UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to NMFS No:
NWR-2012-9429

May 3, 2013

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

Re: Endangered Species Act Biological Opinion, Conference Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for Alder Creek Mill Restoration Project, Willamette River (6th Field HUC 170900120302) and Multnomah Channel (6th Field HUC 170900120205), Multnomah County, Oregon (Corps No.: NWP-2011-449)

Dear Mr. Zinszer:

The enclosed document contains a biological and conference 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 the proposal by the U.S. Army Corps of Engineers (Corps) to authorize Portland Harbor Holdings II, LLC to construct a restoration project at the Alder Creek Mill site on Sauvie Island at the confluence of the Multnomah Channel and the Willamette River under the authorities of section 10 of the Rivers and Harbors Act and section 404 of the Clean Water Act.

In this opinion, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of thirteen species of ESA-listed species: Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*), Upper Willamette River (UWR) spring-run Chinook salmon, Upper Columbia River (UCR) spring-run Chinook salmon, Snake River (SR) spring/summer-run Chinook salmon, SR fall-run Chinook salmon, Columbia River (CR) chum salmon (*O. keta*), LCR coho salmon (*O. kisutch*), SR sockeye salmon (*O. nerka*), LCR steelhead (*O. mykiss*), UWR steelhead, Middle Columbia River (MCR) steelhead, UCR steelhead, and Snake River Basin (SRB) steelhead. The proposed action will not result in the destruction or adverse modification of critical habitat designated for LCR Chinook salmon, UWR Chinook salmon, LCR steelhead, UWR steelhead, or critical habitat proposed for LCR coho salmon. The proposed action will have no effect on designated critical habitat for UCR spring-run Chinook salmon, SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, CR chum salmon, SR sockeye salmon, MCR steelhead, UCR steelhead, and SRB steelhead as designated critical habitat for these species is located 2.5 miles downstream from the action area. Critical habitat for these eight species will not be discussed further.

As required by section 7 of the ESA, NMFS is providing an incidental take statement with the opinion. The incidental take statement describes reasonable and prudent measures NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action. The take statement 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 listed species.

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

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

Please direct questions regarding this opinion to Mischa Connine, in the Oregon State Habitat Office, at 503.230.5401.

Sincerely,

William W. Stelle, Jr.
Regional Administrator

cc: Julie Mentzer, Portland Harbor Holdings

Endangered Species Act (ESA) Section 7(a)(2) Biological and Conference Opinion
and
Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Consultation

Alder Creek Mill Restoration Project, Willamette River (6th Field HUC 170900120302) and Multnomah Channel (6th Field HUC 170900120205), Multnomah County, Oregon (Corps No.: NWP-2011-449)

NMFS Consultation Number: NWR-2012-9429

Action Agency: U.S. Army Corps of Engineers

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 Effect
Snake River spring/summer run Chinook salmon	T	Yes	No	No Effect
Snake River fall-run Chinook salmon	T	Yes	No	No Effect
Columbia River chum	T	Yes	No	No Effect
Lower Columbia River coho salmon	T	Yes	No	No
Snake River sockeye salmon	E	Yes	No	No Effect
Lower Columbia River steelhead	T	Yes	No	No
Upper Willamette River steelhead	T	Yes	No	No
Middle Columbia River steelhead	T	Yes	No	No Effect
Upper Columbia River steelhead	T	Yes	No	No Effect
Snake River Basin steelhead	T	Yes	No	No Effect

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

Consultation Conducted By: National Marine Fisheries Service, Northwest Region

Issued By:

William W. Stelle, Jr.
Regional Administrator

Date: May 3, 2013

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LIST OF ACRONYMS

BA	Biological Assessment
BMP	Best Management Practice
CFR	Code of Federal Regulations
CHART	Critical Habitat Analytical Review Team
CMZ	Channel migration zone
CR	Columbia River
dB	Decibel
EFH	Essential Fish Habitat
ESA	Endangered Species Act
FR	Federal Register
HUC	Hydraulic Unit Code
LCR	Lower Columbia River
MCR	Middle Columbia River
MP	MilePost
MSA	Magnuson Stevens Act
NMFS	National Marine Fisheries Service
OHW	Ordinary High Water
PCE	Primary constituent element
Re: 1μPa	Reference 1 MicroPascal
RM	River Mile
RMS	Root Mean Squared
RPM	Reasonable and prudent measure
SEL	Sound exposure level
SR	Snake River
SRB	Snake River Basin
TRT	Technical Review Team
UCR	Upper Columbia River
U.S.C.	United States Code
UWR	Upper Willamette River
VSP	Viable Salmonid Population
WLC	Willamette/Lower Columbia

1. INTRODUCTION

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

1.1 Background

The National Marine Fisheries Service (NMFS) prepared the biological and conference 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 on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801, *et seq*.) and implementing regulations at 50 CFR 600.

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

1.2 Consultation History

On November 21, 2012, NMFS received a letter from the U.S. Army Corps of Engineers (Corps), requesting formal consultation pursuant to the ESA, and EFH consultation as required under the MSA, for the issuance of a permit under section 10 of the Rivers and Harbors Act and section 404 of the Clean Water Act to Portland Harbor Holdings (PHH). NMFS sent out an additional information request on December 27, 2012. NMFS received the additional information on January 24, 2013. Formal consultation was initiated on January 24, 2013.

PHH, the permit recipient for this action, proposes to construct the Alder Creek Restoration project on Sauvie Island at the confluence of the Willamette River and the Multnomah Channel. The Corps concluded that the proposed action is likely to adversely affect (LAA) 15 ESA-listed species: Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*), Upper Columbia River (UCR) spring-run Chinook salmon, Upper Willamette River (UWR) spring-run Chinook salmon, Snake River (SR) spring/summer-run Chinook salmon, SR fall-run Chinook salmon, Columbia River (CR) chum salmon (*O. keta*), LCR coho salmon (*O. kisutch*), SR sockeye salmon (*O. nerka*), LCR steelhead (*O. mykiss*), UWR steelhead, Middle Columbia River steelhead (MCR), UCR steelhead, and Snake River Basin (SRB) steelhead. The proposed action is also likely to adversely affect critical habitat designated for LCR Chinook salmon, UWR Chinook salmon, LCR steelhead, UWR steelhead, and critical habitat proposed for LCR coho salmon (78 FR 2726).

This opinion is based on information provided in the November 2012 biological assessment (BA), the February 8, 2012 field investigations, the January 24, 2013 additional information, and several meetings in 2011 and 2012. A complete record of this consultation is on file at the Oregon State Habitat Office in Portland, Oregon.

1.3 Proposed Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.

The action is the Corps' issuance of a permit under section 10 of the Rivers and Harbors Act and section 404 of the Clean Water Act to PHH for the Alder Creek restoration project. A summary of the proposed action is described below.

The site is currently occupied by a non-operating commercial sawmill (Figure 1). PHH proposes to develop a habitat restoration project on 64 acres of the southern tip of Sauvie Island, including 2.4 acres within the Multnomah Channel and the Willamette River (Figure 2). The project will include the following elements:

- Remove the existing sawmill and infrastructure (building, road, pads, utilities, and equipment);
- Remove the soil and wood waste push-up berm, which forms a perimeter around the riverward borders of the sawmill complex;
- Excavate material to create subtidal channels, marsh, mudflat, scrub-shrub, and riparian habitats within the active channel margin;
- Excavate approximately 3.09acres to create channels on Sauvie Island that will connect to the Willamette River and Multnomah Channel. Excavate 3.28 acres within the Willamette River and Multnomah Channel to ensure that there is a smooth elevation transition between the created channels and the existing waterways. Excavate 0.32 acres within the Multnomah Channel to remove excess material under the boat ramp;
- Place all excavated material north (inboard) of the levee and establish upland forest
- habitat on the area;
- Establish riparian habitat adjacent to the created active channel margin habitats by grading and planting;
- Remove the fire suppression dock (900 square feet), approximately 75 piles within the Multnomah Channel immediately offshore of the sawmill;
- Install large woody debris within the created channels and marsh/mudflat to provide in-water habitat structure and complexity;
- Juvenile salmonid monitoring via snorkel surveys, beach seining, and trapping; and
- Provide permanent protection of the site (excluding areas already encumbered by easements) through placement of a conservation easement or deed restriction.

These project elements are discussed in detail below.

Sawmill and Infrastructure Removal

PHH proposes to remove several structures on the site. These structures include a sawmill, polebarn, and several smaller buildings. All structures will be dismantled and removed from the site. The industrial nature of the mill raises the potential for industrial products and by-products to be present. A hazardous materials abatement plan will be developed to address these issues. This plan will detail the hazardous materials expected to be found on-site (*i.e.* oils, greases, lubricants, fuel, insulating materials, older construction materials, asbestos-containing material, lead based paint, creosoted wood, *etc.*) and outline proper methods for collection, handling, transport, and disposal of such materials. All hazardous materials resulting from the dismantling of existing mill equipment and infrastructure on-site (*e.g.* oils, lubricants, fuels, etc.) will be disposed of per Oregon Department of Environmental Quality (DEQ)-approved methods and/or in appropriate disposal facilities.

Demolition work will be completed by a wide variety of tools and specialized equipment. Such equipment ranges from hand tools (*e.g.* wrenches, pry bars, hammers, etc.) to specialized equipment (*e.g.* cutting torches, jack hammers, excavators, shears, and demolition hammers, *etc.*). Heavy equipment, such as dozers, excavators, dump trucks, will also be employed to move, load, and remove debris.

Figure 1. Current conditions at the Alder Creek site.

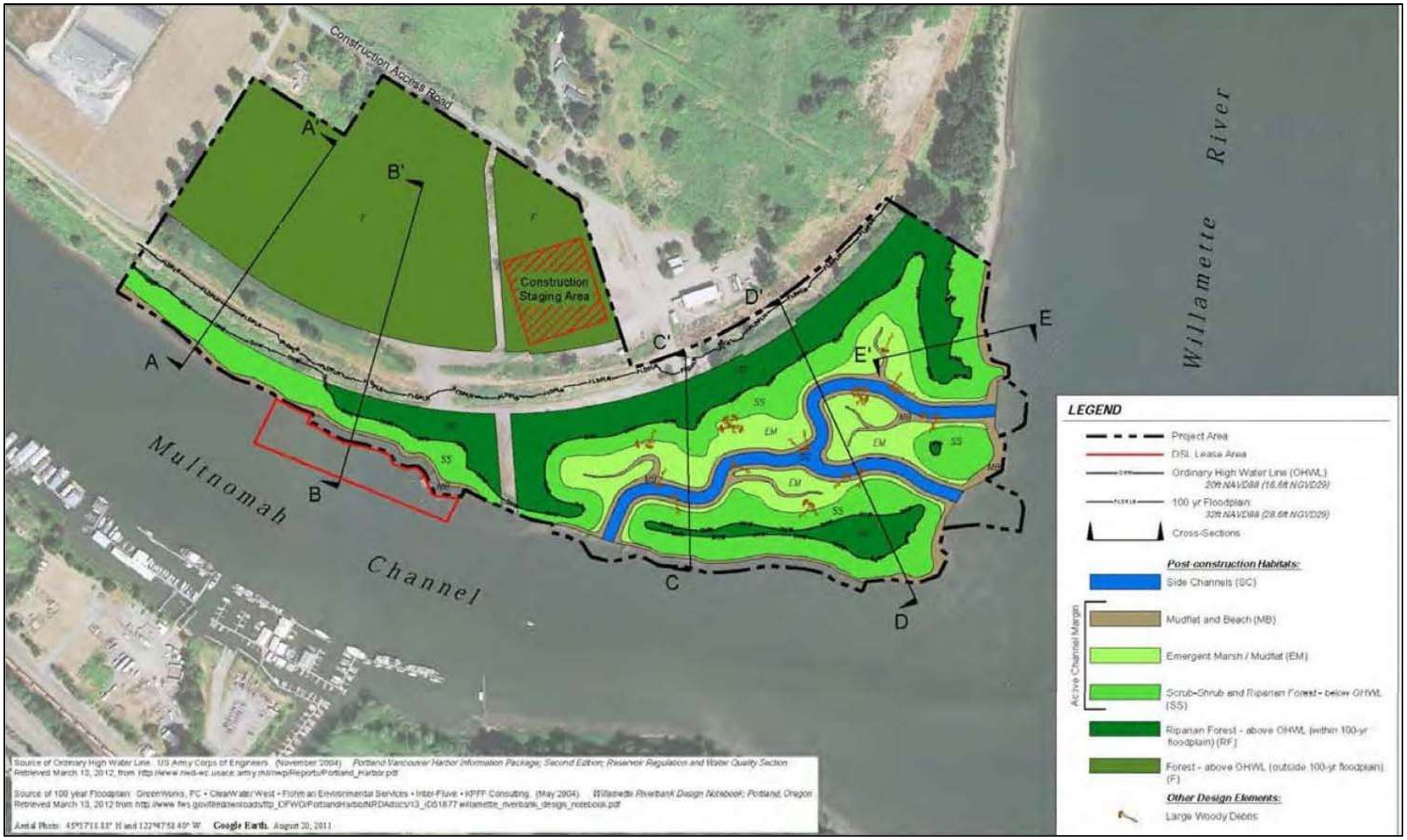

Figure 2. Proposed restoration design at the Alder Creek site.

Soil and Sediment Excavation/Earthwork

Approximately 415,000 cubic yards (cy) of material will be removed riverward of the Sauvie Island Drainage Improvement Company (SIDIC) berm. The excavated area will serve as the foundation for the aquatic (side channels), wetland, and riparian habitats that will be created. The results of the Phase II Environmental Site Assessment (URS, 2011) indicate excavated material will consist of various types of fill including dredge spoils, wood chips, and native soils. The excavated material will be transported across the levee and placed on the former log yard located inboard of the levee. Some excavated native soil (estimated to be 30,000 to 50,000 cy) may be placed on the SIDIC levee and within the SIDIC easement for maintenance purposes, pending approval by SIDIC. Cross-sections of site elevations post-grading are presented in Appendix A of the BA. The excavation and grading will take approximately 2-3 months.

The excavated side channels will meander throughout the site and connect to the Willamette River and the Multnomah Channel, riverward of the SIDIC levee. These side channels will be perennially inundated; however, the water level will fluctuate with the river level and tidal influence during times of low flow.

Soil investigations at the site have included an environmental screening assessment conducted by Maul Foster Alongi in 2010, a Phase I Environmental Site Assessment conducted by URS in 2010, and a Phase II Environmental Site Assessment completed by URS in 2011 (URS 2010, URS 2011). Site sampling documented in these reports indicates there are localized areas of contamination, but that the majority of soil proposed for removal is relatively uncontaminated and meets the DEQ's criteria for clean fill. Contaminants found in soil above risk-screening criteria include petroleum hydrocarbons, metals, polychlorinated biphenyls (PCBs), and semivolatile organic compounds (SVOCs). Contaminants found in groundwater above risk-screening criteria include petroleum hydrocarbons, metals, and SVOCs. Soils were classified into three soil management units as follows:

Unit 1 soils are defined as soils that contain contaminants at concentration that exceed Level II screening level values (SLVs) as defined by the Sediment Evaluation Framework for the Pacific Northwest (USACE *et al.* 2009). These soils can be placed in the log yard (upland forest), but would require capping with "clean" soils (i.e., soils without SLV exceedances) to prevent ecological receptor exposure to the soils.

Unit 2 soils are defined as soils that do not contain contaminants at concentration that exceed the SLVs, but do exceed the clean fill criteria. These soils can be placed in the log yard, but would not require capping. Unit 2 soils could be used to cap Unit 1 soils.

Unit 3 soils are defined as soils with no exceedances of either the Level II SLVs or the clean fill criteria. These soils can be managed at the discretion of PHH, including placement off site. Unit 3 soils include fill and native soils. Should there be an insufficient volume of Unit 2 soil to cover Unit 1 soils in the material placement area, Unit 3 soils will be used as necessary. Currently PHH proposes to place all excavated soils on the inboard side of the SIDIC levee in the log yard, with the exception of 30,000 to 50,000 cy of Unit 3 native soil that would be placed on the SIDIC levee and within the SIDIC easement outboard of the levee for levee maintenance, subject to approval by SIDIC.

In-Water Excavation

Approximately 4.02 acres of material will be excavated below ordinary high water (OHW) in the Willamette River and the Multnomah Channel. Of the 4.02 acres, 3.32 acres will be subtidal channels and will be constructed in the dry, prior to establishing surface water connections to the Willamette River and Multnomah Channel. The remaining 0.7 acres will be excavated within the river channels of the Willamette River and Multnomah Channel to match the gradient of the subtidal channels. Excavation below OHW will take approximately 10 days.

Excavation will be accomplished with a long-reach excavator from the shore and a barge-mounted excavator. Excavation will occur during the ODFW in-water work window (July 1-October 31) for this area. Turbidity curtains will be deployed around in-water excavation work areas to minimize downstream increased suspended sediment.

Piling and Overwater Structure Removal

PHH proposes to remove an overwater fire suppression facility and associated dock, 75 pilings, and riprap from the Multnomah Channel. Pilings and riprap in close proximity to the shore will be removed with an excavator from the shoreline. Pilings in deeper water and the dock will be removed with barge-mounted equipment. A floating surface boom will be installed to capture floating surface debris. Pilings will be removed with a vibratory hammer or a choke chain. If a piling breaks during removal, the piling will be cut 3 feet below mudline. Removed pilings will be placed in a containment basin without removing adhering sediment and will be transported to an appropriate upland disposal facility. Holes left by removed piles will be filled with clean, native sediment. Piling and dock removal will take approximately 3-5 days.

Vegetation Establishment

PHH proposes to create native plant communities, including emergent marsh, riparian scrub-shrub, riparian forest, and upland forest (Figure 3, above). During the excavation work as described above, native vegetation will be minimally disturbed. Any native vegetation that is disturbed during construction will be salvaged and reused. Along the southeastern edge of the site, some trees will be removed in order to create the channel connections. Any trees removed will used as large woody debris (LWD) on the site.

Planting. Herbaceous emergent and grass species will be installed using seed and plugs. Woody vegetation will consist of container stock bare root, and live stakes. All container plants will be procured from native plant nurseries.

Invasive and Non-native Plant Control. Invasive and non-native vegetation removal will include mechanical removal and herbicides. The following project design criteria (PDCs) are proposed for this project element:

Non-herbicide methods. The number of workers will be on-site will be minimized while treating areas within the riparian zone by manual and mechanical plant control (*e.g.*, hand pulling, clipping, stabbing, digging, brush-cutting, mulching or heating with radiant heat, pressurized hot water, or heated foam).

Power equipment. Gas-powered equipment with tanks larger than 5 gallons will be refueled in a vehicle staging area placed 150 feet or more from any natural waterbody, or in an isolated hard zone such as a paved parking lot.

Herbicide applicator qualifications. Herbicides will be applied only 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 and the herbicide transportation and safely plan, as follows.

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. At a minimum, the plan will: (a) Address spill prevention and containment; (b) estimate and limit the daily quantity of herbicides to be transported to treatment sites; (c) require that impervious material be placed beneath mixing areas in such a manner as to contain small spills associated with mixing/refilling; (d) require a spill cleanup kit be readily available for herbicide transportation, storage and application; (e) outline reporting procedures, including reporting spills to the appropriate regulatory agency; (f) ensure applicators are trained in safe handling and transportation procedures and spill cleanup; (g) require that equipment used in herbicide storage, transportation and handling are maintained in a leak proof condition; (h) address transportation routes so that hazardous conditions are avoided to the extent possible; (i) specify mixing and loading locations away from waterbodies so that accidental spills do not contaminate surface waters; (j) require that spray tanks be mixed or washed further than 150 feet of surface water; (k) ensure safe disposal of herbicide containers; (l) identify sites that may only be reached by water travel and limit the amount of herbicide that may be transported by watercraft.

Herbicides. The herbicides proposed for use under this opinion are (some common trade names are shown in parentheses):[1]

aquatic imazapyr (*e.g.*, Habitat™)
aquatic glyphosate (*e.g.*, AquaMaster™, AquaPro™)
aquatic triclopyr-TEA (*e.g.*, Renovate 3™)
chlorsulfuron (*e.g.*, Telar™, Glean™, Corsair™)
clopyralid (*e.g.*, Transline™)
glyphosate (*e.g.*, Rodeo™)
imazapic (*e.g.*, Plateau™)
imazapyr (*e.g.*, Arsenal™, Chopper™)
metsulfuron-methyl (*e.g.*, Escort™)

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[1] 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.

picloram (*e.g.*, Tordon™)
sethoxydim (*e.g.*, Poast™, Vantage™)
sulfometuron-methyl (*e.g.*, Oust™, Oust XP™)
triclopyr (*e.g.*, Garlon 3A™, Tahoe 3A™)

Herbicide adjuvenants. The adjuvenants proposed for use under this opinion are as follows (Table 1). Polyethoxylated tallow amine (POEA) surfactant and herbicides that contain POEA (*e.g.*, Roundup) will not be used.

Table 1. Herbicide adjuvenants, trade names, mixing rates, and application areas.

Adjuvant Type	Trade Name	Mixing Rate (per gallon)	Application Areas
Surfactants	Activator 90™	0.16 - 0.64 fl oz	Upland
	Agri-Dee™	0.16 - 0.48 fl oz	Riparian
	Hasten™	0.16 - 0.48 fl oz	Riparian
	LI 700™	0.16 - 0.48 fl oz	Riparian
	R 11™	0.16 - 1.28 11 oz	Riparian
	Super Spread™	0.16 - 0.32 fl oz	Riparian
	Syl-Tae™	0.16 - 0.48 fl oz	Upland
Drift Retardants	41-A™	0.03 - 0.06 fl oz	Riparian
	Vale™	0.16 fl oz	Upland

Herbicide carriers. Herbicide carriers (solvents) are limited to water or specifically labeled vegetable oil.

Herbicide mixing. Herbicides will be mixed more than 150 feet from any natural waterbody to minimize the risk of an accidental discharge.

Herbicide application rates. Herbicides will be applied at the lowest effective label rates, including the typical and maximum rates given below (Table 2). For broadcast spraying, application of herbicide or surfactant will not exceed the typical label rates.

Table 2. Typical and maximum rates for herbicide applications.

Herbicide	Typical Rate (pounds of active ingredient per acre)	Maximum Rate (pounds of active ingredient per acre)
Imazapic	0.1	0.1875
Clopyralid	0.35	0.5
metsulfuron-methyl	0.03	0.15
Imazapyr	0.45	1.5
sulfometuron-methyl	0.045	0.38
chlorsulfuron	0.056	0.25
triclopyr	1.0	10.0
picloram	0.35	1.0
sethoxydim	0.3	0.45
glyphosate	2.0	8.0

Herbicide application methods. Liquid or granular forms of herbicides will be applied as follows: (a) Broadcast spraying – hand held nozzles attached to back pack tanks or vehicles, or by using vehicle mounted booms; (b) 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 using; (c) hand/selective – wicking and wiping, basal bark, fill ("hack and squirt"), stem injection, cut-stump; (d) triclopyr – will not be applied by broadcast spraying.

Minimization of herbicide drift and leaching. Herbicide drift and leaching will be minimized as follows: (a) Do not spray when wind speeds exceed 10 miles per hour, or are less than 2 miles per hour; (b) be aware of wind directions and potential for herbicides to affect aquatic habitat area downwind; (c) keep boom or spray as low as possible to reduce wind effects; (d) 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; (e) do not apply herbicides during temperature inversions, or when ground temperatures exceed 80 degrees Fahrenheit; (f) do not spray when rain, fog, or other precipitation is falling or is imminent. Wind and other weather data will be monitored and reported for all broadcast applications.

Herbicide buffer distances. The following no-application buffers, which are measured in feet and are based on herbicide formula, stream type, and application method, will be observed during herbicide applications (Table 3). Herbicide applications based on a combination of approved herbicides will use the most conservative buffer for any herbicide included. Buffer widths are in feet, measured as map distance perpendicular to the bankfull elevation for streams, the upland boundary for wetlands, or the upper bank for roadside ditches. Before herbicide application begins, the upland boundary of each applicable herbicide buffer will be flagged or marked to ensure that all buffers are in place and functional during treatment.

Table 3. No-application buffers for herbicides, by stream type and application method.

Herbicide	Perennial Streams and Wetlands, and Intermittent Streams and Roadside Ditches with flowing or standing water present			Dry Intermittent Streams, Dry Intermittent Wetlands, Dry Roadside Ditches		
	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						
Triclopyr	**Not Allowed**	150	150	**Not Allowed**	150	150
Picloram	100	50	50	100	50	50
Sethoxydim	100	50	50	100	50	50
Glyphosate	100	50	50	100	50	50

Monitoring and Maintenance

Post-construction monitoring will include vegetation surveys, fisheries habitat use, benthic species composition, sediment dynamics, water quality and hydrology, and wildlife habitat use. Monitoring will occur for approximately 10 years post-construction. Monitoring activities will include foot traffic, use of hand tools, snorkeling, and seining.

Maintenance activities will include re-vegetation (as described above), invasive vegetation removal (as described above), removal of debris and garbage, and heavy equipment for re-grading, including removing deposition within the off-channel habitat.

Large Woody Debris Addition

PHH proposes to place LWD along the created side channels and within the marsh and mudflat habitat. Engineered log jams (ELJs) may be placed near created channel openings to redirect river water in order to maintain flows within the channels. Wood will be placed with an excavator.

Juvenile Salmonid Monitoring

Juvenile salmonid monitoring will be conducted to determine the presence or absence of juvenile salmonids. Monitoring could take place during years 1,3,5,7, and 10. Surveys will be conducted up to two times per months from February through May. Monitoring will be conducted using snorkel surveys or beach seining. Beach seining will only be conducted until juvenile salmonids are captured. Once juvenile salmonids are captured, beach seining will no longer continue. Snorkel surveys may continue through the remainder of the monitoring period.

Schedule

Upland activities, including demolition and earthwork that are not constrained by the in-water work window could start in late 2012. Most construction activities within and connecting to the Willamette River and Multnomah Channel are expected to occur during the in-water work window in 2013. Piling removal is expected to occur during the in-water work window in 2013 or 2014.

1.4 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The proposed project is located on the tip of Sauvie Island, near the confluence of the Willamette River and Multnomah Channel (Figure 3). For this consultation, the action area includes the streambeds, streambanks, riparian areas, and upland areas within the proposed project area. For this project, the action area also includes all such habitat 1,000 feet downstream of the project area (and/or to the limit of visible turbidity increases resulting from the in-water excavation and the removal of the pilings).

The action area is occupied by LCR Chinook salmon , UWR spring-run Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, CR chum salmon, LCR coho salmon, SR sockeye salmon, LCR steelhead, UWR steelhead, MCR steelhead, UCR steelhead, and SRB steelhead. The action area is designated as critical habitat for LCR Chinook salmon, UWR spring-run Chinook salmon, LCR steelhead, and UWR steelhead. The action area is proposed as critical habitat for LCR coho salmon.

The action area is also designated as EFH for Pacific salmon (PFMC 1999) and is in an area where environmental effects of the proposed project may adversely affect EFH for Pacific salmon.

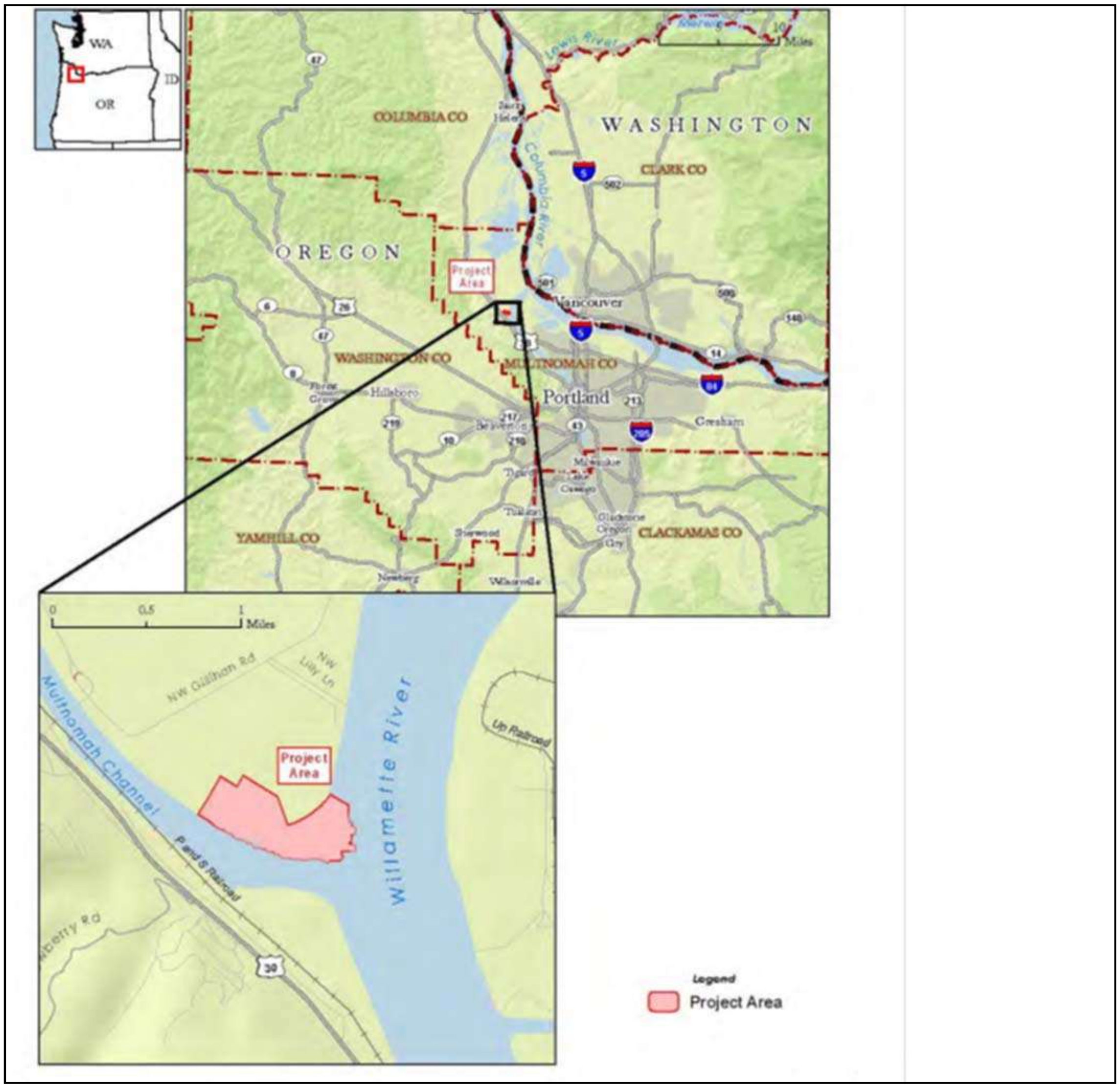

Figure 3. Project location for the Alder Creek project.

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

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the United States 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 and their critical habitat. If incidental take is expected, section 7(b)(4) requires the consulting agency to provide an incidental take statement (ITS) that specifies the impact of any incidental taking and includes reasonable and prudent measures to minimize such impacts.

2.1 Approach to the Analysis

Section 7(a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to insure 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 on the conservation value of 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.[2]

We will use the following approach to determine whether the proposed action 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] Memorandum from William T. Hogarth to Regional Administrators, Office of Protected Resources, NMFS (Application of the "Destruction or Adverse Modification" Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005).

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.

2.2.1 Status of Listed Species

For Pacific salmon and steelhead, , 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 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 13 ESA-listed species, and their designated critical habitats, that occur within the geographic area of this proposed action and are considered in this opinion. More 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 4).

Table 4. 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.

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	1/14/1378 FR 2726	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

* Proposed rulemaking; request for information.

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 5) to better integrate recovery planning information that NMFS is developing on the conservation status of the species and critical habitats considered in this consultation. Recovery domains are the geographically-based areas that NMFS is using to prepare multi-species recovery plans.

Table 5. 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 UCR steelhead MCR 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.[3]

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 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 SS/D risk combines risk for likely, future environmental conditions, and diversity (Ford 2011; McElhany *et al.* 2000; McElhany *et al.* 2007). 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.
- 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

[3] 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.

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 abundance and productivity (A&P) and spatial structure and diversity[4] (SS/D) metrics (Table 6) (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 2012). 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 6. 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 19 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, 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

[4] 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.

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.

Willamette-Lower Columbia Recovery Domain. Species in the Willamette-Lower Columbia (WLC) recovery domain include LCR Chinook salmon, UWR Chinook salmon, CR chum salmon, LCR coho salmon, LCR steelhead, and UWR steelhead. The WLC-TRT has identified 107 demographically independent populations of Pacific salmon and steelhead (Table 7). 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 7. Populations in the WLC recovery domain. Combined extinction risks for salmon and steelhead based on an analysis of Oregon populations.

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.[5] 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 8). Spatial structure has been substantially reduced in several populations. Low abundance, past broodstock 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

[5] 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 2011a).

spawning naturally may also have reduced population productivity (Lower Columbia Fish Recovery Board 2010; 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; 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 2012).

Table 8. 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 2012). 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	VH
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

<u>Abundance and Productivity</u>. 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 2012). Low abundance of natural-origin spawners (100 fish or fewer) has increased genetic and demographic risks. Other LCR Chinook salmon 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 2012; 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 LCR Chinook Salmon in the Action Area. Juvenile LCR Chinook salmon are present in the action area and likely rear year-round. Juvenile downstream migration occurs mid-February through mid-September and peaks mid-March through July. Adult LCR spring-run Chinook salmon will be present in the action area during project activities and will be exposed to the effects of the action. LCR Chinook salmon do not spawn in the action area. Upstream migration occurs mid-January through June and peaks mid-March through May. Adult LCR fall-run Chinook salmon will also present in the action area during project activities. Upstream migration occurs August through November and peaks October through mid-November.

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 9). 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 9. 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 large wood 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 UWR Chinook Salmon in the Action Area. Juvenile UWR Chinook salmon are present in the action area and likely rear year-round. Juvenile downstream migration occurs mid-February through June and peaks mid-March through May. Adult UWR Chinook salmon will be present in the action area during project activities and will be exposed to the effects of the action. UWR Chinook salmon do not spawn in the action area. Adult upstream migration occurs mid-January through June and peaks mid-March through May.

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

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 2012). 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 2012).

Table 10. 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 2012). Persistence probability ratings are very low (VL), low (L), moderate (M), high (H), to very high (VH).

<table>
<tr><th colspan="2">Stratum</th><th rowspan="2">Spawning Population (Watershed)</th><th rowspan="2">A&P</th><th rowspan="2">Diversity</th><th rowspan="2">Spatial Structure</th><th rowspan="2">Overall Persistence Probability</th></tr>
<tr><th>Ecological Subregion</th><th>Run Timing</th></tr>
<tr><td rowspan="7">Coast Range</td><td rowspan="7">Fall</td><td>Young's Bay (OR)</td><td>*</td><td>*</td><td>*</td><td>VL</td></tr>
<tr><td>Grays/Chinook rivers (WA)</td><td>VH</td><td>M</td><td>H</td><td>M</td></tr>
<tr><td>Big Creek (OR)</td><td>*</td><td>*</td><td>*</td><td>VL</td></tr>
<tr><td>Elochoman/Skamakowa rivers (WA)</td><td>VL</td><td>H</td><td>L</td><td>VL</td></tr>
<tr><td>Clatskanie River (OR)</td><td>*</td><td>*</td><td>*</td><td>VL</td></tr>
<tr><td>Mill, Abernathy and Germany creeks (WA)</td><td>VL</td><td>H</td><td>L</td><td>VL</td></tr>
<tr><td>Scappoose Creek (OR)</td><td>*</td><td>*</td><td>*</td><td>VL</td></tr>
<tr><td rowspan="8">Cascade Range</td><td>Summer</td><td>Cowlitz River (WA)</td><td>VL</td><td>L</td><td>L</td><td>VL</td></tr>
<tr><td rowspan="7">Fall</td><td>Cowlitz River (WA)</td><td>VL</td><td>H</td><td>L</td><td>VL</td></tr>
<tr><td>Kalama River (WA)</td><td>VL</td><td>H</td><td>L</td><td>VL</td></tr>
<tr><td>Lewis River (WA)</td><td>VL</td><td>H</td><td>L</td><td>VL</td></tr>
<tr><td>Salmon Creek (WA)</td><td>VL</td><td>L</td><td>L</td><td>VL</td></tr>
<tr><td>Clackamas River (OR)</td><td>*</td><td>*</td><td>*</td><td>VL</td></tr>
<tr><td>Sandy River (OR)</td><td>*</td><td>*</td><td>*</td><td></td></tr>
<tr><td>Washougal River (WA)</td><td>VL</td><td>H</td><td>L</td><td>VL</td></tr>
<tr><td rowspan="2">Columbia Gorge</td><td rowspan="2">Fall</td><td>Lower Gorge (WA & OR)</td><td>VH</td><td>H</td><td>VH</td><td>H</td></tr>
<tr><td>Upper Gorge (WA & OR)</td><td>VL</td><td>L</td><td>L</td><td>VL</td></tr>
</table>

* No data are available to make a quantitative assessment.

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 2012; 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 2012).

Limiting Factors include (NMFS 2012; 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 large wood 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 CR Chum in the Action Area. CR chum spawning aggregations were identified in the mainstem Columbia River. Although chum are not known to spawn in the Willamette River or Multnomah Channel, it is possible that some individuals may stray up these rivers from the Columbia River. Based on timing data of chum in the Columbia River, it is possible that adults could be in the action area during upstream migration and holding September through December. Juveniles could be present during rearing January through May and downstream, migrating juveniles could be present during February through May.

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 Big White Salmon and Hood rivers; in the

Willamette River to Willamette Falls, Oregon; and progeny of 25 artificial propagation programs.[6] 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 2012). Out of the 24 populations that make up this ESU (Table 11), 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 2012; ODFW 2010).

Table 11. 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 2012). 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

[6] 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 2011a).

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 2012). 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 2011a; NMFS 2012).

Limiting Factors include (NMFS 2012; 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 large wood 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 Coho Salmon in the Action Area. Juvenile coho salmon are present in the action area and likely rear year-round. Juvenile downstream migration occurs mid-February through mid-July and peaks mid-March through mid-June. Adult coho salmon will be present in the action area during project activities and will be exposed to the effects of the action. LCR coho salmon do not spawn in the action area. Adult upstream migration occurs August through December and peaks mid-September through mid-November.

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 12).[7] The DPS also includes the

[7] 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).

progeny of ten artificial propagation programs.[8] 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.

Table 12. 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 2012). Persistence probability ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH).

Stratum: Ecological Subregion	Stratum: Run Timing	Population (Watershed)	A&P	Spatial Structure	Diversity	Overall Persistence Probability
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 2012;

[8] 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 2011a).

ODFW 2010). All four strata in the DPS fall short of the WLC-TRT criteria for viability (NMFS 2012).

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 (Lower Columbia Fish Recovery Board 2010; NMFS 2012; ODFW 2010). 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 2012; 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 2012). 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 2012).

Limiting Factors include (NMFS 2012; 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 large wood, 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 LCR Steelhead in the Action Area. Juvenile LCR steelhead are present in the action area and likely rear year-round in the action area. Juvenile downstream migration occurs mid-February through November and peaks March through mid-August. Adult LCR steelhead will be present in the action area during project activities and will be exposed to the effects of the action. LCR steelhead do not spawn in the action area. Adult upstream migration occurs mid-November through June and peaks mid-January through April.

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 13). 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 steelhead 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 13. 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 large wood 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 UWR Steelhead in the Action Area. Juvenile UWR steelhead are present in the action area and likely rear year-round in the action area. Juvenile downstream migration occurs mid-February through November and peaks March through mid-August. Adult UWR steelhead will be present in the action area during project activities and will be exposed to the effects of the action. UWR steelhead do not spawn in the action area. Adult upstream migration occurs mid-November through June and peaks mid-January through April.

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 14). 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 14. 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	31
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 15).

Table 15. 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 (E).

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 15). 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; UCSRB 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 large woody 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 UCR Spring-run Chinook Salmon in the Action Area. Juvenile UCR spring-run Chinook salmon are present in the action area and likely use the area as high water refugia during downstream migration. Juvenile downstream migration occurs February through June and peaks mid-March through May. Adult UCR spring-run Chinook salmon are not likely present in the action area.

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 identified 28 extant and 4 extirpated populations of SR spring/summer-run Chinook salmon, and aggregated these into major population groups (Ford 2011; IC-TRT 2003). Each of these populations faces a “high” risk of extinction (Ford 2011) (Table 16).

Table 16. 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
	Pistol Creek				E
	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.

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 16). 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.

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).

Limiting Factors include (NOAA Fisheries 2011):

- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and large wood 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 Spring/summer-run Chinook Salmon in the Action Area. Juvenile SR spring-run/summer-run Chinook salmon are present in the action area and likely use the area as high water refugia. Juvenile downstream migration occurs mid-February through July and peaks mid-March through May. Adult SR spring-run Chinook salmon are not likely present in the action area.

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 SR 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 would be rated as "maintained."[9]

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 Fall-run Chinook Salmon in the Action Area. Juvenile SR fall-run Chinook salmon are present in the action area and likely use the area as high water refugia during downstream migration. Juvenile downstream migration occurs August through November and peaks October through mid-November. Adult SR fall-run Chinook salmon are not likely present in the action area.

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

[9] "Maintained" population status is for populations that do not meet the criteria for a viable population but do support ecological functions and preserve options for ESU/DPS recovery.

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).

Status of SR Sockeye Salmon in the Action Area. Juvenile SR Sockeye salmon are present in the action area and likely use the area as high water refugia during downstream migration. Juvenile downstream migration occurs March through mid-October and peaks May through mid-June. Adult SR Sockeye salmon are not likely present in the action area.

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 17) (Ford 2011; NMFS 2009).

Table 17. 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 MCR Steelhead in the Action Area. Juvenile MCR steelhead are likely present in the action area for high water refugia and downstream migration. Juvenile downstream migration occurs March through mid-October and peaks mid-April through mid-June. Adult MCR steelhead are not likely present in the action area.

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 18) 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 18)(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 18. 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; UCSRB 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 large woody debris 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 UCR Steelhead in the Action Area. Juvenile UCR steelhead are likely present in the action area and likely use the area as high water refugia and downstream migration. Juvenile downstream migration occurs June through October. Adult UCR steelhead are not likely present in the action area.

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 24 historical populations in five major groups (Table 19) (Ford 2011; IC-TRT 2011). 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 19. 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 2011b). 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	MT

* There is uncertainty in these ratings due to a lack of population-specific data.
** Insufficient 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 2011; NMFS 2011b):

- 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 large woody debris 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

Status of SRB Steelhead in the Action Area. Juvenile SRB steelhead are likely present in the action area and use the area as high water refugia and downstream migration. Juvenile downstream migration occurs June through October. Adult SRB steelhead are not likely present in the action area.

2.2.2 Status of Critical Habitat

We reviewed 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 area. 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.[10] 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).

This section examines critical habitat condition for LCR Chinook salmon, UWR spring-run Chinook salmon, LCR coho salmon, LCR steelhead, and UWR steelhead.

The physical or biological features of freshwater spawning and incubation sites for salmon and steelhead include water flow, quality and temperature conditions and suitable substrate for spawning and incubation, as well as migratory access for adults and juveniles (Table 20). 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

[10] 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).

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.

Table 20. 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, and SR sockeye 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

CHART Salmon and Steelhead Critical Habitat Assessments. The CHART 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.

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, CR chum salmon, and proposed for LCR coho 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. Logging in the Cascade and Coast Ranges, and agriculture, urbanization, and gravel mining on valley floors have contributed to increased erosion and sediment loads throughout the WLC domain.

The mainstem Willamette River has been channelized and stripped of large wood. 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 Corps. 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 large wood 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 2011c; NMFS 2012). The series of dams and reservoirs that make up the FCRPS block an estimated 12 million cy 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 2011c; NMFS 2012). 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 Corps. 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 (PAHs), 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 2011c; NMFS 2012). 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 *et al.* (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 2011c; NMFS 2012). 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 and organochlorine pesticides such as DDT. 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 21).

Table 21. **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). 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
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 (004); & Tualatin River (005)	ST	1	1
Johnson Creek (201)	CK/ST	0/1	2/2
Lower Willamette/Columbia Slough (203)	CK/ST	0	2

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). The action area is a migration corridor for some of the adult salmonids, including LCR Chinook and coho salmon, LCR steelhead, UWR Chinook salmon, and UWR steelhead. The action area for this consultation is a migration corridor and rearing area for all of the juvenile salmonid species addressed in this opinion. Therefore, all populations of the affected species could potentially be affected by the proposed action. The notable exceptions are the LCR Chinook and coho salmon, and LCR steelhead. For these species, populations that occupy watersheds downstream of the action area will not be affected by the proposed action.

The Willamette River watershed covers approximately 11,500 square miles in northwest Oregon between the Coast and Cascade mountain ranges. The river travels 187 miles from its headwaters to its confluence with the Columbia River. Precipitation occurs primarily in the fall, winter, and spring, with little rainfall during June, July, and August. The lowest river flow occurs during late summer. The numerous dams on the Willamette River and its tributary systems largely regulate flows in the mainstem Willamette River.

The lower Willamette River sub-basin is located in a predominantly urban setting of the greater Portland metropolitan region. Habitat conditions within the lower Willamette River are highly degraded. The streambanks have been channelized, off-channel areas developed, many tributaries piped, and the river has been disconnected from its floodplain as the lower valley was urbanized. Silt loading to the lower Willamette River has increased over historic levels due to logging, agriculture, road building, and urban and suburban development within the watershed.

The lower Willamette River sub-basin has been heavily modified in the project vicinity. The channel has been dredged to accommodate commercial shipping, while docks, piers, bulkheads (seawalls), and rock revetment (riprap) have replaced much of the natural bank habitat. Pollution exists from industrial sources, especially in the river sediments. A section of the Portland Harbor, from approximately RM 1.9 to 11.81, was identified as a U.S. Environmental Protection Agency (EPA) Superfund site in 2000. Primary contaminants include mercury, PCBs, PAHs, dioxins, furans, and pesticides (EPA, 2000).

The Multnomah Channel is a branch of the Willamette River starting approximately 15 miles downstream from the Willamette River's convergence with the Columbia River, and is approximately 20 miles long. The Multnomah Channel defines the western side of Sauvie Island before it too joins the Columbia near the city of St. Helens, Oregon.

The Multnomah Channel has been channelized and now flows through an artificially straight stretch before reaching its confluence with the Columbia River at St. Helens. Portions of the channel have hard rock bank protection to protect adjacent farmlands, roads, and utilities. The bottom end of the channel at Scappoose Bay is relatively undiked; however, the Sauvie Island side of the channel has been extensively diked. These modifications have resulted in the simplification of in-channel habitat, disconnection of the channel from its floodplain, and loss of off-channel rearing habitat and wetland areas along the margins of the river. Over-water structures have increased shading, thereby providing an advantage to predatory (northern pikeminnow, smallmouth bass, largemouth bass and walleye) fish. Native aquatic vegetation and shallow water habitat has also been reduced or eliminated in the Multnomah Channel, reducing the amount of refugia available to juvenile fish. Hard bank protection has resulted in reduced benthic invertebrate habitat, an important prey source for ESA-listed juvenile salmon and steelhead.

The condition of habitat within the action area is generally degraded. Lack of habitat complexity and poor water quality have led to reduced survival for juvenile and adult salmon and steehead migrating through the action area. The introduction of non-native predators has also reduced survival. Juvenile fish rearing in the action area find semi-functional habitat, but poor water quality and lack of forage impede growth and reduce survival. It is likely that habitat degradation has reduced the quantity of food available for these fish. Despite the poor conditions for anadromous fish, the action area retains its ability to serve as a functional migration corridor. There are no passage barriers and the area has sufficient water quantity to provide fish passage year round. Fish that travel through the area quickly can avoid experiencing effects caused by the degraded baseline. However, fish that linger in the area will experience the adverse effects described above. The overall impact of the baseline conditions is a slight reduction in the abundance and productivity of populations migrating through the action area.

Condition of Critical Habitat PCEs in the Action Area

The NMFS' Critical Habitat Analytical Review Team (CHART) designated the lower Willamette/Columbia River corridor is of "high" conservation value for the watershed and this corridor is highly essential to ESU conservation (NOAA Fisheries 2005). The CHART noted that this corridor connects every watershed and population in this ESU with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is a particularly important area for this ESU as both juveniles and adults make the critical physiological transition between life in freshwater and marine habitats (Marriott *et al*. 2002). Channel modifications; dams; irrigation impoundments and withdrawals; road building and maintenance; river, estuary, and ocean traffic; urbanization; and wetland loss and removal in the watershed were identified by the CHART as needing special management considerations or protection (NOAA Fisheries 2005).

Critical habitat is designated in the action area for LCR Chinook salmon, UWR Chinook salmon, LCR steelhead, and UWR steelhead, and proposed for LCR coho salmon. The action area supports two PCEs; freshwater rearing and migration corridor. As noted above, the condition of the critical habitat PCEs in the action area is generally poor with most of the physical and biological features impaired. Water quality is poor with water temperature higher than what is ideal for salmonids during summer, elevated levels fecal coliform, and elevated levels of contaminants (PCBs, PAHs, metals, pesticides, dioxins, and furans). There are no passage barriers identified within the action area. Water quantity may be altered from the natural hydrograph due to water withdrawals upstream of the action area. Floodplain connectivity has been reduced due to loss of wetlands and extensive diking.

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 still are reasonably certain to occur.

The proposed action will affect salmonid species considered in this opinion by causing physical, chemical, and biological changes to the environment. These effects include a reduction in water quality from the use of herbicides, a temporary reduction in water quality from increased suspended sediment and contaminants, and harassment/displacement from piling removal and excavation of native material below OHW, and a long-term increase in rearing and foraging habitat from the creation of sub-tidal channels and placement of LWD. Monitoring and sampling of juvenile salmonids will result in harassment/displacement and direct take on individual juvenile salmonids. Harrassment/displacement of juvenile salmonids will occur from snorkel surveys and direct take of individual salmonids will occur from handling during trapping.

Table 22 shows the summary of effects to ESA-listed species, including life history type affected and duration of effects.

Table 22. Summary of potential effects to ESA-listed species, including life history type affected and duration of effects.

Species	Exposure to Chemical Toxicity (Herbicides) (Annually for 10 years)	Release of Contaminants (Wood Preservatives) (5 days anytime between July 1 and October 31)	Suspended Sediment (10 days anytime between July 1 and October 31)	Removal of Over-water Structures (Long-term)	Off- and Side-Channel Habitat Creation, Set-back Existing Berm, and Wetland Restoration (Long-term)	Monitoring of Juvenile Salmonids
LCR Chinook salmon	Adults and juveniles	Adults and juveniles	Adults and juveniles	Juveniles	Juveniles	Juveniles
UWR Chinook salmon	Adults and juveniles	Juveniles	Juveniles	Juveniles	Juveniles	Juveniles
CR Chum	Adults and juveniles	Adults	Adults	Juveniles	Juveniles	Juveniles
UCR spring-run Chinook salmon	Juveniles	Juveniles	Juveniles	Juveniles	Juveniles	Juveniles
SR spring/summer run Chinook salmon	Juveniles	Juveniles	Juveniles	Juveniles	Juveniles	Juveniles
SR fall-run Chinook salmon	Juveniles	Juveniles	Juveniles	Juveniles	Juveniles	Juveniles
LCR coho salmon	Adults and juveniles	Adults and juveniles	Adults and Juveniles	Juveniles	Juveniles	Juveniles
SR sockeye salmon	Juveniles	Juveniles	Juveniles	Juveniles	Juveniles	Juveniles
LCR steelhead	Adults and juveniles	Adults and juveniles	Adults and juveniles	Juveniles	Juveniles	Juveniles
UWR steelhead	Adults and juveniles	Adults and juveniles	Adults and juveniles	Juveniles	Juveniles	Juveniles
MCR steelhead	Juveniles	Juveniles	Juveniles	Juveniles	Juveniles	Juveniles
UCR steelhead	Juveniles	Juveniles	Juveniles	Juveniles	Juveniles	Juveniles
SRB steelhead	Juveniles	Juveniles	Juveniles	Juveniles	Juveniles	Juveniles

Effects on Species

<u>Chemical Toxicity</u>. 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 ditches. Stream margins 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. 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.

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 an 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 with ester formulations. For example, ester formulations triclopyr are very susceptible to vapor drift, particularly at temperatures above 80°F.

When herbicides are applied with a sprayer, nozzle height controls the distance a droplet must fall before reaching the 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 speed. The higher that an application is made above the ground, the more likely it is to be above an inversion layer that will not allow herbicides to mix with lower air layers and will increase long distance drift. Several proposed PDCs address these concerns by ensuring that herbicide treatments will be made using ground equipment or by hand, under calm conditions, preferably when humidity is high and temperatures are relatively low. Ground equipment reduces the risk of drift, and hand equipment nearly eliminates it.

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. 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.

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. Point sources are discrete, identifiable locations that discharge relatively high local concentrations. The proposed PDCs minimize these concerns by ensuing proper calibration, mixing, and cleaning of equipment. Non-point source groundwater contamination of herbicides is relatively uncommon but can occur when a mobile herbicide is applied in areas with a shallow water table. Proposed PDCs minimize this danger by restricting the formulas used, and the time, place and manner of their application to minimize offsite movement.

Herbicides and associated compounds are likely to affect listed fish through several pathways. Lethal or sub-lethal toxicity to listed fish result if concentrations are high. Bioaccumulation rates are low to very low for all herbicides in the proposed action, and bioaccumulation of herbicides is not expected to occur.

Herbicides and associated compounds are likely to affect periphyton, zooplankton, and macroinvertebrates in the stream. The use of herbicides near aquatic environments decreases biomass production of periphyton, zooplankton, and macroinvertebrates. Herbicides also decrease the species richness of zooplankton and macroinvertebrates (Relyea 2005). The reduction of periphyton, zooplankton, and macroinvertebrates will cause a decrease of prey organisims for juvenile salmonds. Potential effects to juvenile salmonids include a reduction in feeding rates and growth, which could potentially decrease survival of a few individuals.

The risk of acute indirect exposure to sub-lethal concentrations of herbicides is possible from the proposed vegetation treatments. Sub-lethal effects can include disruption of behavior such as migration, feeding, and predator avoidance (Meehan 1991; Sandahl *et al.* 2004; Scholz *et al.* 2000). Behavioral changes are driven by molecular-level physiological events, such as changes in enzymatic function, ligand-receptor interaction, or oxygen metabolism (Weis *et al.* 2001). Such small or subtle changes in physiological function can have biologically relevant consequences (McEwen and Wingfield 2003), even though they are difficult or impossible to measure. These changes could potentially injure a few individuals.

Juvenile and adult life stages of salmonids could be indirectly exposed to sub-lethal concentrations of herbicides or associated compounds. In addition, herbicides will likely reduce juvenile salmonid prey organisms abundance and productivity. Herbicides will be used annually for a 10-year period. The proposed application methods, timing restrictions, buffers and other minimization measures will significantly reduce the likelihood of herbicides reaching the aquatic environment in concentrations that will kill or harm adult salmonids. However, herbicides that are applied to the water's edge will likely cause sub-lethal effects to juvenile salmonids that will significantly affect normal behavior patterns. Although the effects of herbicides could potentially injure a few individuals, they are unlikely to die. The proposed action will not decrease population abundance and productivity.

Release of Contaminants. The proposed action included construction activities that will occur within and adjacent to the Willamette River and Multnomah Channel.
Use of heavy equipment during the proposed construction activities creates the opportunity for accidental spills of fuel, lubricants, hydraulic fluid, and other petroleum products, which, if spilled in the vicinity of the action area, could injure or kill aquatic organisms. In addition, the discharge of construction water used for vehicle washing, concrete washout, and other purposes can carry sediments and a variety of contaminants to the Willamette River and Multnomah Channel. Petroleum-based contaminants contain PAHs, which can cause lethal as well as sublethal effects to fish and other aquatic organisms (Neff 1985).

Instream construction will elevate the risk for chemical contamination of the aquatic environment within the action area. The proposed conservation measures, such as, including staging vehicles and equipment fueling away from aquatic resources, will minimize the risk from chemical contamination during in-water work activities.

The proposed action will include the removal of treated piles. Although it is unknown which chemicals the piles are treated with, creosote, Ammoniacal Copper Zinc Arsenate (ACZA), and Chromated Copper Arsenate (CCA) are common substances used to preserve wood.

Creosote is host to a variable mix of over 300 preservative compounds, including phenolic compounds and nitron- sulfer- or oxygenated heterocyclics, dissolved in an oil-based solvent (Poston 2001). Of the most significant concern to aquatic life are PAHs, which can make up 65-85% of creosote treatment. Creosote, or its PAH constituents, have been shown to be cytotoxic, genotoxic, mutagenic, and carcinogenic in a number of organisms, both in the laboratory and in the field (Malins *et al.* 1985; Von Burg and Stout 1992; Fournie and Vogelbein 1994; Gagne *et al*. 1995; Shugart 1995 as cited in Vines *et al.* 2000).

ACZA and CCA compounds contain heavy metals chromium, copper, and arsenic. As these metals occur naturally in the environment, organisms tend to metabolically regulate them to a prescribed level and when exposure exceeds the physiological ability to deal with the metals, toxicity occurs. Copper is the main metal of concern because unlike terrestrial organisms, aquatic organisms are particularly sensitive to its presence. Copper also leaches the most, followed by arsenic and chromium (Warner and Solomon 1990).

Likely effects of elevated water column and sediments concentrations of copper and PAHs to the salmonids include, but are not limited to: (1) Reduced growth and survival rates; (2) altered hematology; and (3) reproductive effects, including reduced frequency of spawning, reduced egg production, and increased deformities in fry (Sorensen 1991).

The most probable route of exposure to leached or diffused contaminants from creosote treated wood for salmon is through the consumption of contaminated prey (Poston 2001). Hence, exposure is greatest for salmon when they are feeding in areas of sediment deposition immediately beside treated wood structures.

Treated wood piles will be removed using a vibratory hammer and disposed of in an upland location. Although the preservatives are tightly bound to the wood fibers and leaching rates have diminished over time, the removal of treated wood piles is likely to temporarily (5 days) increase the exposure of aquatic organisms to these chemicals to. This is especially true if the piling is cut or broken and a new surface is exposed, or if contaminated wood fragments are introduced or left on the riverbed (Poston 2001), or if contaminated sediment is suspended. Any increase in contaminant exposure due to sediment re-suspension is expected to be short-term (5 days) and limited to the immediate vicinity of removal activity. Juvenile and adult life stages of salmonids could be exposed to sub-lethal concentrations of wood preservatives, which could reduce the survival of a few individuals. Although the effects of exposure to wood preservatives could potentially decrease survival of a few individuals, the effects are not likely to decrease population abundance and productivity.

The long-term release of toxic chemicals from treated wood piles have been known to occur, with the initial leaching rates the greatest and eventually diminishing over time (USACE 1997). Ingram *et al.* (1982) determined that even after 12 years, a creosote-treated pile leaches 8.0 $\mu g/cm^2$/day of creosote. Vines *et al.* (2000) has shown that pilings over 40 years of age still contain diffusible amounts of creosote that migrate from the product into the environment. Therefore, it is likely that the treated wood piles subject to the proposed action are consistent sources of chemical contaminants and the permanent removal of the piles will result in a long-term benefit to water quality.

Suspended Sediment Increases. Construction activities are likely to temporarily increase suspended sediment levels through the re-suspension of sediments from piling removal and removal of native material below OHW.

Potential effects from project-related increases in suspended sediment on ESA-listed species include, but are not limited to: (1) Reduction in feeding rates and growth, (2) physical injury, (3) physiological stress, (4) behavioral avoidance, and (5) reduction in macroinvertebrate populations.

An increase in turbidity from suspension of fine sediments can adversely affect fish macro-invertebrates downstream from the work site. At moderate levels, turbidity has the potential to reduce primary and secondary productivity; at higher levels, turbidity may interfere with feeding and may injure and even kill both juvenile and adult fish (Berg and Northcote 1985; Spence *et al.* 1996). However, Bjornn and Reiser (1991) found that adult and larger juvenile salmonids appear to be little affected by the high concentrations of suspended sediments that may be experienced during storm and snowmelt runoff episodes.

Exposure duration is a critical determinant of the occurrence and magnitude of turbidity caused by physical or behavioral turbidity effects (Newcombe and Jensen 1996). Salmonids have evolved in systems that periodically experience short-term pulses (days to weeks) of high suspended sediment loads, often associated with flood events, and are adapted to such seasonal high pulse exposures. However, research indicates that chronic exposure can cause physiological stress responses that can increase maintenance energy and reduce feeding and growth (Servizi and Martens 1991). In a review of 80 published reports of fish responses to suspended sediment in streams and estuaries, Newcombe and Jensen (1996) documented increasing severity of ill effects with increases in dose (concentration multiplied by exposure duration).

Behavioral avoidance of turbid waters by juvenile salmonids may be one of the most important effects of suspended sediments (Birtwell *et al.* 1984; DeVore *et al.* 1980; Scannell 1988). Salmonids have been observed to move laterally and downstream to avoid turbid plumes (Lloyd *et al.* 1987; McLeay *et al.* 1984; McLeay *et al.* 1987; Scannell 1988; Servizi and Martens 1991). If the turbidity is severe enough to affect a significant cross-section of the river, the behavioral avoidance of turbid waters may impede or delay downstream or upstream migrations of adult and juvenile ESA-listed species. Salmon rearing in the action area during construction may also be exposed to other stress factors which may impose a cumulative burden in combination with increases in turbidity.

The construction activities that will most likely result in elevated suspended sediment are the removal of piles and removal of native stream bank material. The project-related suspended sediment increases will be localized and take part in a small portion of the lateral extent of the Willamette River and Multnomah Channel. Rearing and foraging behavior of juvenile salmonids, and migrating adult salmonids will be altered during increased turbidity plumes for two weeks during construction. Turbidity created by the project will cause interruption of essential behaviors and could potentially injure or kill a few individuals. Although the effects of turbidity could potentially injure or kill a few individuals, the loss of individuals is not likely to decrease population abundance and productivity.

Removal of Over-Water Structures. PHH proposes to remove an over-water fire suppression dock on the Multnomah Channel. The dock is 900 square feet.

The dock currently creates shadows that could allow predators to remain in darkened areas (barely visible to prey) and watch for prey to swim by against a bright background (high visibility). Prey species moving around structure(s) are unable to see the predators in the dark areas under or beside structure(s) and are therefore more susceptible to predation. Predator species, such as, bluegill (*Lepomis macrochirus*), smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*), and pikeminnow (*Ptychocheilus oregonensis*) are associated with fresh water.

The presence of the dock may also disrupt migration of smaller juvenile salmonids that use nearshore areas. The presence of the dock may result in juvenile salmonid delaying passage or forcing them into deeper water areas in an attempt to go around the structures. Juvenile Chinook salmon and coho salmon use backwater areas during their outmigration (Parente and Smith 1981). Littoral areas are important for juvenile salmonid migration (Ward *et al.* 1994). McCabe *et al.* (1986) using a 50 m (164 feet) beach seine found extensive usage of nearshore areas in the Columbia River estuary by subyearling Chinook salmon. Ledgerwood *et al.*(1990) using a 95 m

(312 feet) beach seine fishing in depths to 6 m (20 feet) found extensive use of nearshore habitat in the Lower Columbia River by subyearling Chinook salmon. Dawley *et al.* (1986) using a 95 m beach seine fishing in depths to 3 m (10 feet) found extensive use of nearshore habitat in the Lower Columbia River by subyearling Chinook salmon. Sampling by them in 1968 found nearshore usage by subyearling Chinook salmon to be 15 times greater than in the adjacent channel area and that yearling Chinook salmon, coho salmon and steelhead were more often caught in deeper waters (Dawley *et al.* 1986).

Shading from the dock may also reduce juvenile salmonid prey organism abundance and the complexity of the habitat by reducing aquatic vegetation and phytoplankton abundance (Kahler *et al.* 2000).

In-water structures (tops of pilings) also provide perching platforms for avian predators such as double-crested cormorants (*Phalacrocorax auritis*) (Kahler *et al.* 2000), from which they can launch feeding forays.

Upon completion, there will be a removal of 900 square feet of an over-water structure. Removal of the dock will likely increase the salmonid prey organism abundance. The removal of the dock will result in an increase in the survival of juvenile salmonids from reducing piscivorous predators, reducing avian predators, and restoring migration and feeding patterns of juvenile salmonids. The removal of over-water structures at a small scale does not necessarily improve population spatial structure; however, it can potentially increase survival, population abundance and productivity.

<u>Off- and Side-channel Habitat Creation</u>. Side channel wetlands and ponds provide important habitats for juvenile fish. Many historical off- and side-channels have been blocked from main stream channels for flood control or by other land management activities, or have ceased functioning due to other in-stream sediment imbalances. This proposed action includes the creation of new off- and side-channel habitats. When these areas are more regularly and permanently available, as in larger river basins, they can provide high value winter rearing habitat for salmon (Saldi-Caromile *et al*. 2004).

The effects of creating new off- and side-channel habitats will include relatively intense, but short-term restoration construction effects, as discussed above. The indirect effects are likely to include equally intense beneficial effects to habitat diversity and complexity (WDFW 2004), including increased overbank flow and greater potential for groundwater recharge in the floodplain; greater channel complexity and/or increased shoreline length; increased floodplain functionality; and increased width of riparian corridors. Improved riparian functions are likely to include increased shade and hence moderated water temperatures and microclimate; increased organic material supply; water quality improvement; filtering of sediment and nutrient inputs; more efficient nutrient cycling; and restoration of flood-flow refuge for ESA-listed fish (Saldi-Caromile *et al*. 2004).

Estuary areas are important transitional areas for all species of salmonids, (Groot and Margolis 1991). Side-and off-channel habitat are limited in the Lower Willamette River. The creation of these habitat types at a small scale does not necessarily improve population spatial structure;

however, it does make available additional habitat that can potentially increase population abundance and productivity.

Set-back Existing Berm. The direct and indirect effects of this type of proposed action are very similar to off- and side-channel habitat restoration discussed above. The proposed set-back allows the river to reconnect with its floodplain and reestablish natural ecological processes. This action is likely to affect a larger area overall because the area isolated by an existing berm is larger than that included in an off- or side-channel feature.

Wetland Restoration. The proposed wetland restoration is likely to have effects similar to those of restoration construction; off-and side channel restoration; set-back of existing berm, as described above.

Juvenile Salmonid Monitoring. The primary effect of the proposed juvenile salmonid monitoring will be in the form of harassment, capturing, and handling fish. The following subsections describe the effects of each activity.

Observation. ESA-listed fish would be observed in-water (*e.g.*, by snorkel surveys or from the banks). Direct observation is the least disruptive method for determining a species' presence/absence and estimating their relative numbers. Its effects are also generally the shortest-lived and least harmful of the monitoring activities discussed in this section because a cautious observer can effectively obtain data while only slightly disrupting the fishes' behavior. Fry and juveniles frightened by the turbulence and sound created by observers are likely to seek temporary refuge in deeper water or behind or under rocks or vegetation. In extreme cases, some individuals may leave a particular pool or habitat type and then return when observers leave the area. Harassment is the primary effect associated with these observation activities, and few if any injuries (and no deaths) are expected to occur—particularly in cases where monitoring is observed from the stream banks rather than in the water.

Capture/handling. Any physical handling or disturbance is known to be stressful to fish (Sharpe *et al.* 1998). The primary contributing factors to stress and death from handling are excessive doses of anesthetic, differences in water temperatures (between the river 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 salmonids increases rapidly from handling if the water temperature exceeds 18ºC or dissolved oxygen is below saturation. The proposed action would only seine fish which could result in injury from entanglement in the seine and descaling from rubbing. High levels of stress can both immediately debilitate individuals and over a longer period, increase their vulnerability to physical and biological challenges (Sharpe *et al*. 1998).

Effects on Designated Critical Habitat

Designated critical habitat within the action area for ESA-listed salmon and steelhead considered in this opinion consists of freshwater rearing sites and freshwater migration corridors and their essential PCEs as listed below. The effects of the proposed action on these features are summarized as a subset of the habitat-related effects of the action that were discussed more fully above. The critical habitat analysis begins with a summary of the effects of the proposed habitat improvement activities on critical habitat PCEs. An evaluation of the effects of the action impact the quality and function of critical habitat PCEs at the watershed scale and then the species-wide scale follows.

Freshwater rearing sites.
Water quantity. Water quantity will be not affected.

Floodplain connectivity. No adverse effects to floodplain connectivity will occur, but long-term beneficial effects are expected from several activities including berm removal, and creation of side channels. These actions will restore interaction between the stream and its floodplain, raising the water table and improving general riparian function.

Water quality. Short-term adverse effects to water quality, as described above, will occur when near-water or in-water construction occurs. Increased turbidity and increased levels of chemical contaminants resulting from construction will last for a few hours to a maximum of a few weeks. Minor inputs of chemical herbicides as described earlier will degrade water quality for a period of hours to days for a 10 year period.

Forage. Minor reductions in invertebrate forage will occur as a result of increased fine sediment generated by construction activities. This will affect to a few hundred feet below construction sites, and these areas will be recolonized by invertebrates within a few months. Short-term reductions in algae and macroinvertebrates will occur as described in the analysis of herbicide effects.

In the long term, the restoration activities that improve riparian function help to encourage establishment of healthy riparian plant community. Food available to juveniles may increase from nutrient enrichment, and the relative abundance of aquatic invertebrates may change locally in response to physical changes in habitat. Where habitat complexity is increased, juveniles are likely to benefit from a wider array of prey species and improved efficiency while foraging.

Natural cover. In the long term, large wood placement and riparian planting will improve cover for salmon and steelhead.

Freshwater migration corridors.
Free passage. Free passage will not be affected.

Water quantity. Water quantity will not be affected.

Water quality. Water quality will be affected as described above.

Natural cover. Natural cover will be affected as described above.

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 in the action area was described in the Status of the Species and Critical Habitats and Environmental Baseline sections, above. Among those activities were agriculture, urbanization, industrial development, and river restoration. Those actions were driven by a combination of economic conditions and general resource demands associated with settlement of local and regional population centers.

Agricultural, urbanization, and industrial development caused many long-lasting environmental changes that harmed ESA-listed species and their critical habitats, such as degraded freshwater habitat, especially floodplain connectivity and function, channel structure and complexity, riparian areas and large wood recruitment, and degraded water quality and altered stream temperature. 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.

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 around the City of Portland area. The 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. Counties that are gaining population around the City of Portland are likely to experience greater resource demands, and therefore more adverse environmental effects. Additional residential and commercial development and a general increase in human activities are expected to cause localized degradation of freshwater and estuarine habitat. Some of the overall effects of restoration projects, will lead to localized improvements to freshwater habitat. When these influences are considered collectively, we expect trends in habitat quality to remain flat. We expect cumulative effects would 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 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 in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we will add the effects of the action (Section 2.4) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5) to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) 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).

The proposed action will affect nearly all populations of the species covered in this opinion, with the exception of some LCR species with populations that occupy watershed downstream of the action area. The status of these species vary considerably from low to high risk of extinction as described in the *Status of the Species* section, above.

The condition of habitat within the action area is generally degraded, including lack of habitat complexity and poor water quality. Despite the poor conditions for anadromous fish, the action area retains its ability to serve as a functional migration corridor.

Nearly all individuals of UWR species and a majority of LCR species will pass through the action area. Adults migrate through the action area during upstream migration and juveniles use the action area as rearing and migration habitat during downstream migration. The majority of adult UCR, SR, MCR, UCR, SRB, and CR species use the Columbia River as upstream migration and would not be affected by the proposed action. However, the small number of juveniles that stray into the Multnomah Channel and Willamette River would be affected by the proposed action. Juvenile fish from the UCR, SR, MCR, UCR, SRB, and CR species use the action area as rearing and migration habitat during downstream migration, although to a lesser extent than UWR and LCR species.

The in-water work will occur when all species of juvenile salmonids could potentially be present during downstream migration, except for CR chum salmon, LCR Chinook salmon, LCR coho salmon, LCR steelhead, and UWR steelhead adults could potentially be present during construction. The herbicide application will take place annually for a 10 year period. Due to variable timing applications, all ESUs of salmonid could potentially be subject to the effects of herbicide application. Although the effects of the proposed action are likely to kill or injure a few fish, the effects will be too small to cause a biologically meaningful effect at the population scale. The overall percentage of individuals of each species that could be present, is small. This very small proportion of the number of individuals in each population will be adversely affected by capture, increased suspended sediment, and exposure to contaminants.

After construction, all species of salmonids will have access to newly created off-channel habitat. The removal of the dock and creation of the off-channel habitat will not necessarily improve salmonid population spatial structure; however, it does make available additional habitat that can potentially increase population and species abundance and productivity.

Therefore, the proposed action, taken with the environmental baseline and cumulative effects, is not likely to appreciably reduce the likelihood of survival and recovery of the species covered in this opinion.

Adverse effects to the quality and function of critical habitat PCEs and biological and physical features influenced by this project will be minor and of a low intensity. The effects on water quality during construction from increased turbidity and exposure to contaminants will last for 2 weeks, but no long-term increase in turbidity will result from the proposed action. The effects on water quality from the use of herbicides will occur annually for 10 years. None of the anticipated short-term adverse effects will reach a magnitude such that the conservation role of critical habitat will be impaired. The lower Willamette/Columbia River corridor is of "high" conservation value for the watershed and this corridor is highly essential to nearly all individual of UWR species and a majority of LCR species. The removal of the dock and creation of off-channel habitat will improve the rearing and migration PCEs and have a long-term positive effect on the quality and function of critical habitat.

2.7 Conclusion

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

We also conclude that the proposed action will not result in the destruction or adverse modification of critical habitat proposed for LCR coho salmon. You may ask NMFS to confirm the conference opinion as a biological opinion issued through formal consultation 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 or in the information used during the conference, we will confirm the 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.[11] 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.

2.8.1 Amount or Extent of Take

Activities necessary to construct the project and monitor juvenile salmonids will occur within the active channel of the Multnomah Channel and the Willamette River. The in-water work will occur when all species of juvenile salmonids could potentially be present during downstream migration. LCR Chinook salmon, CR chum salmon, LCR coho salmon, LCR steelhead, and UWR steelhead adults could potentially be present during upstream migration. It is reasonably certain that some listed salmonids will be present in the action area during the in-water work and at times when herbicides will be applied. Adverse effects to juveniles will include harassment and delayed downstream migration. Adverse effects to adults will include harassment and delayed upstream migration. These effects are reasonably certain to result in harassment of adults and juveniles, and harm of adults and juveniles (avoidance behaviors) that will likely lead to injury or death of a few individuals.

The use of herbicides will occur annually within the floodplain and along the water's edge of the newly created side channels. The herbicide application will occur anytime throughout the year and could affect all species of rearing juvenile salmonids. Adult salmonids, will likely be exposed to herbicides at levels that would disrupt normal behavior. The effects are reasonable certain to result in incidental take/harassment of juvenile salmonids that will likely lead to injury of a few individuals.

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 the proposed action. Thus, the distribution and abundance of fish within the 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 the proposed action. In such circumstances, NMFS cannot provide an amount of take that would be caused by some elements of the proposed action, including in-water work and herbicide application.
The amount of take for juvenile salmonid monitoring is based on sampling data (Teel *et al.* 2009) conducted on off-channel sites on and around Sauvie Island. Based on these data, juvenile

[11] 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.

salmonid monitoring is reasonable certain to capture or injure up to 31 juvenile Chinook salmon, 31 juvenile coho salmon, and 31 juvenile steelhead as a single occurrence within the 10 year monitoring period. Approximately one percent of the fish handled or captured will likely die (one fish per species). Seining, as a method of monitoring, will cease once any juveniles are captured. If this amount of take is exceeded, the reinititation provision of this opinion will apply.

The best available indicator for the extent of take caused by in-water construction is the extent of suspended sediment plumes. This feature best integrates the likely take pathway associated with in and near water construction, is proportional to the anticipated amount of take, and is the most practical and feasible indicator to measure. Thus, the extent of take indicator that will be used as a reinitiation trigger for this consultation is increased suspended sediment from construction activities with suspended sediment plumes 1,000 feet from the boundary of construction activities at 10% over the background level.

The best available indicator for the extent of take for herbicide application is the number of acres treated per year. This feature best integrates the likely take pathway associated with this action, is proportional to the anticipated amount of take, and is the most practical and feasible indicator to measure. Thus, the extent of take indicator that will be used as a reinitiation trigger for this consultation is herbicide application on a maximum of 60 acres per year.

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 action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.8.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures 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 action:
The Corps shall:

1. Minimize incidental take from project-related activities by applying conditions to the proposed action that avoid or minimize adverse effects to water quality and the ecology of aquatic systems.
2. Ensure completion of a monitoring and reporting program to confirm that the take exemption for the proposed action is not exceeded, and that the terms and conditions in this incidental take statement are effective in minimizing incidental take.

2.8.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the Corps or any applicant must comply with them in order to implement the reasonable and prudent measures (50 CFR

402.14). The Corps or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this 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, the Corps shall ensure that:

   a. Work Window. To minimize effects to juvenile salmonids, construction shall be limited to the in-water work window of July 1-October 31.

2. To implement reasonable and prudent measure #2, the Corps shall ensure that:

   a. Turbidity. Monitoring shall be conducted and recorded as described below. Monitoring shall occur each day during daylight hours when in-water work is being conducted.
      i. Representative background point. An observation must be taken every 2 hours at a relatively undisturbed area at least 600 feet upcurrent from in-water disturbance to establish background turbidity levels for each monitoring cycle. Background turbidity, location, time, and tidal stage must be recorded prior to monitoring downcurrent.
      ii. Compliance point. Monitoring shall occur every 2 hours approximately 1,000 feet downcurrent from the point of disturbance and be compared against the background observation. The turbidity, location, time, and tidal stage must be recorded for each sample.
      iii. Compliance. Results from the compliance points should be compared to the background levels taken during that monitoring interval. Turbidity may not exceed an increase of 10% above background at the compliance point during construction.
      iv. Exceedance. If an exceedance occurs, the applicant must modify the activity and continue to monitor every 2 hours. If an exceedance over the background level continues after the second monitoring interval, the activity must stop until the turbidity levels return to background. If the exceedances continue, then work must be stopped and NMFS notified so that revisions to the BMPs can be evaluated.
      v. If the weather conditions are unsuitable for monitoring (heavy fog, ice/snow, excessive winds, rough water, *etc.*), then operations must cease until conditions are suitable for monitoring.
      vi. Copies of daily logs for turbidity monitoring shall be available to NMFS upon request.

   b. Herbicide Application. Report the number of acres of herbicide application annually.

   c. Juvenile Salmonid Monitoring. Report the following data for juvenile fish sampling:
      i. Means of fish monitoring.
      ii. Number of ESA-listed salmonids observed or captured.

iii. Condition of ESA-listed salmonids released.
iv. Any incidence of observed injury or mortality.

d. Reporting. The applicant reports all monitoring items, including turbidity observations to NMFS within 60 days of the close of any work window that had in-water work within it. Any exceedance of take covered by this opinion must be reported to NMFS immediately. The report will include a discussion of implementation of the terms and conditions in #1, above.

e. The applicant will submit monitoring reports to:

National Marine Fisheries Service
Oregon State Habitat Office
Attn: NWR-2012-9429
1201 NE Lloyd Boulevard, Suite 1100
Portland, OR 97232-2778

2.9 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

NMFS offers the following conservation recommendation:

- Minimize the use of herbicides for non-native and invasive vegetation control by exploring alternative methods of vegetation control.

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

2.10 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.

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 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 proposed action and action area for this consultation are described in the Introduction to this document. The action area includes areas designated as EFH for various life-history stages of Chinook and coho salmon as identified in the Fishery Management Plan for Pacific coast salmon (PFMC 1999).

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 proposed action will have adverse effects on EFH designated for Chinook and coho salmon. Adverse effects of the proposed action will include sub-lethal effects from exposure to contaminants to juvenile and adult Chinook and coho salmon, harassment and increased suspended sediment during construction on juvenile and adult Chinook and coho salmon, and delayed upstream migration of adult Chinook and coho salmon.

3.3 Essential Fish Habitat Conservation Recommendations

NMFS expects that fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2 above, approximately 60 acres of designated EFH for Pacific coast salmon.

1. Follow term and condition 1 as presented in the ESA portion of this document to minimize adverse effects to water quality and the ecology of aquatic systems from project-related activities (implementation).

2. Follow term and condition 2 as presented in the ESA portion of this document to minimize adverse effects to water quality and the ecology of aquatic systems from project-related activities (general construction and in-water work).
3. Implement the conservation recommendation presented as part of the ESA portion of this document.

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' 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' EFH conservation recommendations (50 CFR 600.920(l)).

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The 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 Corps. Other interested users could include PHH. An individual copy of this opinion was provided to the Corps. This opinion will be posted on the NMFS Northwest Region web site (http://www.nwr.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/EFH consultation contain more background on information sources and quality.

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

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

5. REFERENCES

Berg, L., and T.G. Northcote. 1985. AChanges In Territorial, Gill-Flaring, and Feeding Behavior in Juvenile Coho Salmon (Oncorhynchus kisutch) Following Short-Term Pulses of Suspended Sediment.@ Canadian Journal of Fisheries and Aquatic Sciences 42:1410-1417.

Bindoff, N.L., J. Willebrand, V. Artale, A, Cazenave, J. Gregory, S. Gulev, K. Hanawa, C. Le Quéré, S. Levitus, Y. Nojiri, C.K. Shum, L.D. Talley and A. Unnikrishnan. 2007. Observations: Oceanic Climate Change and Sea Level. P. 385-432 in: Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.). Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Birtwell I. K., G. F. Hartman, B. Anderson, D. J. McLeay and J. G. Malick. 1984. A Brief Investigation of Arctic Grayling (*Thymallus arcticus*) and Aquatic Invertebrates in the Minto Creek Drainage, Mayo, Yukon Territory: An Area Subjected to Placer Mining. Canadian Technical Report of Fisheries and Aquatic Sciences.

Bjornn, T.C., and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. Pages 83-138 in W.R. Meehan, editor Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19:83-138.

Bottom, D.L., C.A. Simenstad, J. Burke, A.M. Baptista, D.A. Jay, K.K. Jones, E. Casillas, M.H. Schiewe. 2005. Salmon at river's end: The role of the estuary in the decline and recovery of Columbia River salmon. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-68, 246 p.

Busch, S., P. McElhany, and M. Ruckelshaus. 2008. A comparison of the viability criteria developed for management of ESA listed Pacific salmon and steelhead. Northwest Fisheries Science Center, National Marine Fisheries Service, Seattle, Washington.

Dawley, E.M., R.D. Ledgerwood, T.H. Blahm, C.W. Sims, J.T. Durkin, R.A. Kirn, A.E. Rankis, G.E. Monan, and F.J. Ossiander. 1986. Migrational Characteristics, biological observations and relative survival of juvenile salmonids entering the Columbia River estuary, 1966-1983. Project # 81-102. Bonneville Power Administration. Portland, Oregon. 256 p.

DeVore P. W., L. T. Brooke and W. A. Swenson. 1980. The Effects of Red Clay Turbidity and Sedimentation on Aquatic Life in the Nemadji River System. Impact of Nonpoint Pollution Control on Western Lake Superior. S. C. Andrews, R. G. Christensen and C. D. Wilson. Washington, D.C., U.S. Environmental Protection Agency.

EPA (U.S. Environmental Protection Agency). 2000. Fact Sheet: Portland Harbor, Portland Oregon. U.S. EPA Region 10 Seattle, Washington. June 2006.

Fernald, A.G., P.J. Wigington Jr., and D.H. Landers. 2001. Transient storage and hyporheic flow along the Willamette River, Oregon: Field measurements and model estimates. Water Resources Research 37(6): 1681-1694.

Ford, M.J., (editor). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-113. 281 p.

Fresh, K.L., E. Casillas, L.L. Johnson, and D.L. Bottom. 2005. Role of the estuary in the recovery of Columbia River Basin salmon and steelhead: An evaluation of the effects of selected factors on salmonid population viability. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-69, 105 p.

Gregory, S. L., Ashkenas, D. Oetter, P. Minear, and K. Wildman. 2002a. “Historical Willamette River channel change,” pp. 18-26 in D. Hulse, S. Gregory, and J. Baker, eds. for the Pacific Northwest Ecosystem Research Consortium. *Willamette River Basin planning atlas: Trajectories of environmental and ecological change*. Corvallis, OR: Oregon State University Press.

Gregory, S., L. Ashkenas, D. Oetter, P. Minear, R. Wildman, P. Minear, S. Jett, and K. Wildman. 2002b. “Revetments,” pp. 32-33 in D. Hulse, S. Gregory, and J. Baker, eds. for the Pacific Northwest Ecosystem Research Consortium. *Willamette River Basin planning atlas: Trajectories of environmental and ecological change*. Corvallis, OR: Oregon State University

Gregory, S., L. Ashkenas, P. Haggerty, D. Oetter, K. Wildman, D. Hulse, A. Branscomb, and J. VanSickle. 2002c. “Riparian vegetation,” pp. 40-43 in D. Hulse, S. Gregory, and J. Baker, eds. for the Pacific Northwest Ecosystem Research Consortium. *Willamette River Basin planning atlas: Trajectories of environmental and ecological change*. Corvallis, OR: Oregon State University Press.

Groot, C., and L. Margolis. 1991. Pacific salmon life histories. UBC Press, Vancouver, British Columbia, Canada.

IC-TRT (Interior Columbia Technical Recovery Team). 2003. Working draft. Independent populations of Chinook, steelhead, and sockeye for listed evolutionarily significant units within the Interior Columbia River domain. NOAA Fisheries. July.

IC-TRT. 2007. Viability criteria for application to Interior Columbia Basin salmonid ESUs. Review draft. March. Northwest Fisheries Science Center, National Marine Fisheries Service, Seattle, Washington. 35

IC-TRT. 2011. Draft recovery plan for Idaho Snake River spring/summer Chinook and steelhead populations in the Snake River spring/summer Chinook salmon evolutionarily significant unit and Snake River steelhead distinct population segment (chapters 1-3) National Marine Fisheries Service, Northwest Region, Protected Resources Division. Boise, Idaho. http://www.idahosalmonrecovery.net.

Ingram L. L., G. D. McGinnis, L. R. Gjovik and G. Roberson. 1982. Migration of Creosote and Its Components from Treated Piling Sections in a Marine Environment. Journal of the American Wood-Preservers' Association. 120-129.

ISAB (Independent Scientific Advisory Board). 2007. Climate change impacts on Columbia River Basin fish and wildlife. ISAB Climate Change Report, ISAB 2007-2, Northwest Power and Conservation Council, Portland, Oregon.

JCRMS (Joint Columbia River Management Staff). 2010 joint staff report concerning stock status and fisheries for sturgeon and smelt. Oregon Department of Fish and Wildlife and Washington Department of Fish and Wildlife.

Kahler T., M. Grassley and D. Beauchamp. 2000. A Summary of the Effects of Bulkheads, Piers and Other Artificial Structures and Shorezone Development on ESA-Listed Salmonids in Lakes. 74.

LCFRB (Lower Columbia Fish Recovery Board). 2010. Washington lower Columbia salmon recovery & fish and wildlife subbasin plan. May 28. Final. Lower Columbia Fish Recovery Board, Olympia, Washington. Available: http://www.lcfrb.gen.wa.us/Recovery%20Plans/June%202010%20RP/Vol%201/FINAL_Vol%20I%20Ch%201%20Intro%202010%20May.pdf

Ledgerwood, R.D., F.P. Thrower, and E.M. Dawley. 1990. Diel sampling of migratory juvenile salmonids in the Columbia River estuary. Fishery Bulletin 89:69-78.

Lloyd, D.S., J.P. Koenings, and J.D. LaPerriere. 1987. AEffects of Turbidity in Fresh Waters of Alaska.@ North American Journal of Fisheries Management 7: 18-33.

Marriott, D., and 27 contributors. 2002. Lower Columbia River and Columbia River Estuary Subbasin Summary. Report Prepared for the Northwest Power Planning Council, dated May 17, 2002. (Available at: http://www.cbfwa.org/)

McCabe, G.T., R.L. Emmett, W.D. Muir, and T.H. Blahm. 1986. Utilization of the Columbia River estuary by subyearling Chinook salmon. Northwest Science 60(2):113-124.

McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Dept. of Commerce, NOAA Technical Memorandum, NMFS-NWFSC-42.

McElhany, P., C. Busack, M. Chilcote, S. Kolmes, B. McIntosh, J. Myers, D. Rawding, A. Steel, C. Steward, D. Ward, T. Whitesel, and C. Willis. 2006. Revised viability criteria for salmon and steelhead in the Willamette and Lower Columbia Basins. Review Draft. Willamette/Lower Columbia Technical Recovery Team and Oregon Department of Fish and Wildlife, 178 p. (April 1, 2006)

McElhany, P., M. Chilcote, J. Myers, and R. Beamesderfer. 2007. Viability status of Oregon salmon and steelhead populations in the Willamette and Lower Columbia Basins. Prepared for Oregon Department of Fish and Wildlife and National Marine Fisheries Service, Portland, Oregon.

McEwen B. S. and J. C. Wingfield. 2003. The Concept of Allostasis in Biology and Biomedicine. Hormones and Behavior. 43(1): 2-15.

McElhany, P., M. H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-NWFSC-42, 156p.

McLeay, D.J., G.L. Ennis, I.K. Birtwell, and G.F. Hartman. 1984. AEffects On Arctic Grayling (*Thymallus arcticus*) of Prolonged Exposure to Yukon Placer Mining Sediment: A Laboratory Study.@ Canadian Technical Report of Fisheries and Aquatic Sciences 1241.

McLeay, D.J., I.K. Birtwell, G.F. Hartman, and G.L. Ennis. 1987. AResponses of Arctic Grayling (*Thymallus arcticus*) To Acute and Prolonged Exposure to Yukon Placer Mining Sediment.@ Canadian Journal of Fisheries and Aquatic Sciences 44: 658-673.

Meehan W. R. 1991. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication 19.

Myers, J.M., C. Busack, D. Rawding, A.R. Marshall, D.J. Teel, D.M. Van Doornik, M.T. Maher. 2006. Historical population structure of Pacific salmonids in the Willamette River and lower Columbia River basins. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-NWFSC-73, 311 p.

Neff J. M. 1985. Polycyclic Aromatic Hydrocarbons. In: G.M. Rand and S.R. Petrocelli (Ed). Fundamentals of Aquatic Toxicology. Washington, D.C., Hemisphere Publishing.

Newcombe C. P. and J. O. T. Jensen. 1996. Channel Suspended Sediment and Fisheries: A Synthesis for Quantitative Assessment of Risk and Impact. North American Journal of Fisheries Management. 16: 693-727.

NMFS. 2011a. 5-year review: summary and evaluation of Lower Columbia River Chinook, Columbia River chum, Lower Columbia River coho, and Lower Columbia River steelhead. National Marine Fisheries Service. Portland, Oregon.

NMFS. 2011b. 5-year review: summary and evaluation of Snake River sockeye, Snake River spring-summer Chinook, Snake River fall-run Chinook, Snake River Basin steelhead. National Marine Fisheries Service, Portland, Oregon.

NMFS. 2011c. Columbia River estuary ESA recovery plan module for salmon and steelhead. Prepared for NMFS by the Lower Columbia River Estuary Partnership (contractor) and PC Trask & Associates, Inc. (subcontractor). National Marine Fisheries Service, Northwest Region. Portland, Oregon. January. http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/upload/Estuary-Mod.pdf.

NMFS. 2012. Proposed ESA recovery plan for Lower Columbia River coho salmon, Lower Columbia River Chinook salmon, Columbia River chum salmon, and Lower Columbia River steelhead. National Marine Fisheries Service, Northwest Region. April.

NOAA Fisheries. 2005. Critical habitat analytical review teams for 12 evolutionarily significant units of west coast salmon and steelhead. Protected Resources Division, Portland, Oregon. August. 27 p.

NOAA Fisheries. 2011. Biennial report to Congress on the recovery program for threatened and endangered species October 1, 2008 – September 30, 2010. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Washington, D.C.

NRC (National Research Council). 1995. Science and the Endangered Species Act. Committee on scientific issues in the Endangered Species Act. Commission on Life Sciences. National Research Council. National Academy Press, Washington, D.C.

ODFW. 2010. Lower Columbia River conservation and recovery plan for Oregon populations of salmon and steelhead. Oregon Department of Fish and Wildlife. Salem, Oregon.

ODFW and NMFS (Oregon Department of Fish and Wildlife and National Marine Fisheries Service, Northwest Region). 2011. Upper Willamette River conservation and recovery plan for Chinook salmon and steelhead.

Parente, W.D., and J.G. Smith. 1981. Columbia River Backwater Study Phase II. U.S. Dept of Interior. Fisheries Assistance Office. Vancouver, Washington. 87 pp.

PFMC. 1999. Description and identification of essential fish habitat, adverse impacts and recommended conservation measures for salmon. Appendix A to Amendment 14 to the Pacific Coast Salmon Plan. Pacific Fishery Management Council, Portland, Oregon. March.

Poston, T. 2001. Treated wood issues associated with overwater structures in marine and freshwater environments. Prepared for the Washington Departments of Fish and Wildlife, Ecology, and Transportation. Olympia, Washington.

Relyea. R.A. 2005. The impact of insecticides and herbicides on the biodiversity and productivity of aquatic communities. Ecological Applications. 15:618-627.

Saldi-Caromile, K., K. Bates, P. Skidmore, J. Barenti, D. Pineo. 2004. Stream Habitat Restoration Guidelines: Final Draft. Co-published by the Washington Departments of Fish and Wildlife and Ecology and the U.S. Fish and Wildlife Service. Olympia, Washington.

Sandahl J. F., D. H. Baldwin, J. J. Jenkins and N. L. Scholz. 2004. Odor-Evoked Field Potentials as Indicators of Sublethal Neurotoxicity in Juvenile Coho Salmon (*Oncorhynchus kisutch*) Exposed to Copper, Chlorpyrifos, or Esfenvalerate. Canadian Journal of Fisheries and Aquatic Sciences. 61: 404-413.

Scannell, P.O. 1988. Effects of Elevated Sediment Levels from Placer Mining on Survival and Behavior of Immature Arctic Grayling. Alaska Cooperative Fishery Unit, University of Alaska. Unit Contribution 27.

Scheuerell, M.D., and J.G. Williams. 2005. Forecasting climate-induced changes in the survival of Snake River spring/summer Chinook salmon (*Oncorhynchus tshawytscha*). Fisheries Oceanography 14:448-457.

Scholz N. L., N. K. Truelove, B. L. French, B. A. Berejikian, T. P. Quinn, E. Casillas and T. K. Collier. 2000. Diazinon Disrupts Antipredator and Homing Behaviors in Chinook Salmon (*Oncorhynchus tshawytscha*). Canadian Journal of Fisheries and Aquatic Sciences. 57(9): 1911-1918.

Sedell, J.R. and J. L. Froggatt. 1984. Importance of streamside forests to large rivers: The isolation of the Willamette River, Oregon, USA from its floodplain by snagging and streamside forest removal. *International Vereinigung für Theoretische und Angewandte Limnologie Verhandlungen* 22:1828-1834.

Servizi, J.A., and D.W. Martens. 1991. Effects of temperature, season, and fish size on acute lethality of suspended sediments to coho salmon. Canadian Journal of Fisheries and Aquatic Sciences 49:1389-1395.

Sharpe, C.S., D.A. Thompson, H.L. Blankenship, C.B. Schreck. 1998. Effects of Routine Handling and Tagging Procedures on Physiological Stress Responses in Juvenile Chinook Salmon. The Progressive Fish-Culturist. 60(2):81-87.

Sherwood, C.R., D.A. Jay, R.B. Harvey, P. Hamilton, and C.A. Simenstad. 1990. Historical changes in the Columbia River estuary. Progress in Oceanography 25:299–357.

Spence, B.C., G.A. Lomnicky, R.M. Hughes, and R.P. Novitzki. 1996. An ecosystem approach to salmonid conservation. Report by ManTech Environmental Research Services, Inc., Corvallis, Oregon, to National Marine Fisheries Service, Portland, Oregon.

Teel, D.J, C. Baker, D. R. Kuligowski, T.A. Friesen, and B. Shields 2009. Genetic stock composition of subyearling Chinook salmon in seasonal floodplain wetlands of the Lower Willamette River, Oregon. Transactions of the American Fisheries Society 138:1, 211-217.

UCSRB (Upper Columbia Salmon Recovery Board). 2007. Upper Columbia spring Chinook salmon and steelhead recovery plan. Available: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Upper-Columbia/upload/UC_Plan.pdf

URS. 2010. Phase I Environmental Site Assessment for Alder Creek Mill Site. Prepared for Portland Harbor Holdings II, LLC. April 2011. Portland, Oregon.

URS. 2011. Phase II Environmental Site Assessment for Alder Creek Mill Site. Prepared for Portland Harbor Holdings II, LLC. April 2011. Portland, Oregon.

USACE (U.S. Army Corps of Engineers). 1997. Letter and Revised Biological Assessment, from W.B. Paynter, to Ms. Elizabeth Holmes Gaar, for the Use of Treated Wood in the Columbia River.

USACE, U.S. Environmental Protection Agency, Washington Department of Ecology, Washington Department of Natural Resources, Oregon Department of Environmental Quality, Idaho Department of Environmental Quality, National Marine Fisheries Service, and U.S. Fish and Wildlife Service. 2009. Sediment evaluation framework for the Pacific Northwest.

USGCRP (U.S. Global Change Research Program). 2009. Global Climate Change Impacts in the United States. Cambridge University Press, New York.

USGS (U.S. Geological Survey). 2001. Evaluation of Acoustic Telemetry and Positioning Systems to Monitor Movements of Sturgeon at Three Tree Point. Western Fisheries Research Center, Cook, Washington.

Vines C. A., T. Robbins, F. J. Griffin and G. N. Cherr. 2000. The Effects of Diffusible Creosote Derived Compounds on Development in Pacific Herring (*Clupea pallasi*). Aquatic Toxicology. 51: 225-239.

Wainwright, T.C., M.C. Chilcote, P.W. Lawson, T.E. Nickelson, C.W. Huntington, J.S. Mills, K.M.S. Moore, G.H. Reeves, H.A. Stout, and L.A. Weitkamp. 2008. Biological recovery criteria for the Oregon Coast coho salmon evolutionarily significant unit.

Ward, D.L., A.A. Nigro, R.A. Farr, and C.J. Knutsen. 1994. Influence of Waterway Development on Migrational Characteristics of Juvenile Salmonids in the Lower Willamette River, Oregon. North American Journal of Fisheries Management 14:362-371.

Warner J. E. and K. R. Solomon. 1990. Acidity as a Factor in Leaching of Copper, Chromium, and Arsenic from Cca-Treated Dimension Lumber. Environmental Toxicology and Chemistry. 9(1331-1337).

WDFW (Washington Department of Fish and Wildlife), U.S. Fish and Wildlife Service, and Washington Department of Ecology. 2004. Stream habitat restoration guidelines, available from the Washington Department of Fish and Wildlife, Washington Department of Fish and Wildlife, Habitat Technical Assistance, Olympia, Washington.

Weis J. S., G. Smith, T. Zhou, C. Santiago-Bass and P. Weis. 2001. Effects of Contaminants on Behavior: Biochemical Mechanisms and Ecological Consequences. Bioscience. 51(3): 209-217.

Wentz, D.A., B. A. Bonn, K. D. Carpenter, S. R. Hinkle, M. L. Janet, F. A. Rinella, M. A. Uhrich, I. R. Waite, A. Laenen, and K. E. Bencala. 1998. Water Quality in the Willamette Basin, Oregon, 1991-95: U.S. Geological Survey Circular 116, online at http://water.usgs.gov/pubs/circ1161, updated June 25, 1998

Zabel, R.W., M.D. Scheuerell, M.M. McClure, and J.G. Williams. 2006. The interplay between climate variability and density dependence in the population viability of Chinook salmon. Conservation Biology 20:190-200.