4.3 Effects of the Action on Designated Critical Habitat

Each individual project, completed as proposed, including full application of the PDC for site restoration, is likely to have the following effects on critical habitat PCEs or physical and biological features. These effects will vary somewhat in degree between actions because of differences in the scope of construction at each site, and in the current condition of PCEs and the factors responsible for those conditions. This assumption is based on the fact that all of the actions are based on the same set of underlying actions, and the PCEs and conservation needs identified for each species are also essentially the same. In general, ephemeral effects are likely to last for hours or days, short-term effects are likely to last for weeks, and long-term effects are likely to last for months, years or decades. The intensity of each effect, in terms of change in the PCE 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 PCEs that is greater than the full range of effects summarized here.

No more than 54 actions in a single recovery domain have been completed using the SLOPES IV opinion in a single year (2012, 54 in WLC recovery domain). As noted above, we anticipate 68 or fewer road, culvert, bridge and utility line projects will be completed in a single recovery domain, in a single year, using this opinion and most domains will have many fewer (Table 28). This number of projects is already small compared to the total number of watersheds in each recovery domain, but the intensity of those project effects appears far smaller when considered as a function of their average streamside footprint relative to the total streamside area in each recovery domain. The streamside footprint that will be temporarily disturbed by the full program each year corresponds to the area where almost all direct construction impacts will occur.

Because the area affected for individual projects is small, the intensity and severity of the effects described is relatively low, and their frequency in a given watershed is very low, PCE conditions and conservation value of critical habitat at the site level or reach level are likely to quickly return to, and improve beyond, critical habitat conditions that existed before the action. Moreover, most projects completed under the proposed program, and thus the proposed action as a whole, is also reasonably certain to lead to some degree of ecological recovery within each action area, including the establishment of environmental conditions associated with functional aquatic habitat and high conservation value. This is because most actions are likely to partially or fully correct improper or inadequate engineering designs in ways that will help to restore lost habitat, improve water quality, reduce upstream and downstream channel impacts, improve floodplain connectivity, and reduce the risk of structural failure. Improved fish passage through culverts and more functional floodplain connectivity, in particular, may have long-term beneficial effects.

Summary of the effects of the action on salmon and steelhead critical habitat PCEs:

1. Freshwater spawning sites
    a. Water quantity – Brief reduction in flow due to short-term construction needs, reduced riparian permeability, increased riparian runoff, and reduced late season flows; slight longer-term increase based on improved stormwater management, riparian function, and floodplain connectivity.
    b. Water quality – Short-term increase in total suspended solids, dissolved oxygen demand, and temperature due to riparian and channel disturbance; longer-term improvement due to more normal temperature and sediment load, reduced contaminants, and increased dissolved oxygen due to improved stormwater management, riparian, streambank, and channel conditions, ecological connectivity, and more normative community structure.
    c. Substrate – Short-term reduction in quality due to increased compaction and sedimentation; long-term increase in quality due to a more functional sediment balance, with increased gravel and large wood supply, improved riparian, streambank, and channel conditions, improved ecological connectivity, and more normative community structure.
2. Freshwater rearing sites
    a. Water quantity – as above.
    b. Floodplain connectivity – Short-term decrease due to increased compaction and riparian disturbance; long-term improvement due to improvements in stormwater management, riparian, streambank and channel conditions, and ecological connectivity.
    c. Water quality – as above.
    d. Forage – Short-term decrease due to riparian and channel disturbance, and water quality impairments; long-term improvement due to increased quantity and quality of forage due to increased habitat diversity and productivity caused by improved riparian, streambank, and channel conditions, improved ecological connectivity, and more normative community structure.
    e. Natural cover – Short-term decrease due to riparian and channel disturbance; long-term increase due to improved habitat diversity and productivity, including space, width-depth ratio, pool frequency, pool quality, and off-channel habitat caused by improved riparian, streambank, and channel conditions, improved ecological connectivity, and more normative community structure.
3. Freshwater migration corridors
    a. Free passage – Short-term decrease due to decreased water quality and in-water work isolation; long-term increase due improved water quantity and quality, greater habitat diversity, more natural cover, and more normative community structure caused by improved riparian conditions, streambank conditions, and ecological connectivity.
    b. Water quantity – as above.
    c. Water quality – as above.

    d. Natural cover – as above.

4. Estuarine areas
    a. Free passage – no effect.
    b. Water quality – as above.
    c. Water quantity – as above.
    d. Salinity – no effect.
    e. Natural cover – as above.
    f. Forage – as above.
5. Nearshore marine areas
    a. Free passage – no effect.
    b. Water quality – Short-term increase in contaminants, impoverished community structure; long-term reduced contaminants, more normative community structure.
    c. Water quantity – no effect.
    d. Forage – as above.
    e. Natural cover – Short-term decrease in natural cover quantity and quality due to reduced large wood; long-term increase in natural cover due to increased LW.
6. Offshore marine areas – These PCEs do not occur in the action area.

Summary of the effects of the action on green sturgeon critical habitat physical and biological features: Critical habitat for the southern DPS of green sturgeon was designated in 2009, and the designation includes coastal U.S. marine waters within 60 fathoms depth from Monterey Bay, California (including Monterey Bay), north to Cape Flattery, Washington. Within the action area this includes the Lower Columbia River estuary and certain coastal bays and estuaries in Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay) (USDC 2009).

1. Estuarine areas
    a. Food – Short-term decrease due to stream and river-bottom disturbance.
    b. Passage – Short-term decrease due to stream and river-bottom channel disturbance.
    c. Sediment quality – Short-term decrease due to stream and river-bottom disturbance.
    d. Water quality – Short-term increase in turbidity, dissolved oxygen demand, and temperature due to riparian and channel disturbance.
2. Coastal marine areas
    a. Food resources– no effect.
    b. Migratory corridor – no effect.
    c. Water quality – Short-term increase in contaminants, impoverished community structure; long-term reduced contaminants, more normative community structure.

Summary of the effects of the action on eulachon critical habitat physical and biological features: Critical habitat for eulachon includes: (1) Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, and with migratory access for adults and juveniles; (2) freshwater and estuarine migration corridors associated with spawning and incubation sites that are free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted;

and, (3) nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival. The essential features for eulachon critical habitat are as follows:

1. Freshwater spawning sites and incubation
    a. Flow – Ephemeral reduction due to short-term construction needs, reduced riparian permeability and increased riparian runoff due to soil compaction; slight long-term increase based on improved riparian function and floodplain connectivity.
    b. Water quality – Short-term releases of suspended sediment and contaminants, increased dissolved oxygen demand, and increased temperature due to riparian and channel disturbance. Long-term water quality will improve as riparian vegetation becomes established.
    c. Water temperature – Slight long-term improvement based on improved riparian function and floodplain connectivity.
    d. Substrate – Short-term reduction due to increased compaction and sedimentation and removal. Long-term benefit from the restoration of natural sediment transport.
    e. Free passage – Short-term decrease due to decreased water quality and in-water work isolation. Long-term improvement after stream connectivity is improved as a result of improved stream crossings structures.
2. Freshwater and estuarine migration corridors
    a. Free passage – Short-term decrease due to decreased water quality and in-water work isolation. Long-term improvement after stream connectivity is improved as a result of improved stream crossings structures.
    b. Flow – as above.
    c. Water quality – as above.
    d. Water temperature – no effect.
    e. Food – no effect.
3. Nearshore and offshore marine foraging areas
    a. Food – no effect.
    b. Water quality – no effect.

Summary of effects to critical habitat for all listed species. Projects covered by this opinion, both individually and collectively, are likely to have some short-term impacts, but none of those impacts will be severe enough to impair the ability of critical habitat to support recovery. The frequency of disturbance will usually be limited to a single project or, at most, a few projects within the same watershed. It is also unlikely that several projects within the same watershed, or even within the same action area, will have a severe enough adverse effect on the function of PCEs (physical and biological features) to affect the conservation value of critical habitat in the project-level action area, watershed, or designation area. Also, on the whole, the proposed action is reasonably certain to lead to some degree of ecological recovery within each action area, including the establishment or restoration of environmental conditions associated with functional habitat and high conservation value. Road crossings that improve fish passage, in particular, are likely to have long-term beneficial effects at the watershed or designation-wide scale (Roni *et al.* 2002).

Synthesis of Effects. The scope of each type of activity that could be authorized under the proposed program is narrowly prescribed, and is further limited by PDC tailored to avoid or minimize direct and indirect adverse effects of those activities. Administrative PDC are in place to ensure that requirements related to the scope of actions allowed and the mandatory PDC operate to limit direct lethal effects on listed fish to a few deaths associated with isolation and dewatering of in-water work areas, an action necessary to avoid greater environmental harm. Most other direct adverse effects will likely be transitory and within the ability of both juvenile and adult fish to avoid by bypassing or temporarily leaving the proposed action area. Such behavioral avoidance will probably be the only significant biological response of listed fish to the proposed program. This is because areas affected by the specific projects undertaken are likely to be widely distributed (the frequency of the disturbance will be limited to a single event or, at most, a few projects within the same watershed) and small compared with the total habitat area.

As noted above (Table 2), the number of projects in a single recovery domain using the prior versions of this opinion in a single year has varied greatly. During the period when SLOPES IV was in effect (2008-2012), the most projects (134, 46%) occurred in the WLC recovery domain, while 36% (n=105) occurred in the OC recovery domain. (Many fewer projects occurred in the IC and SONCC recovery domains.) However, few actions per year have occurred in a single 5th field watershed over this large region. Projects were even more separated in the other recovery domains. The intensity of the predicted effects within the action area, in terms of the total condition and value of PCEs after each action is completed, and the severity of the effects, given the recovery rate for those same PCEs, are such that the function of PCEs and the conservation value of critical habitat are likely to be only impaired for a short time due to actions funded or carried out under this opinion. The PCE conditions in each action area are likely to quickly return to, or exceed, pre-action levels. Thus, it is unlikely that several actions within the same watershed, or even within the same action area, will have an important adverse effect on the function of PCEs or the conservation value of critical habitat at the action area, watershed, or designation scales. The intensity and severity of environmental effects for each project will be comprehensively minimized by targeted PDC. The recovery timeframe for properly functioning habitat conditions is unlikely to be appreciably reduced.

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-level 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 PCEs 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 in 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 2011). Nonetheless, resource-based industries are likely to continue to have an influence on environmental conditions within the program-action area for the indefinite future. However, over time those industries have adopted management practices that avoid or reduce many of their most harmful impacts, as is evidenced by the extensive conservation measures included with the proposed action, but which were unknown or in uncommon use until even a few years ago.

While natural resource extraction within Oregon 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). The percentage increase in population growth may provide 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 from approximately 3.4 to 3.8 million, primarily due to migration from other states (U.S. Census Bureau 2011). Most of that growth occurred before the economic slowdown that began in 2007. Half of the population increase occurred in Oregon's three most populated counties in the Portland area. Other large counties in the Willamette Valley also gained population although the largest increase statewide, 37%, was in Deschutes County in central Oregon. Only 12% of Oregon's population lives east of the Cascade Mountains, a primarily rural area with an economic base dominated by agriculture and Federal lands. Eight eastern counties lost population during the last decade. The State population is expected to continue to grow in the future, although the rate of growth has slowed and is unlikely to change soon.

The adverse effects of non-Federal actions stimulated by general resource demands are likely to continue in the future driven by changes in human population density and standards of living.

These effects are likely to continue to a similar or reduced extent in the rural areas of the Willamette Valley, eastern Oregon, and along the Oregon Coast where counties are maintaining or losing population. Counties that are gaining population around the City of Portland, parts of the Willamette Valley, and part of central Oregon are likely to experience greater resource demands, and therefore more adverse environmental effects. Oregon's 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 careful 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; NMFS 2011f; NWPCC 2012; OWEB 2011). 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. Similarly, 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 and nearshore 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 related to resource-based industries at this program scale 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 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. The future effects of river restoration are also unpredictable for the same reasons, but their net beneficial effects may grow with the increased sophistication and size of projects completed and the additive effects of completing multiple projects in some watersheds.

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 freshwater and estuarine 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. This will lead to localized improvements to freshwater and estuarine habitat. 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 PCEs or physical and biological features 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 as a result 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 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).

As described in Section 2.2, individuals of many ESA-listed salmon, steelhead, green sturgeon, and eulachon use the program action area to fully complete the migration, spawning and rearing parts of their life cycle; some salmon, steelhead, and eulachon migrate and rear in the program action area; and some species only migrate through, once as out-migrating juveniles and then again as adult fish on upstream spawning migration. The viability of the various populations that comprise the 15 salmon and steelhead species considered in this opinion ranges from extirpated or nearly so to populations that are a low risk for extinction. The southern eulachon population abundance has declined significantly since the early 1990s and there is no evidence to date of their returning to former population levels.

Adult upstream migrating ESA-listed salmonids are present primarily from early spring through autumn but upstream migrating fish may be found year-around. Shallow water habitats are an important rearing habitat for juvenile salmon and steelhead, especially for species that spend an extended amount of time in freshwater. The highest densities of juvenile salmon and steelhead occur in the spring when individuals of all the species may be present, with the lowest densities occurring in the summer and fall. The juvenile fish tend to inhabit shallow waters near the shoreline but have been observed at depths of 20 feet. Some individuals spend little time in shallow water or in the estuary during juvenile migration, although food produced in the shallow waters and estuaries may still be important to the migrating fish.

Southern DPS green sturgeon consists of populations originating from coastal watersheds south of the Eel River in Humboldt County, California, with the only known spawning population in the Sacramento River. When not spawning, this anadromous species is broadly distributed in nearshore marine areas from Mexico to the Bering Sea. Within the action area, this includes the Lower Columbia River estuary and certain coastal bays and estuaries in Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay) (USDC 2009). Large estuaries are clearly important habitats for green sturgeon (Lindley *et al.* 2011). Southern green sturgeon subadults and adults may enter the action area for non-breeding, non-rearing purposes. Tagged adults and subadults in the San Francisco Bay estuary occupied shallow depths during directional movements but stayed close to the bottom during non-directional movements, presumably because they were foraging in depths as shallow as 1.7 m (Kelly *et al.* 2007). However, information from fisheries-dependent sampling suggests that green sturgeon only occupy large estuaries during the summer and early fall, and would not be present in large numbers during the in-water work period (Moser and Lindley 2007), which is generally late-fall to spring in Oregon estuaries (ODFW 2008).

Southern eulachon typically enter the Columbia River, and probably the Umpqua River, from mid-December to May with peak entry and spawning during February and March. In Oregon, they spawn in the mainstem Columbia River and Sandy River. Eulachon eggs are believed to hatch in 30-40 days. Young eulachon are feeble swimmers, usually present near the bottom as they are transported downstream but they may be found throughout the water column.

The action area is designated as critical habitat for ESA-listed salmon, steelhead, green sturgeon, and eulachon. The physical and biological features of salmon and steelhead critical habitat in the action area are freshwater spawning, freshwater rearing, adult and juvenile migration corridors, estuarine and nearshore marine habitats. The features of eulachon critical habitat that are likely to be affected by the proposed action are freshwater spawning and incubation habitat, and freshwater migration. There is no designated critical habitat for green sturgeon in Oregon riverine, estuarine and marsh areas. Green sturgeon critical habitat has been designated along the Oregon coast down to 60 fathoms depth. The features of green sturgeon critical habitat in nearshore habitat are food resources, migratory corridor, and water quality.

Climate change and human development have and continue to adversely affect critical habitat, creating limiting factors and threats to the recovery of the ESA listed species.

Information in Section 2.3 described the environmental baseline in the action area as widely variable but NMFS assumes that road, culvert, bridge and utility line projects will occur at sites where the environmental baseline does not fully meet the biological requirements of individual fish due to the presence of impaired fish passage, floodplain fill, streambank degradation, or degraded riparian conditions. Similarly, it is likely that the environmental baseline is also not meeting the biological requirements of individual fish of ESA-listed species at sites where projects will occur 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, but the quality of critical habitat at those sites is likely to improve due to completion of the projects.

As described in Section 2.4, most short-term effects of road, culvert, bridge and utility line actions on ESA-listed fish and designated critical habitat include effects related to erosion and runoff from the construction site, work area isolation, and the use of herbicides. Each project that eventually will be implemented under this opinion will be carefully designed and constrained by conservation measures such that construction impacts of projects will cause only short-term, localized, and minor effects. The longer-term impacts of many of these projects are likely to include corrections of engineering flaws in existing stream crossings that do not currently allow for adequate fish passage or the functional riparian area or floodplains. Although these short-term effects can be intense in a relatively small area, our experience shows that individual projects do not tend to be in close proximity to each other such that those impacts overlap.

As noted in Sections 2.2 and 2.3, climate change is likely to affect all species considered in this opinion and their habitat in the program area. These effects are expected to be positive and negative, but are likely to result in a generally negative trend for stream flow and temperature.

As described in Section 2.5, the cumulative effects of state and private actions that are reasonably certain to occur within the action area are also variable across the program action area. In urban areas there will be continued population growth, but improvements in some redevelopment practices will begin to improve negative baseline conditions in those areas. Similarly, some agricultural and forestry practices in rural areas are also less likely to adversely affect ESA-listed fish species that was true in the past. Federal efforts to improve aquatic habitat conditions in the State of Oregon action area are also likely to gradually improve habitat conditions in some areas.

In summary, taken as a whole, the SLOPES for Stormwater, Transportation or Utilities will result in relatively intense but brief disturbances to a small number of areas distributed throughout each recovery domain, but these disturbances will not appreciably reduce or prevent the increase of abundance or productivity of the populations addressed by this consultation. This is because: (1) Effects from construction-related activities are short-term and temporary, (2) a very small portion of the total number of fish in any one population will be exposed to the adverse effects of the proposed action, and (3) the geographic extent of the adverse effects is small when compared to the size of any watershed where an action will occur or the total area occupied by any of the species affected. Similarly, SLOPES for Stormwater, Transportation or Utilities will not affect the diversity of any populations or species because the effects of the action will not affect factors that primarily influence population diversity such as management of hatchery fish or selective harvest practices. Projects that improve fish passage may improve population spatial structure. Minimizing adverse impacts, and in some cases improving habitat conditions, will, over the long term, support populations with higher abundance and productivity.

The conservation value of critical habitat within the action area for salmon and steelhead varies by life history strategy, and is higher for species with stream-type histories than for the ocean-type. That is because the latter group is more reliant on shallow-water habitats and small tributaries that are easily affected by a wide range of natural and human disturbances. In Oregon, critical habitat for eulachon is designated in the Lower Columbia River, Umpqua River, Ten Mile Creek, and the Sandy River. For habitat in the Columbia River, the size of the river helps to intercept and buffer the short-term impact of construction actions, and to attenuate the benefits of local restoration, although it is likely that increasing the conservation function of estuaries will be a focus of future restoration projects. Green sturgeon critical habitat could only be affected if the project were to affect nearshore habitat.

For the most part, the conservation value of these critical habitats is high and the proposed action, as a whole, will have minor short-term effects on the quality and function of critical habitat PCEs. The full set of management measures proposed by the Corps will ensure that these short-term effects to PCEs remain minimal. As road, culvert, bridge and utility line projects accumulate over time, habitat conditions may improve and critical habitat will be able to better serve its intended conservation role, supporting viable populations of ESA-listed salmon, steelhead, green sturgeon, and eulachon.

Thus, the proposed program is not likely to result in appreciable reductions in the likelihood of both survival and recovery of listed species by reducing their numbers, reproduction, or distribution; or reduce the value of designated or proposed critical habitat for the conservation of the species. These conclusions are based on the factors analyzed in the above paragraphs as well as the following: (1) individual review is required of each project that will be covered to ensure that its effects, combined with the aggregated effects of other SLOPES Stormwater, Transportation or Utility projects, fall within the range of actions analyzed in this opinion, and that each applicable conservation measure is included as a project element or an enforceable condition of the permit document; (2) taken together, the conservation measures applied to each project will ensure that any short-term effects to water quality, habitat access, habitat elements, channel conditions and dynamics, flows, and watershed conditions will be brief, minor, and scheduled to occur at times that are least sensitive for the species' life-cycle; (3) the underlying requirement of an ecological design approach that protects and stimulates natural habitat forming processes is expected to result in authorization of many projects that will have beneficial long-term effects; and (4) the frequency of the disturbance is expected to be limited within the same watershed and thus there is not expected to be any significant aggregate or synergistic impact of the individual SLOPES Stormwater, Transportation or Utility projects; and (5) the individual and combined effects of all actions permitted in this way, when taken together with cumulative effects, are not expected to impair currently properly functioning habitats, appreciably reduce the functioning of already impaired habitats, or retard the long-term progress of impaired habitats toward proper functioning condition essential to the long-term survival and recovery at the population, ESU, or DPS scale.

2.7 Conclusion

After reviewing the current status of the listed species, the environmental baseline within the action area, the effects of the proposed program, any effects of interrelated and interdependent actions, and cumulative effects, it is NMFS's biological opinion that the SLOPES for Stormwater, Transportation or Utilities is not likely to jeopardize the continued existence of LCR Chinook salmon, UWR Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer run Chinook salmon, SR fall-run Chinook salmon, CR chum salmon, LCR coho salmon, 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 their designated critical habitats.

We also conclude that that the proposed action will not adversely modify critical habitat proposed for LCR coho salmon. You may ask NMFS to adopt the conference opinion as a biological opinion when critical habitat for LCR coho salmon is designated. The request must be in writing. If we review the proposed action and find there have been no significant changes to the action that will alter the contents of the opinion and no significant new information has been developed (including during the rulemaking process), we may adopt the conference opinion as the biological opinion on the proposed action and no further consultation will be necessary.

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 results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. For this consultation, we interpret "harass" to mean an intentional or negligent action that has the potential to injure an animal or disrupt its normal behaviors to a point where such behaviors are abandoned or significantly altered.[48] 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 incidental take statement.

[48] NMFS has not adopted a regulatory definition of harassment under the ESA. The World English Dictionary defines harass as "to trouble, torment, or confuse by continual persistent attacks, questions, *etc*." The U.S. Fish and Wildlife Service defines "harass" in its regulations as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3). The interpretation we adopt in this consultation is consistent with our understanding of the dictionary definition of harass and is consistent with the Service's interpretation of the term.

2.8.1 Amount or Extent of Take

Work necessary to construct and maintain the projects authorized under SLOPES for Stormwater, Transportation or Utilities will take place beside and within aquatic habitats that are reasonably certain to be occupied by individuals of the 17 ESA-listed species considered in this consultation. As described below, the proposed action is likely to cause incidental take of one or more of those species. Juvenile life stages are most likely to be affected, although adults will sometimes also be present when the projects occur in coastal areas or the Willamette Valley, and when projects do not involve work within the active channel and therefore may not be constrained by application of an in-water work window.

Juvenile fish will be captured during work area isolation necessary to minimize construction-related disturbance of streambank and channel areas caused by stormwater outfalls, roads, culverts, bridges, and utility lines. In-stream disturbance that cannot be avoided by work area isolation will lead to short-term increases in suspended sediment, temperature, dissolved oxygen demand, or other contaminants, and an overall decrease in habitat function that harms adult and juvenile fish by denying them normal use of the action area for reproduction, rearing, feeding, or migration. Exclusion from preferred habitat areas causes increased energy use and an increased likelihood of predation, competition and disease that is reasonably likely to result in injury or death of some individual fish.

Similarly, adult and juvenile fish will be harmed by construction-related disturbance of upland, riparian and in-stream areas for actions related to stormwater facilities, boulder placement, LW restoration, pile driving or removal, streambank restoration, spawning gravel restoration, and related in-stream work. The effects of those actions will include additional short-term reductions in water quality, as described above, and will also harm adult and juvenile fish as described above. Herbicide applications will result in herbicide drift or transportation into streams that will harm listed species by chemically impairing normal fish behavioral patterns related to feeding, rearing, and migration. These effects are also reasonably likely to result in injury or death of some individual fish.
This take will typically occur within an area that includes the streamside and channel footprint of each project, and downstream for pathways that are caused by diminished water quality. Projects that require two or more years of work to complete will cause adverse effects that last proportionally longer, and effects related to runoff from the construction site may be exacerbated by winter precipitation. These adverse effects may continue intermittently for weeks, months, or years until riparian vegetation and floodplain vegetation are restored and a new topographic equilibrium is reached. Incidental take that meets the terms and conditions of this incidental take statement will be exempt from the taking prohibition.

Capture of juvenile fish during in-water work area isolation

NMFS does not anticipate that any green sturgeon or eulachon will be captured as a result of work necessary to isolate in-water construction areas, although as described in section 2.4.1, up to 3,968 juvenile individuals (but no adults), per year, of the salmon and steelhead species considered in this consultation will be captured, and this capture results in take even though the vast majority of the fish are likely to be released and survive with no adverse effects (Table 28). Because the captured fish are from different species that are similar to each other in appearance and life history, and to unlisted species that occupy the same area, it is not possible to assign this take to individual species. In addition, it is not possible to measure the exact number of fish that die as a result of handling (but there is a relationship between the number of fish handled and the number that die). Therefore, the amount of take that is exempted under this Incidental Take Statement is the capture and related handling of 3,968 juvenile salmonids.

<u>Harm due to habitat-related effects</u>

Take caused by the habitat-related effects of this action cannot be accurately quantified as a number of fish because the distribution and abundance of fish that occur within an action 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 NMFS precisely predict the number of fish that are reasonably certain to be injured or killed if their habitat is modified or degraded by actions 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 action without causing additional stress and injury. In such circumstances, NMFS uses 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 streambank and channel areas. The best available indicator for the extent of take due to construction-related disturbance of streambank and channel areas is the total length of stream reach that will be modified by construction each year. This variable is proportional to the amounts of harm that the proposed action is likely to cause through short-term degradation of water quality and physical habitat. Based on our estimate of the annual number of projects that will be implemented (Table 28), NMFS assumes that up to 128 actions per year may be funded or carried out under this opinion. We estimate that each action may modify up to 300 lineal feet of riparian and shallow-water habitat; therefore, the extent of take for construction-related disturbance of streambank and channel areas is 38,400 linear stream feet per year. 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 action on a regular basis.

Construction-related disturbance of upland and wetland areas. The best available indicator for the extent of take caused due to construction-related disturbance of upland and wetland areas during road, culvert, bridge, and utility line projects, is an increase in visible suspended sediment. This variable is proportional to the water quality impairment those actions will cause, including increased sediment, temperature, and contaminants, and reduced dissolved oxygen. NMFS assumes that an increase in sediment will be visible in the immediate vicinity of the action area and for a distance downstream, and the distance that increased sediment will be visible is proportional both to the size of the disturbance and to the width of the wetted stream (Rosetta 2005). Also, a turbidity flux may be greater at project sites that are subject to tidal or coastal scour.

The applicant will complete and record the following water quality observations to ensure that any increases in suspended sediment do not exceed background levels:

1. Take a turbidity sample 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, or 300 feet upstream from the project area if it is subject to tidal or coastal scour. Record the observation, location, and time before monitoring at the downstream point.
2. Take a second visual observation, immediately after each upstream observation, approximately 50 feet downstream from the project area in streams that are 30 feet wide or less, 100 feet from the project area for streams between 30 and 100 feet wide, 200 feet from the discharge point or nonpoint source for streams greater than 100 feet wide, and 300 feet from the discharge point or nonpoint source for areas subject to tidal or coastal scour. Record the downstream observation, location, and time.
3. 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.
4. If the exceedence continues after the second monitoring interval (after 8 hours), the activity must stop until turbidity returns to background levels.

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 (as estimated using turbidity measurements, as described below) 50 feet from the project area in streams that are 30 feet wide or less, 100 feet from the discharge point or nonpoint source of runoff for streams between 30 and 100 feet wide, 200 feet from the discharge point or nonpoint source for streams greater than 100 feet wide, or 300 feet from the discharge point or nonpoint source for areas subject to tidal or coastal scour. If monitoring or inspections show that the pollution controls are ineffective, immediately mobilize work crews to repair, replace, or reinforce controls as necessary.

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 will 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. 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 plant control under this opinion. 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, 1.0% of the acres of riparian habitat within a 6th-field HUC per year (PDC 35).. 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 action on a regular basis.

Stormwater runoff. The extent of take will be exceeded if the following combination of stormwater facility inspection, maintenance, and operation standards are not completed or attained because those variables will determine whether the stormwater treatment system continues to reduce the concentration of pollutants in stormwater runoff as designed, and thus reflect the amount of incidental take analyzed in the opinion (Claytor and Brown 1996; Santa Clara Valley Urban Runoff Pollution Prevention Program 1999; Santa Clara Valley Urban Runoff Pollution Prevention Program 2001):

1. Each part of the stormwater system, including the catch basin and flow-through planter, must be inspected and maintained at least quarterly for the first three years, at least twice a year thereafter, and within 48-hours of a major storm event, i.e., a storm event with greater than or equal to 1.0 inch of rain during a 24-hour period (City of Portland 2008a; Valentine 2012).
2. All stormwater must drain out of the catch basin within 24-hours after rainfall ends, and out of the flow-through planter within 48-hours after rainfall ends.
3. All structural components, including inlets and outlets, must freely convey stormwater.
4. Desirable vegetation in the flow-through planter must cover at least 90% of the facility – excluding dead or stressed vegetation, dry grass or other plants, and weeds.

In summary, the best available indicators for amount and extent of take for these proposed actions are as follows. For actions that involve:

- ***Capture of juvenile fish during in-water work area isolation*** – The amount of take is 3,968 juvenile salmonids handled per year.
- ***Construction-related disturbance of streambank and channel*** – The extent of take indicator is 38,400 linear stream feet per year.
- ***Construction-related disturbance of upland and wetland areas*** – The extent of take indicator for suspended sediments and contaminants is no more than a 10% increase in natural stream turbidity visible beyond the discharge point or nonpoint source of runoff.
- ***Application of herbicide within the riparian area*** – The extent of take indicator is a treated area of up 1.0% of the acres of riparian habitat within a 6th-field HUC per year.

- ***Stormwater runoff*** – The extent of take indicator for stormwater management is combination of stormwater facility inspection, maintenance, and operations standards as described above.

NMFS assumes that the proposed actions will continue to be distributed among the recovery domains in the same proportion as in the past and has assigned this take to individual recovery domains whenever possible (Table 29).

Table 29. Extent of take indicators for actions authorized or carried out under the SLOPES Stormwater, Transportation or Utility opinion, by NMFS recovery domain. "WLC" means Willamette/Lower Columbia; "IC" means Interior Columbia; "OC" means Oregon Coast; "SONCC" means Southern Oregon/Northern California Coasts; and "n" is the estimated number of projects per year, as described in section 2.4.1.

Extent of Take Indicator	Recovery Domains			
	WLC n=68	IC n=9	OC n=40	SONCC n=11
Salmonids captured (number salvaged)	2,108	279	1,240	341
Visible suspended sediment (turbidity)	≤10% increase in natural stream turbidity			
Streambank alteration (linear feet)	20,400	2,700	12,000	3,300
Herbicide applications (acres)	1.0% of a riparian habitat within a 6th-field HUC/year			
Stormwater management	Stormwater facility inspection, maintenance, recording, and reporting			

2.8.2 Effect of the Take

In Section 2.7, NMFS 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 to minimize the amount or extent of incidental take (50 CFR 402.02).

The following measures are necessary and appropriate to minimize the impact of incidental take of listed species from the proposed program.

The Corps shall:

1. Minimize incidental take due to authorizing or conducting projects by ensuring that all such projects use the conservation measures described in the proposed action and analyzed in this opinion, as appropriate.
2. Ensure completion of a comprehensive monitoring and reporting program regarding all restoration projects authorized or conducted by the Corps.

2.8.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the Corps, 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 Corps has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this 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 (conservation measures for restoration projects), the Corps shall ensure that:
   a. Every action funded or carried out under this opinion will be administered by the Corps consistent with conservation measures 1 through 12.
   b. For each action involving construction, conservation measures 12 through 39, as appropriate, will be added as an enforceable permit condition.
   c. For specific types of actions, the Corps will apply criteria 40 through 43 as appropriate.
2. To implement reasonable and prudent measure #2 (monitoring and reporting), the Corps 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 slopes.nwr@noaa.gov.
      i. Project notification at least 30-days before start of construction (Part 1).
      ii. Project completion within 60-days of end of construction (Part 1 with Part 2 completed).
      iii. Fish salvage within 60-days of work area isolation with fish capture (Part 1 with Part 3 completed).
   b. The Corps' Regulatory and Civil Works Branches will each submit a monitoring report to NMFS by February 15 each year that describes the Corps efforts to carry out this opinion. The report will include an assessment of overall program activity, a map showing the location and type of each action authorized and carried out under this opinion, and any other data or analyses the Corps deems necessary or helpful to assess habitat trends as a result of actions authorized under this opinion.
   c. The Corps' Regulatory and Civil Works Branches will each attend an annual coordination meeting with NMFS by March 31 each year to discuss the annual

monitoring report and any actions that will improve conservation under this opinion, or make the program more efficient or more accountable.

d. Failure to provide timely reporting may constitute a modification of SLOPES that has an effect to listed species or critical habitat that was 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 recommendations are discretionary measures that NMFS believes are consistent with this obligation and therefore should be carried out by the Corps:

- The effectiveness of some types of stream restoration actions are not well documented, partly because decisions about which restoration actions deserve support do not always address the underlying processes that led to habitat loss. NMFS recommends that the Corps encourage applicants to use species' recovery plans to help ensure that their actions will address those underlying processes that limit fish recovery.
- NMFS recommends that the Corps evaluate web-based reporting to lessen the administrative burden, with the goal of improving completion reporting and tracking of incidental take.

Please notify NMFS if the Corps carries out these recommendations so that 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

As provided in 50 CFR 402.16, 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 take 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 to 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.

2.11 "Not Likely to Adversely Affect" Determination

For purposes of the ESA, "effects of the action" means the direct and indirect effects of an action on the listed species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action (50 CFR 402.02). The applicable standard to find that a proposed action is NLAA listed species or critical habitat is that all of the effects of the action are expected to be discountable, insignificant, or completely beneficial (USFWS and NMFS 1998). Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur.

Southern Resident Killer Whale Determination. Southern resident killer whales spend considerable time in the Georgia Basin from late spring to early autumn, with concentrated activity in the inland waters of Washington State around the San Juan Islands, and typically move south into Puget Sound in early autumn (NMFS 2008d). Pods make frequent trips to the outer coast during this season. In the winter and early spring, southern resident killer whales move into the coastal waters along the outer coast from the Queen Charlotte Islands south to central California, including coastal Oregon and off the Columbia River (NMFS 2008d).

No documented sightings exist of southern resident killer whales in Oregon coastal bays, and there is no documented pattern of predictable southern resident occurrence along the Oregon outer coast and any potential occurrence will be infrequent and transitory. Southern resident killer whales primarily eat salmon and prefer Chinook salmon (Hanson *et al.* 2010; NMFS 2008d).

The proposed program may affect the quantity of killer whale's preferred prey, Chinook salmon. Any salmonid take including Chinook salmon up to the aforementioned amount and extent of take will result in an insignificant reduction in adult equivalent prey resources for southern resident killer whales that may intercept these species within their range.

NMFS finds that any affect the proposed program may have on southern resident killer whales, including indirect effects on their prey, is likely to be discountable, insignificant or beneficial. Therefore, NMFS finds that the proposed program may affect, but is not likely to adversely affect southern resident killer whales.

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

The consultation requirement of 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 effects occur when EFH quality or quantity is reduced by a direct or indirect physical, chemical, or biological alteration of the waters or substrate, or by the loss of (or injury to) benthic organisms, prey species and their habitat, or other ecosystem components. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by the Corps and descriptions of EFH for Pacific coast groundfish (PFMC 2005), coastal pelagic species (PFMC 1998), and Pacific coast salmon (PFMC 1999) 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 Pacific Fishery Management Council (PFMC) described and identified EFH for groundfish (PFMC 2005), coastal pelagic species (PFMC 1998), and Chinook salmon, coho salmon, and Puget Sound pink salmon (PFMC 1999). The proposed action and action area for this consultation are described in the Introduction to this document. The action area includes areas designated as EFH for various life-history stages of groundfish, coastal pelagic species, and Chinook and coho salmon.

3.2 Adverse Effects on Essential Fish Habitat

Based on information provided by the action agency and the analysis of effects presented in the ESA portion of this document, NMFS concludes that the proposed action will have adverse effects on EFH designated for Pacific Coast salmon in freshwater where projects will occur. Pacific salmon, groundfish and coastal pelagic species will also be adversely affected in estuaries, including estuarine areas designated at habitat areas of particular concern (HAPCs) in the Lower Columbia River and at other river mouths, bays, estuaries, and coastal waters where projects will occur.

1. Freshwater EFH quantity will be reduced due to short-term construction needs, reduced riparian permeability, and increased riparian runoff. There will be a slight longer-term increase in freshwater EFH quantity and quality based on improved riparian function and floodplain connectivity.
2. Freshwater EFH quality will be reduced due to a short-term increase in turbidity, dissolved oxygen demand, and temperature due to riparian and channel disturbance.
3. Freshwater, estuarine and nearshore EFH quality will experience a longer-term degradation due to continued stormwater discharge that contains PAHs, dissolved and suspended metals, and other persistent contaminants of concern that will be absorbed or ingested by salmon, sometimes in prey that will increase the concentration of contaminants through a process of bioaccumulation..
4. Freshwater EFH quality will experience a longer-term improvement due to improved riparian function, floodplain connectivity, and improved stormwater treatment.
5. Tributary substrate will have a short-term reduction in quality due to increased compaction and sedimentation, and a long-term increase in quality due to gravel placement, and increased sediment storage from boulders and large wood.
6. Floodplain connectivity will have a short-term decrease due to increased compaction and riparian disturbance during construction, and a long-term improvement due to streambank stabilization methods that incorporate vegetation.

7. Forage will have a short-term decrease in availability due to riparian and channel disturbance and a long-term increase in availability due to improved habitat diversity and complexity, and improved riparian function and floodplain connectivity.
8. Natural cover will have short-term decrease due to riparian and channel disturbance, and a long-term increase due to improved habitat diversity and complexity, improved riparian function and floodplain connectivity.
9. Fish passage will be impaired in the short-term due to decreased water quality and in-water work isolation, and improved over the long-term due to improved stream-road crossing structures, water quantity and quality, habitat diversity and complexity, forage, and natural cover.

3.3 Essential Fish Habitat Conservation Recommendations

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

1. The effectiveness of stream restoration actions is not well documented, partly because decisions about which restoration actions deserve support do not always address the underlying processes that led to habitat loss. NMFS recommends that the Corps encourage applicants to use species' recovery plans to help ensure that their actions will address those underlying processes that limit fish recovery.
2. As appropriate to each action issued a regulatory permit under this opinion, include the PDC for general construction and types of actions (*i.e.*, 13 through 43) as enforceable permit conditions, except 18 (fish capture and release).
3. Include each applicable PDC for construction and types of actions (*i.e.*, 13 through 43) as a final action specification of every WRDA civil works action carried out under this opinion, except 18 (fish capture and release).

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the Corps must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS'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 Corps 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's EFH conservation recommendations (50 CFR 600.920(l)).

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this opinion is the Army Corps of Engineers, Portland District, for road, culvert, bridge, and utility line actions. An individual copy of this opinion was provided to the Corps. This opinion will be posted on the NMFS West Coast Region web site (http://www.westcoast.fisheries.noaa.gov). 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 response 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 Forms

Email Guidelines

The **SLOPES** programmatic e-mail box (slopes.nwr@noaa.gov) is to be used for actions submitted to the National Marine Fisheries Service (NMFS) by the Federal Action Agencies for formal consultation (50 CFR § 402.14) under **SLOPES Stormwater, Transportation or Utilities.**

The Corps must ensure the final project is being submitted 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 form 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 Only**. All other pre-decisional communication should be conducted **outside** the use of the slopes.nwr@noaa.gov e-mail.

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

1. Action Implementation Form, containing Action Notification, Action Completion, and Fish Salvage and Site Restoration/Compensatory Mitigation reports (if fish salvage and/or site restoration/compensatory mitigation are conducted).
2. Map(s) and project design drawings (if applicable).
3. Final project plan.

The Corps shall ensure that NMFS receives a Fish Salvage reports (if fish salvage is conducted) and Action Completion Report, within 60 days after in-water work completion.

E-mail Titling Conventions

In the subject line of the email (see below for requirements), clearly identify which SLOPES programmatic you are submitting under (Restoration, In-water/Over-water Structures, or **Stormwater, Transportation or Utilities**), the specific submittal category (30-day approval, no approval, project completion, withdrawal, or salvage report), the Corps Permit Number, the Applicant Name, County, Waterway, 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 SLOPES programmatic you are submitting under (Restoration, In-water/Over-water Structures, or **Stormwater, Transportation or Utilities**);
2. The specific submittal category (30-day approval, no approval, action completion, withdrawal, salvage report, or site restoration/compensatory mitigation);
3. Corps Permit number;
4. Applicant Name (you may use last name only, or **commonly used** abbreviations);
5. County;
6. Waterway; and
7. State.

Examples:

SLOPES Programmatic Specific Submittal Category, Corps Permit #, Applicant Name, County, Waterway, State

Action Notification

Transportation No Approval, 200600999, Smith, Multnomah, Willamette, Oregon
Transportation_30-day Approval, 200600999, Smith, Multnomah, Willamette, Oregon

Project Completion

Transportation Completion, 200600999, Smith, Multnomah, Willamette, Oregon

Natural Hazard Response Report

Transportation Natural Hazard Response, 200600999, Smith, Multnomah, Willamette, Oregon

Salvage Report

Transportation Salvage, 200600999, Smith, Multnomah, Willamette, Oregon

Withdrawal

Transportation Withdrawal, 200600999, Smith, Multnomah, Willamette, 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 SLOPES **Stormwater, Transportation or Utilities** 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

ACTION IMPLEMENTATION FORM INSTRUCTIONS

NMFS Review and Approval. The Corps project manager shall submit the below form, with the Action Notification portion completed, to NMFS at *slopes.nwr@noaa.gov* for notification or approval.

The Following Actions Require Approval from NMFS. NMFS will notify the Corps within 30 calendar days if the actions are approved or disqualified.

a. Pile installation (PDC 15)
b. Fish screens on pump intakes for dewatering at a rate that exceeds 3 cfs (PDC 34)
c. Stormwater facilities (PDC 36 & 43)
d. New or upgraded stormwater outfalls (PDC 36 & 43)
e. Compensatory mitigation (PDC 39)
f. Alluvium placement that occupies more than 25% of the channel bed or more than 25% of the bankfull cross sectional area (PDC 41d)
g. LW placement that occupies greater than 25% of the bankfull cross section area (PDC 41e)
h. Vegetated riprap with LW (PDC 41f)
i. Engineered log jams (PDC 41h)
j. Grade stabilization (PDC 42b)
k. Road-stream crossing replacement or retrofit (42e)
l. Fish passage restoration
m. Restoration of a historic stream channel
n. Blasting
o. Earthwork at an 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 the Corps' best professional judgment
p. Modification or variance of any requirement

Attach 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

The Following Actions Do Not Require Approval from NMFS. Any action that involves (a) natural hazard response; (b) streambank and channel stabilization; (c) routine road surface, culvert and bridge maintenance activity; or (d) utility line crossings.

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

Action Completion Reporting. It is the applicant's responsibility to submit this form to the Corps within 60 days of completing all work below ordinary high water (OHW). Upon receipt, the Corps will resubmit this form with the Action Completion Report portion completed to NMFS at *slopes.nwr@noaa.gov*. If it is a Corps project, the Corps shall complete and submit this form within 60 days of completing the project.

Natural hazard response reporting. It is the applicant's responsibility to submit this form to the Corps within 30 days of completing all work below OHW. Upon receipt, the Corps will resubmit this form with the Action Completion Report portion completed to NMFS at *slopes.nwr@noaa.gov*. If it is a Corps project, the Corps shall complete and submit this form within 30 days of completing the project.

Fish Salvage Reporting. It is the applicant's responsibility to submit this form to the Corps within 60 days of completing a capture and release as part of an action completed under SLOPES V Transportation. Upon receipt, the Corps will resubmit this form with the Fish Salvage Report portion completed to NMFS at *slopes.nwr@noaa.gov*. If it is a Corps project, the Corps shall complete and submit this form within 60 days of completing fish salvage operations.

ACTION IMPLEMENTATION FORM

1. Action Notification

DATE OF REQUEST:		**NMFS TRACKING #: NWR-2013-9717**	
TYPE OF REQUEST:	☐ ACTION NOTIFICATION (NO APPROVAL) ☐ ACTION NOTIFICATION (APPROVAL REQUIRED)		
Statutory Authority:	☐ ESA ONLY ☐ EFH ONLY ☐ ESA & EFH COMBINED		
Lead Action Agency:	**Corps of Engineers**		
Action Agency Contact:		Corps Action ID #:	
Applicant:		Individual DSL Permit #:	
Project Name:			
6th Field HUC & Name:			
Latitude & Longitude (in signed degrees format: DDD.dddd)			
Proposed Construction Period:	***Start Date:***		***End Date:***
Proposed Length of Channel and/or Riparian Modification in linear feet:			
Proposed Area of Herbicide Application in acres:			

Project Description:

Type of Action:
Identify the type of action proposed.

Actions Requiring **No Approval** from NMFS:

- ☐ Natural Hazard Response
- ☐ Streambank and channel stabilization
- ☐ Road surface, culvert and bridge maintenance
- ☐ Utility line stream crossing

Actions Requiring **Approval** from NMFS:

- ☐ Pile installation
- ☐ Fish screen design for diversion >3 cfs
- ☐ Stormwater facilities
- ☐ New or upgraded stormwater outfalls
- ☐ Compensatory mitigation
- ☐ Alluvium placement in >50% channel bed or >25% of the bankfull cross sectional area
- ☐ LW in >25% bankfull cross section of channel
- ☐ Vegetated riprap with large wood
- ☐ Engineered log jams
- ☐ Grade stabilization
- ☐ Road-stream crossing replacement or retrofit
- ☐ Fish passage restoration
- ☐ Restoration of a historic stream channel
- ☐ Blasting
- ☐ Earthwork at an EPA Superfund site, state-designated clean-up site, or the likely impact zone of a significant contaminant source
- ☐ Modification or variance of any requirement

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

ESA Species

- ☐ Upper Willamette River spring-run Chinook
- ☐ Upper Willamette River steelhead
- ☐ Lower Columbia River Chinook
- ☐ Lower Columbia River steelhead
- ☐ Lower Columbia River coho
- ☐ Columbia River chum
- ☐ MCR steelhead
- ☐ UCR spring-run Chinook
- ☐ UCR steelhead
- ☐ SR spring/summer run Chinook
- ☐ SR fall-run Chinook
- ☐ SR steelhead
- ☐ Snake River sockeye
- ☐ Oregon Coast coho
- ☐ SONCC coho
- ☐ Green sturgeon
- ☐ Eulachon

EFH Species

- ☐ Salmon, Chinook
- ☐ Salmon, coho
- ☐ Coastal Pelagics
- ☐ Groundfish

Terms and Conditions:

Check the Terms and Conditions from the biological opinion that will be included as conditions on the permit issued for this proposed action. Please attach the appropriate plan(s) for this proposed action.

Administrative ☐ Electronic notification ☐ Site assessment for contaminants ☐ Action completion report ☐ Site access ☐ Salvage notice ☐ Natural hazard response General Construction Measures ☐ Flagging sensitive areas ☐ Temporary erosion controls ☐ Temporary access roads ☐ Fish passage criteria ☐ In-water work period ☐ Work area isolation ☐ Capture and release ☐ Electrofishing ☐ Construction water ☐ Dust abatement ☐ Fish screen criteria ☐ Erosion/pollution control plan ☐ Choice of equipment ☐ Vehicle staging and use ☐ Stationary power equipment ☐ Work from top of bank ☐ Site restoration ☐ Turbidity monitoring	Natural Hazard ☐ Declaration ☐ Contact NMFS Road Maintenance/ Rehabilitation/ Replacement ☐ Road/culvert/bridge maintenance ☐ Grade stabilization ☐ Rock structures ☐ Permanent stream-road crossing replacement Stormwater Management Plan ☐ Design criteria ☐ Low Impact Development ☐ Water quality BMPs ☐ Water quantity BMPs ☐ Maintenance Plan ☐ Monitoring and Reporting Utility Stream Crossings ☐ Design criteria Post-Construction Reporting ☐ Action Completion Report ☐ Fish Salvage Report ☐ Site Restoration/Compensatory Mitigation Report	Streambank/Channel Stabilization ☐ Alluvium placement ☐ Large wood (LW) placement ☐ Vegetated riprap with LW ☐ Woody plantings ☐ Herbaceous cover ☐ Streambank shaping ☐ Coir logs ☐ Soil reinforcement ☐ Engineered log jams ☐ Floodplain flow spreaders ☐ Fertilizer ☐ Fencing ☐ Filling scour hole ☐ Slope stabilization with rock Invasive and Non-native Plan Control ☐ Non-herbicide methods ☐ Power equipment ☐ Herbicide applicator qualifications ☐ Transportation and safety plan ☐ Approved herbicides ☐ Approved herbicide adjuvants ☐ Approved herbicide carriers ☐ Approved herbicide application rates ☐ Approved application methods ☐ Minimize herbicide drift and leaching ☐ Required no-spray buffer distances

2. ACTION COMPLETION REPORT

The applicant shall submit this form to the Corps within 60 days of completing all work below ordinary high water (OHW). The Corps shall submit this form to NMFS at *slopes.nwr@noaa.gov* upon receipt from the applicant. If it is a Corps project, the Corps shall submit this form within 60 days of completing all work below OHW.

Actual Start and End Dates for the Completion of In-water Work:	***Start*:**	***End*:**
Actual Linear-feet of Riparian and/or Channel Modification within 150 feet of OHW		
Actual Acreage of Herbicide Treatment		
Turbidity Monitoring/Sampling Completed	☐ Yes (include details below)	☐ No
Stormwater Monitoring/Report Completed	☐ Yes (include details below)	☐ No

Please include the following:

1. Attach as-built drawings for any action involving a riprap revetment, stormwater management facility, or a bridge rehabilitation or replacement.
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 number, type and diameter of any pilings removed or broken during removal.
6. Describe any riparian area cleared within 150 feet of OHW.
7. Describe turbidity monitoring (visual or by turbidimeter) including dates, times and location of monitoring and any exceedences and steps taken to reduce turbidity observed.
8. Describe site restoration.
9. Attach stormwater management plan.
10. Attach stormwater facility inspection, maintenance, and recording plan.

If the project was a Natural Hazard Response, ALSO include the following:

1. Name of the natural hazard event.
2. Type of natural hazard.
3. Name of the public transportation district manager that declared the response necessary.
4. NMFS staff contacted, with date and time of contact.

5. Description of the amount and type of riprap or other material used to repair a culvert, road, or bridge.
6. Assess the effects of the initial response to listed species and critical habitats.
7. Summary of the design criteria followed and not followed.
8. Remedial actions necessary to bring the initial response into compliance with design criteria in this opinion.

3. FISH SALVAGE REPORT

If applicable: The applicant shall submit a completed Fish Salvage Report and Fish Salvage Data Table (see below) to the Corps within 60 days of completing a capture and release as part of an action completed under SLOPES V Transportation. The Corps will submit the report to NMFS at *slopes.nwr@noaa.gov* upon receipt from the applicant. If it is a Corps project, the Corps shall submit this form to NMFS within 60 days of completing a capture and release event.

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

Supervisory Fish Biologist: ______________________

Address: ______________________

Telephone Number: ______________________

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

Fish Salvage Data

Water Temperature:

Air Temperature:

Time of Day:

ESA-Listed Species	Number Handled		Number Injured		Number Killed	
	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult
Lower Columbia River Chinook						
Upper Willamette River Chinook						
Upper Columbia River spring-run Chinook						
Snake River spring/summer run Chinook						
Snake River fall-run Chinook						
Chinook, unspecified						
Columbia River chum						
Lower Columbia River coho						
Oregon Coast coho						
Southern Oregon/Northern California Coasts coho						
Snake River sockeye						
Lower Columbia River steelhead						
Upper Willamette River steelhead						
Middle Columbia River steelhead						
Upper Columbia River steelhead						
Snake River Basin steelhead						
Steelhead, unspecified						
Southern green sturgeon						
Eulachon						

4. SITE RESTORATION/ COMPENSATORY MITIGATION

By December 31 of any year in which the Corps approves that the site restoration or compensatory mitigation is complete, the Corps, will submit a complete Site Restoration/Compensatory Mitigation Reporting Form, or its equivalent, with the following information to NMFS at slopes.nwr@noaa.gov.

Describe the location of mitigation or restoration work.

Summarize the results of mitigation or restoration work completed.