U.S. FISH AND WILDLIFE SERVICE PROGRAMMATIC BIOLOGICAL OPINION

for

Bonneville Power Administration's Columbia River Basin Habitat Improvement Program (HIP III)

Action Agency: Bonneville Power Administration

Consultation Conducted by: U.S. Fish and Wildlife Service, Oregon Fish and Wildlife Office

Date Issued: November 8, 2013

Issued by: Rollie White

Acting for Paul Henson, Ph.D.
State Supervisor

Refer to: 2013-F-0199
Tails no.: 01EOFW00-2013-F-0199

Suggested Citation:

U.S. Fish and Wildlife Service. 2013. Formal section 7 programmatic consultation on BPA's Columbia River Basin Habitat Improvement Program. Oregon Fish and Wildlife Office, Portland, Oregon. TAILS no. 01EOFW00-2013-F-0199.

Table of Contents

Table of Tables

Table of Figures

1.0 Introduction

The Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), as amended, establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to insure, in consultation with the U.S. Fish and Wildlife Service (FWS or Service) and the National Marine Fisheries Service (NMFS), as appropriate, that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitats. Section 7(a)(4) of the ESA requires Federal agencies to confer with USFWS and NMFS (the Services), as appropriate, in cases where the agency or the Services have determined that a proposed or ongoing Federal action is likely to jeopardize the continued existence of species proposed to be listed under section 4 of the ESA or result in the destruction or adverse modification of critical habitat proposed to be designated for such species.

We encourage Federal agencies to conference on actions that may affect a proposed species or proposed critical habitat. In such cases, conference concurrence determinations or conference opinions can be adopted as formal concurrences or biological opinions, respectively, after a proposed species is listed or the critical habitat is designated. Such an approach can avoid disruption of project implementation due to the need to initiate and complete formal consultation at the time of listing or designation. It also facilitates or promotes action agency consideration of the conservation needs of proposed species and the recovery function of proposed critical habitat.

This document transmits the USFWS's biological opinion (BO) based on an interagency consultation on Bonneville Power Administration's Columbia Basin Habitat Improvement Program (HIP) pursuant to sections 7(a)(2) and 7(a)(4) of the ESA and its implementing regulations found in the Code of Federal Regulations (CFR) at 50 Part 402. BPA's HIP program consists of aquatic and wildlife habitat restoration projects designed and implemented to restore or enhance stream and riparian function as well as upland wildlife habitat. These projects will improve channel dimensions and stability, sediment transport and deposition, riparian, wetland, and floodplain function, hydrologic function, as well as water quality. Furthermore, such improvements will help address limiting factors related to spawning, rearing, migration, and more for ESA listed and other native fish and wildlife species. BPA's biological assessment (BA) was received at the Service's Pacific Region Office on July 27, 2012. An amended BA was provided to the Service's Oregon Fish and Wildlife Office on August 26, 2013. The initial BA addressed effects of the proposed action on the federally threatened bull trout (*Salvelinus confluentus*), and threatened Oregon chub (*Oregonichthys crameri*), as well as federally listed anadromous salmon and steelhead under the jurisdiction of the NMFS.

Upon review of the initial BA by the Service's Oregon Fish and Wildlife Office, a recommendation was made to BPA to include federally listed and proposed wildlife and plant species in the consultation. BPA agreed to the request and the Service offered to help develop project design criteria and conservation measures for wildlife and plants to minimize the proposed action's effects. It was agreed that once complete, BPA would send a revised proposed action, by way of a BA amendment, to the Service. BPA and the Service met numerous times in the fall of 2012 and winter and spring 2013 to discuss the amendment and other aspects of the consultation such as widening the action area to include western Montana. A final BA amendment from BPA was received by the Service on August 26, 2013. The amendment requested concurrence from the Service with BPA's determination that the proposed action "may affect, but is not likely to adversely affect", a suite of listed and proposed wildlife and plant species and aquatic invertebrates. In addition to bull trout and Oregon chub, the amendment requested formal consultation on marbled murrelet (*Brachyramphus marmoratus*) and its designated critical habitat. A draft BO was subsequently provided to BPA on September 20, 2013. BPA provided comments on the draft BO back to the Service on October 21, 2013.

This document includes our concurrence on BPA's determination that the proposed action may affect, but is "not likely to adversely affect", a suite of other federally listed and proposed species and their respective critical habitats (discussed in the Concurrences section below). This BO is based on information provided in BPA's July 2012 BA and August 2013 BA Amendment, published literature and other sources of information. A complete decision record for this consultation is on file at the Service's Oregon Fish and Wildlife Office in Portland, Oregon.

Time Frame of Proposed Action

Although BPA's proposed actions under their HIP I and HIP II consultations with NMFS were for a set period of 5 years each, with the HIP III proposed action, BPA is proposing their action indefinitely. The Service and NMFS agreed to this proposal with the caveat that any new listings of species or critical habitat within the action area will be cause for reinitiation.

1.1 Background

In 1980, Congress passed the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Public Law 96-501), which authorized the creation of the Northwest Power Planning Council (now called the Northwest Power and Conservation Council, NPCC) with representatives appointed by the states of Idaho, Montana, Oregon, and Washington. The Act directed the NPCC to prepare a program to "protect, mitigate and enhance fish and wildlife, including related spawning grounds and habitat, on the Columbia River and its tributaries … affected by the development, operation, and management of hydroelectric projects while assuring the Pacific Northwest an adequate, efficient, economical and reliable power supply." BPA's authority and responsibility to fund fish and wildlife habitat improvement actions derive in large part from this law. The NWPCC's Columbia River Basin Fish and Wildlife Program (the Fish and Wildlife Program) (NWPPC 2000) is the largest regional effort in the nation to recover, rebuild, and mitigate fish, wildlife and associated habitats.

In addition to the projects identified through the NWPCC's Fish and Wildlife Program, BPA funds other fish and wildlife habitat projects that may be covered under the HIP III consultation. With the listing of a number of anadromous fish species under the ESA in the late 1990s, BPA, the U.S. Army Corps of Engineers (USACE), and U.S. Bureau of Reclamation (BOR) (together the "Action Agencies") began a series of consultations with the Services on the operation and maintenance of the Federal Columbia River Hydropower System (FCRPS). The latest of these is the 2008 FCRPS consultation, a multi-species biological opinion that addresses the aggregate effects of continued operation and maintenance of the Columbia and Snake River hydropower system by the Action Agencies on the tributaries, mainstem, and estuary and plume, on ESA-listed species (NMFS 2008). Since 1978, BPA has committed nearly $12.5 billion to support Northwest fish and wildlife recovery.

BPA's operations are governed by several statutes, including the Northwest Power Act. Among other things, this Act directs BPA to protect, mitigate, and enhance fish and wildlife affected by the development and operation of the FCRPS. To assist in accomplishing this, the Act requires BPA to fund fish and wildlife protection, mitigation, and enhancement actions consistent with the Northwest Power and Conservation Council's (NPCC's) Fish and Wildlife Program. Under this program, the NPCC makes recommendations to BPA concerning which fish and wildlife projects to fund. It is important to note that we are consulting on a set of actions that BPA routinely funds through that programunder the authorities of the Northwest Power Act.

BPA funds the implementation of about 500 habitat restoration projects a year through the HIP. The projects include repairing and improving fish spawning and rearing habitat, studying fish diseases, resident fish mitigation, providing fish passage, and protecting and improving wildlife habitat. Certain fish and wildlife habitat improvement projects funded by BPA are the focus of this consultation. BPA funds these projects in fulfillment of its obligations under two auspices: The NPCC's Columbia River Basin Fish and Wildlife Program, and the various Biological Opinions issued to BPA.

Since BPA is one of the Action Agencies involved in the 2008 FCRPS BO, the estuary and tributary habitat improvement actions proposed under the HIP III consultation include many of the habitat actions developed to implement the 2010/2008 FCRPS BO. The goals, objectives, scientific foundation and actions of the Fish and Wildlife Program are structured in a "framework," an organizational concept for fish and wildlife mitigation and recovery efforts, that brings together ESA requirements for recovering listed species, the broader requirements of the Northwest Power Act, and the policies of the states and Indian Tribes of the Columbia River Basin into a comprehensive program that has a solid scientific foundation. Fish and wildlife projects are recommended to BPA by the NPCC through a process that includes review by an independent scientific review panel, regional fish and wildlife agencies, Indian Tribes, and BPA. The majority of actions are to be covered under the FCRPS BO, as well as the habitat actions being implemented for the NPCC's Fish and Wildlife Program. While the 2008 FCRPS Opinion is currently under remand to the District Court, the Action Agencies are continuing to implement the updated proposed actions. To the extent additional habitat improvement actions are committed to in the remand process for the 2008 FCRPS Opinion, most are expected to be covered by the HIP III consultations and resulting opinions from the USFWS and NMFS.

1.2 Consultation History

After issuance of the FCRPS 2000 BO, a number of Reasonable and Prudent Alternatives (RPAs) were implemented to improve habitat conditions towards salmon survival and recovery. While the proposed habitat improvement projects are, in the long term, beneficial to many listed species, some actions produce short-term adverse effects and required further ESA consultation. Many of the proposed activities are minor in nature and their effects are similar. Because of new ESA listings and the large number of habitat improvement projects being implemented under the Fish and Wildlife Program, BPA engaged the Services for programmatic coverage on habitat improvement activities beginning in 1999.

On August 1, 2003, NMFS issued a programmatic opinion and essential fish habitat (EFH) consultation (NMFS No. 2003/00750) for the BPA's HIP I. This program is carried out according to the BPA's authority under the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Public Law 96-501) throughout the Columbia River basin to mitigate for the effects of the FCRPS on fish, wildlife, and their habitat.

On June 21, 2007, the BPA submitted a new BA to NMFS and re-initiated formal consultation for the Habitat Improvement Program. A second BO (HIP II BO) was signed on January 10, 2008, to cover calendar years 2008-2012. As shown in more detail in the next section, BPA has continued to increase the numbers of projects using the HIP II BO during the time the programmatic has been in place.

Beginning in 2010, BPA created a quality control process to review all HIP documents prior to submission to NMFS to improve consistency, and thus more detailed implementation information is available from 2010 forward. Under HIP II, 753 project activities were funded and implemented (again, one project may involve more than one activity category). Of these, 263 were vegetation management projects, with a total of 23,887 acres treated with herbicides (primarily eastern Oregon, eastern Washington, and Idaho); of these, 3,186 acres were within riparian areas. Other common activities, in descending order of frequency, were installing habitat-forming natural materials and instream structures; fish passage (maintain facilities and improve passage); and replacement of bridges, culverts, and fords. Table 1 provides information on the total number of projects that were covered under HIP II by activity category and subcategory.

Table 1. Total number of projects that were covered under NMFS' HIP II BO by activity category and subcategory, from 2008 through April 30, 2012.

Category	Subcategory
Surveying, Construction, Operation, and Maintenance Activities (136)	
Planning and Habitat Protection Actions (78)	
	Survey Stream Channels, Floodplains, and Uplands; Install Stream Monitoring
	Devices such as Steamflow and Temperature Monitors (57)
	Acquire Fee-Title Easement, Enter Cooperative Agreements, Lease Land, and/or Water (6)
	Protect Streambanks Using Bioengineering Methods (15)
Small-Scale Instream Habitat Actions (110)	
	Install Habitat-Forming Natural Materials Instream Structures (43)
	Improve Secondary Channel Habitats (17)
	Create Rehabilitate, and Enhance Riparian and Wetland Habitat (16)
	Improve Fish Passage (34)
	Supplement In-Channel Nutrients (0)
Livestock Impact Reduction (55)	
	Construct Fencing for Grazing Control (29)
	Install Off-Channel Watering Facilities (22)
	Harden Fords for Livestock Crossing of Streams (4)
Control of Soil Erosion from Upland Farming (28)	
	Create Upland Conservation Buffers (2)
	Implement Conservation Cropping Systems (0)
	Stabilize Soils via Planting and Seeding (16)
	Implement Erosion Control Practices (10)
Irrigation and Water Delivery/Management Actions (35)	
	Convert Delivery System to Drip or Sprinkler Irrigation (1)
	Convert Water Conveyance from Open Ditch to Pipeline, Line Leaking Ditches and Canals (8)
	Convert from Instream Diversions to Groundwater Wells for Primary Water Sources (5)
	Install or Upgrade/Maintain Existing Fish Screens (8)
	Consolidate Diversions, Replace Irrigation Diversion with Pump Station, Remove Diversion(9)
	Install or Replace Return Flow Cooling Systems (1)
	Install Irrigation Water Siphon Beneath Waterway (2)
Native Plant Community Establishment and Protection (321)	
	Plant Vegetation (58)
	Manage Vegetation Using Physical Controls (43)
	Manage Vegetation Using Herbicides (220)
Road Actions (45)	
	Maintain Roads (13)
	Maintain, Remove, and Replace Bridges, Culverts, and Fords (27)
	Decommission Roads (5)
Special Actions (2)	
	Install/Develop Wildlife Structures (2)

In September of 2011, BPA contacted both NMFS and USFWS to discuss programmatic consultation on their HIP program. After numerous telephone conversations, e-mail exchanges, and meetings to clarify the scope and implementation of the HIP III consultation, BPA decided to move forward with a joint BA that would address aquatic species under both USFWS and NMFS jurisdiction. During this initiation of consultation, BPA, NMFS, and USFWS staff met numerous times to discuss issues and refine the activity descriptions and conservation measures. While BPA is consulting with NMFS for the third time on the HIP program, the consultation between BPA and the USFWS represents the first programmatic consultation between the two agencies on the HIP program.

On July 27, 2012, the Service received a final BA and request for consultation from BPA. In the months following receipt of the BA, the Service determined that the proposed action could potentially impact a number of federally listed and proposed terrestrial species. Consequently, we requested BPA consider amending the HIP III BA to include terrestrial species to which they agreed, with the caveat that the Service would provide assistance. In addition, BPA requested via email to the Service on 10/15/2012, that the action area be widened to include western Montana (the action area previously included just Oregon, Washington and Idaho). We received a BA amendment from BPA on August 26, 2013, that clarified the action area and addressed potential effects to terrestrial species. We consider the August 26, 2013 date as the date that a complete package was received for initiating formal consultation with the Service on the HIP III proposed action.

On September 20, 2013, the Service submitted a draft final BO to BPA. BPA's comments on the draft BO were received by the Service on October 21, 2013, and a final BO was signed by the Service on November 8, 2013.

1.3 Concurrences on other Listed and Proposed Species

As noted above, BPA's original BA did not consider effects to federally listed and proposed terrestrial species and several aquatic invertebrates that could potentially be impacted by the aquatic restoration actions contained in the HIP III proposed action. Based on examination of projects previously implemented under BPA's HIP I and HIP II program, the Service determined the vast majority of actions proposed under the HIP III program would likely have insignificant or discountable affects to these species and associated critical habitat, particularly if general and species-specific conservation measures (CMs) were followed to avoid or reduce the likelihood of adverse effects to these species. BPA subsequently agreed to amend their BA to include these species (Table 2 below) and the Service agreed to draft general and species-specific CMs that BPA would adopt as part of their proposed action through an amended BA.

Both agencies agreed that the measures would be developed such that if adhered to by BPA and their project proponents, would allow BPA to reach a Not Likely to Adversely Affect (NLAA) determination for each of the potentially affected terrestrial and aquatic invertebrate species and any associated critical habitat. It was further agreed that if a restoration project implemented under the HIP program could not adhere to the general and species-specific CMs, thus avoiding adverse effects, then the project would need to be modified to comply with the CMs, or a variance would need to be requested from the Service, or the project would need to undergo individual section 7 consultation. Furthermore, if species currently proposed are listed during the time period this consultation is in effect, and the listing is finalized without any substantive changes, then this document will also represent the Service's concurrence on the "may affect, not likely to adversely affect" determinations for the proposed action because the effects of the action are insignificant and discountable or wholly beneficial. No further section 7 consultation for these species would be necessary.

We considered BPA's request for our concurrence that the HIP III proposed action may affect, but is not likely to adversely affect the listed species shown in Table 2. We agree that with implementation of the general and species-specific CMs described in Appendix D to this document, effects to these species are extremely unlikely to occur, and are therefore insignificant or discountable. Thus we concur with your determination of effects on listed and proposed species (Table 2) from specific activities described as part of the HIP III proposed action.

Our concurrences are based on the following summarized information available to the Service and presented in BPA's final BA and August 2013 BA Amendment:

- The goals of BPA's HIP III program addressed in the programmatic BA is to restore native habitats to benefit native fish, wildlife, and plant species, including federally listed species.
- By following the General and Activity-Specific CMs identified in the proposed action and the terrestrial and aquatic invertebrate CMs identified in Appendix D of this document, short-term impacts to habitats, including designated and proposed critical habitats, respectively, supporting the federally listed species in Table 1 are limited to those that are insignificant, discountable or wholly beneficial. Adverse effects to these habitats are not anticipated.
- By following the general and species-specific CMs the proposed action is not likely to result in harm or harassment to the federally listed and proposed species identified in Table 2 below.
- No primary constituent elements (PCEs) or constituent/essential biological elements, as appropriate, in designated critical habitat for the species listed in Table 1 will be adversely affected by the proposed action. The General and Activity-Specific CMs and terrestrial and aquatic invertebrate CMs have been designed to substantially minimize or eliminate the amount and severity of potential effects to the physical and biological habitat components represented by PCEs or constituent/essential biological elements for the species.

Table 2. Listed or Proposed Species and Critical Habitat Concurrences

SPECIES/CRITICAL HABITAT & STATUS			STATE				Categories of Action							
SPECIES	ESA Status	Critical Habitat	ID	MT	OR	WA	Fish Passage Restoration	River, Stream, Floodplain, and Wetland Restoration	Invasive and Non-native Plant Control	Piling Removal	Road and Trail Erosion Control, Maintenance, and Decommissioning	In-channel Nutrient Enhancement	Irrigation and Water Delivery/Management Actions	Fisheries, Hydrologic, and Geomorphologic Surveys
MAMMALS														
Canada lynx - Contiguous US DPS	T	Y	X	X	X	X	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Columbian White-tailed Deer	E	N			X	X	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Gray wolf	E	N				X	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Grizzly Bear	T	N	X	X		X	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
North American wolverine	PT	N	X	X	X	X	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Northern Idaho ground squirrel	T	N	X				NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Pygmy rabbit	E	N				X	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Woodland caribou - Selkirk Mtn	E	Y	X			X	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
BIRDS														
Northern spotted owl	T	Y			X	X	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Short-tailed albatross	E	N			X	X	NE	NE	NE	NE	NE	NE	NE	NE
Streaked horned lark	T	Y			X	X	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Western snowy plover	T	Y			X	X	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
INVERTEBRATES														
Banbury Springs limpet	E	N	X				NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Bliss Rapids snail	T	N	X				NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Bruneau Hot springsnail	E	N	X				NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Snake River Physa snail	E	N	X				NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Fender's blue butterfly	E	N			X		NE	NLAA	NLAA	NE	NLAA	NE	NE	NE

SPECIES/CRITICAL HABITAT & STATUS			STATE				Categories of Action							
SPECIES	ESA Status	Critical Habitat	ID	MT	OR	WA	Fish Passage Restoration	River, Stream, Floodplain, and Wetland Restoration	Invasive and Non-native Plant Control	Piling Removal	Road and Trail Erosion Control, Maintenance, and Decommissioning	In-channel Nutrient Enhancement	Irrigation and Water Delivery/Management Actions	Fisheries, Hydrologic, and Geomorphologic Surveys
Oregon silverspot butterfly	T	N			X	X	NE	NLAA	NLAA	NE	NLAA	NE	NE	NE
Taylor's checkerspot butterfly	E	Y			X		NE	NLAA	NLAA	NE	NLAA	NE	NE	NE
PLANTS														
Bradshaw's lomatium	E	N			X	X	NE	NLAA	NLAA	NE	NLAA	NE	NE	NE
Cook's lomatium	E	Y			X		NE	NE	NLAA	NE	NLAA	NE	NE	NE
Gentner's fritillary	E	N			X		NE	NE	NLAA	NE	NLAA	NE	NE	NE
Golden paintbrush	T	N			X	X	NE	NE	NLAA	NE	NLAA	NE	NE	NE
Howell's spectacular thelypody	T	N			X		NE	NE	NLAA	NE	NLAA	NE	NE	NE
Kincaid's lupine	T	Y			X	X	NE	NE	NLAA	NE	NLAA	NE	NE	NE
Large-flowered wooly meadowfoam	E	Y			X		NE	NE	NLAA	NE	NLAA	NE	NE	NE
Malheur wire-lettuce	E	Y			X		NE	NE	NLAA	NE	NLAA	NE	NE	NE
McFarlane's four o'clock	T	N	X		X		NE	NE	NLAA	NE	NLAA	NE	NE	NE
Nelson's checkermallow	T	N			X	X	NE	NLAA	NLAA	NE	NLAA	NE	NE	NE
Rough popcorn flower	E	N			X		NE	NE	NLAA	NE	NLAA	NE	NE	NE
Showy stickseed	E	N				X	NE	NE	NLAA	NE	NLAA	NE	NE	NE
Slickspot peppergrass	PT	P	X				NE	NE	NLAA	NE	NLAA	NE	NE	NE
Spalding's catchfly	T	N	X	X	X	X	NE	NE	NLAA	NE	NLAA	NE	NE	NE
Umtanum Desert buckwheat	PT	Y				X	NE	NE	NLAA	NE	NLAA	NE	NE	NE
Ute ladies' tresses	T	N	X	X		X	NE	NLAA	NLAA	NE	NLAA	NE	NE	NE
Water howellia	T	N	X	X	X	X	NE	NLAA	NLAA	NE	NLAA	NE	NE	NE

SPECIES/CRITICAL HABITAT & STATUS			STATE				Categories of Action							
SPECIES	ESA Status	Critical Habitat	ID	MT	OR	WA	Fish Passage Restoration	River, Stream, Floodplain, and Wetland Restoration	Invasive and Non-native Plant Control	Piling Removal	Road and Trail Erosion Control, Maintenance, and Decommissioning	In-channel Nutrient Enhancement	Irrigation and Water Delivery/Management Actions	Fisheries, Hydrologic, and Geomorphologic Surveys
Wenatchee Mtn checkermallow	E	Y				X	NE	NE	NLAA	NE	NLAA	NE	NE	NE
Western lily	E	N			X		NE	NLAA	NLAA	NE	NLAA	NE	NE	NE
Willamette daisy	E	Y			X		NE	NLAA	NLAA	NE	NLAA	NE	NE	NE
White Bluffs bladderpod	PT	Y				X	NE	NE	NLAA	NE	NLAA	NE	NE	NE

Although Oregon spotted frog (*Rana pretiosa*) and associated critical habitat were proposed for listing in the Federal Register on August 29, 2013, we are choosing to not conference on this species in this consultation due to the fact that limited conservation measures and project design criteria have been developed for this species that would be relevant to the restoration actions included in BPA's proposed action. We anticipate developing conservation measures over the next year that could be applied to restoration projects when and if the species is listed. If a federal listing is announced, the Service will coordinate with BPA on review of spotted frog distribution relative to the HIP III action area and on an assessment of likely effects from HIP III implementation. If implementation of conservation measures and project design criteria (to be developed) can ensure insignificant or discountable effects to Oregon spotted frog, then we will amend our BO accordingly to include this species in the concurrence section. If we determine implementation of HIP III will likely have adverse affects on Oregon spotted frog, we will reinitiate consultation and amend our BO to include Oregon spotted frog. In the interim period between now and a listing determination, please consider reviewing the proposed critical habitat unit maps on our website: http://www.fws.gov/wafwo/osf.html

The proposed critical habitat maps respresent the best available information on the distribution of this species in Oregon and Washington. There are 14 critical habitat unit maps, 8 of which document occurrence within the HIP III action area. These include Units 5 and 6 in Washington (Kickatat and White Salmon river basins), and in Oregon, Unit 7 (L. Deschutes), Units 8A and 8B (Upper Deschutes), Unit 9 (Little Deschutes), Unit 10 (McKenzie), and Unit 11 (Middle Fork Willamette). If a HIP III action is planned within an area of spotted frog occupancy based on the maps referenced above, we recommend contacting Jennifer O'Reilly (Oregon) at (541) 541-312-7146 or Deanna Lynch (Washington) at (360) 753-9545 to discuss possible conservation measures.

2.0 Biological Opinion

This Biological Opinion (BO) presents the results of our consultation with BPA on the HIP III proposed action. For the jeopardy analyses, the Service reviewed the status of bull trout, Oregon chub, and marbled murrelet, the environmental baseline in the action area, the effects of the action, and cumulative effects (50 CFR 402.14(g)).

For the critical habitat destruction or adverse modification analysis, the Service considered the status of critical habitat, the functional condition of critical habitat in the action area (environmental baseline), the likely effects of the action on that level of function, and the cumulative effects. From this assessment, the Service discerned whether any predicted change in the function of the constituent elements of critical habitat in the action area would be enough, in view of existing risks, to appreciably reduce the conservation value of the critical habitat at the designation scale. This analysis does not employ the regulatory definition of "destruction or adverse modification" at 50 CFR 402.02. Instead, this analysis relies on statutory provisions of the ESA, including those in section 3 that define "critical habitat" and "conservation," in section 4 that describe the designation process, and in section 7 that set forth the substantive protections and procedural aspects of consultation, and on agency guidance for application of the "destruction or adverse modification" standard (Hogarth 2005).

2.1 Summary of Changes from the Previous HIP II Consultation with NMFS

The HIP III proposed action is a reorganization and expansion of the original HIP II activity categories. By using existing BOs on similar restoration-based programmatic actions, BPA has taken advantage of existing successful approaches to promote regional consistency in design criteria for similar project types. The documents used include: USFWS Partners for Fish and Wildlife, U.S. Forest Service (USFS) and Bureau of Land Management (BLM) Aquatic Restoration BO (ARBO I and ARBO II BA), NOAA Restoration Center's BO, USACE Standard Local Operating Procedures for Endangered Species (SLOPES IV) (Restoration and Transportation) (in Oregon), USACE Washington State Fish Passage and Habitat Enhancement Restoration Programmatic consultation, and NMFS' HIP I and HIP II BOs. Using project design criteria, conservation measures, and language from these existing programs, BPA has added activities that are new to the HIP such as piling removal, low flow consolidation, headcut and grade stabilization, boulder structures, engineered logjams, and channel reconstruction. BPA also widened the action area for HIP III beyond the Columbia River Basin in Oregon, Washington and Idaho to include western Montana and Oregon coastal river basins from the Columbia River south to Cape Blanco in southwestern Oregon, to reflect anticipated HIP expenditures in these geographic areas.

With HIP III, BPA has proposed to form an internal restoration review team (RRT) of technical experts who shall provide a design review of each moderate to high-risk project in accordance with design complexity and significance. This is a new internal quality assurance/quality control (QA/QC) process at BPA, the role of which is to define high, medium, and low risk project types, and then provide additional review on medium and higher risk projects. This process is described in detail in Appendix C of this BO. The RRT structure will include a Team leader, Core Team members, technical Team members, and representatives from NMFS and USFWS. The RRT will evaluate projects to (a) ensure consistency among projects, (b) maximize ecological benefits of restoration and recovery projects, and (c) ensure consistent use and implementation throughout the geographic area covered by the USFWS and NMFS BOs.

3.0 Description of the Proposed Action

Aquatic and wildlife habitat restoration projects are generally designed and implemented to restore or enhance stream and riparian area function and fish habitat. The projects included under this programmatic consultation will improve channel dimensions and stability, sediment transport and deposition, riparian, wetland, and floodplain functions, hydrologic function, as well as water quality. Furthermore, such improvements will help address limiting factors related to spawning, rearing, migration, and more for ESA-listed and other native fish species.

3.1 Categories of Actions

The following nine categories of actions that are anticipated to receive funding by BPA are described in more detail later in this BO. As previously noted, the aquatic and wildlife restoration activity categories listed below represent the integration, consolidation and expansion of prior restoration programmatic consultations in the Pacific Northwest to take advantage of successful approaches and to promote regional consistency in design criteria for similar project types.

1. **Fish Passage Restoration.**
   Profile Discontinuities.
   a. Dams, Water Control or Legacy Structure Removal.
   b. Consolidate, or Replace Existing Irrigation Diversions.
   c. Headcut and Grade Stabilization.
   d. Low Flow Consolidation.
   e. Providing Fish Passage at an Existing Facility.
   Transportation Infrastructure.
   f. Bridge and Culvert Removal or Replacement.
   g. Bridge and Culvert Maintenance.
   h. Installation of Fords.
2. **River, Stream, Floodplain, and Wetland Restoration.**
   a. Improve Secondary Channel and Wetland Habitats.
   b. Set-back or Removal of Existing, Berms, Dikes, and Levees.
   c. Protect Streambanks Using Bioengineering Methods.
   d. Install Habitat-Forming Natural Material Instream Structures (Large Wood, Boulders, and Spawning Gravel).
   e. Riparian Vegetation Planting.
   f. Channel Reconstruction.
3. **Invasive and Non-Native Plant Control.**
   a. Manage Vegetation using Physical Controls.

    b. Manage Vegetation using Herbicides.

4. **Piling Removal.**
5. **Road and Trail Erosion Control, Maintenance, and Decommissioning.**
    a. Maintain Roads.
    b. Decommission Roads.
6. **In-channel Nutrient Enhancement.**
7. **Irrigation and Water Delivery/Management Actions.**
    a. Convert Delivery System to Drip or Sprinkler Irrigation.
    b. Convert Water Conveyance from Open Ditch to Pipeline or Line Leaking Ditches or Canals.
    c. Convert from Instream Diversions to Groundwater Wells for Primary Water Sources.
    d. Install or Replace Return Flow Cooling Systems.
    e. Install Irrigation Water Siphon Beneath Waterway.
    f. Livestock Watering Facilities.
    g. Install New or Upgrade/Maintain Existing Fish Screens.
8. **Fisheries, Hydrologic, and Geomorphologic Surveys.**
9. **Special Actions (for Terrestrial Species).**
    a. Install/develop Wildlife Structures.
    b. Fencing construction for Livestock Controll
    c. Implement Erosion Control Practices.
    d. Plant Vegetation.
    e. Tree Removal for LW Projects.

3.2 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area for this consultation is the Columbia River Basin within the contiguous United States excluding the portion of Nevada that is in the Columbia Basin (Figure 1). At the request of the NMFS, the action area also includes Oregon coastal river basins from Cape Blanco in the south to the Columbia River in the north.

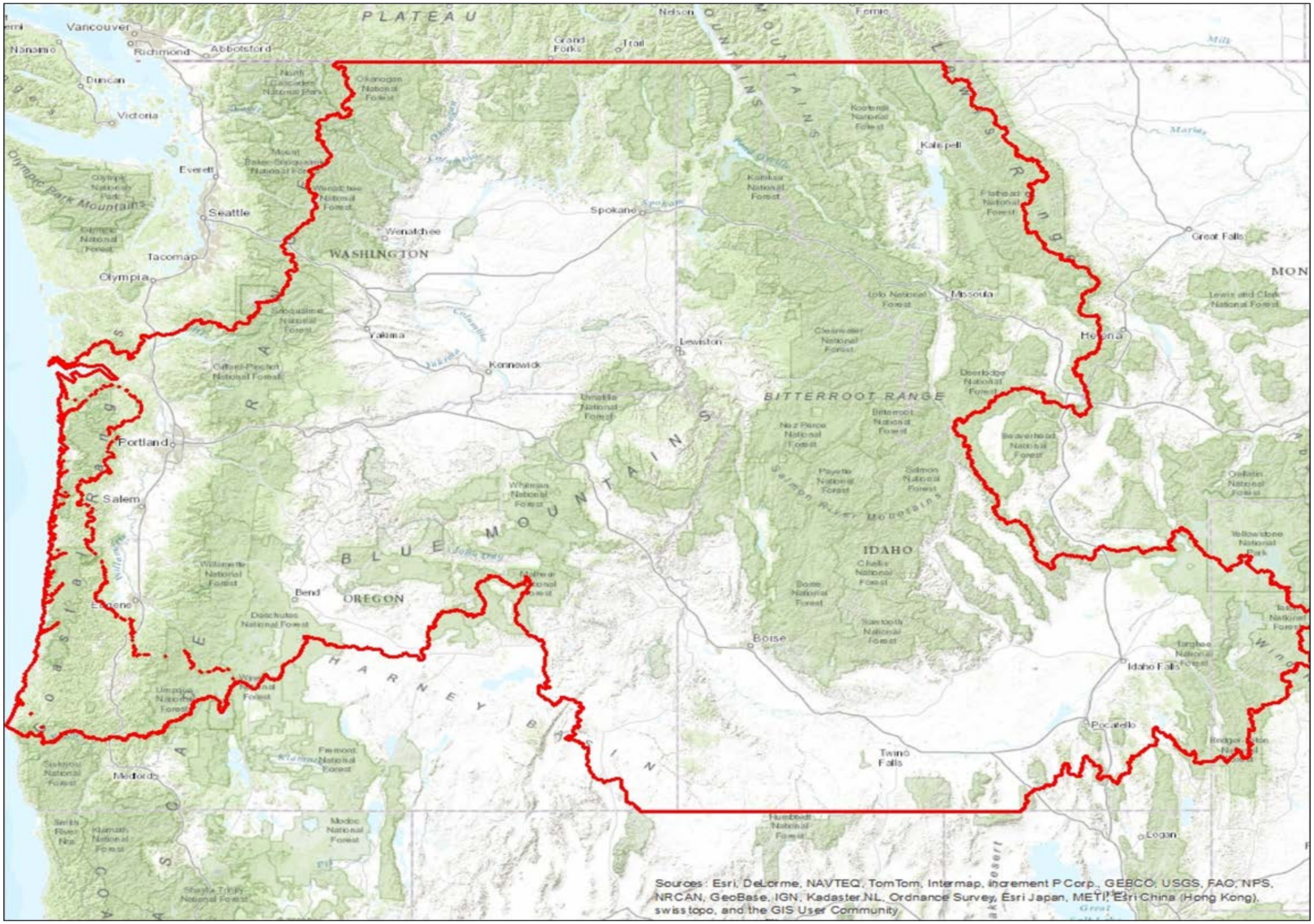

Figure 1. BPA's HIP III Action Area

3.3 Program Administration

3.3.1 Project Review and Notification

To ensure ESA Section 7 compliance under the HIP III consultation for each site-specific action, BPA environmental compliance (EC) staff will individually review each action through information submitted by the project sponsor. For HIP funded projects occurring on U.S. Forest Service (USFS) and Bureau of Land Management (BLM) lands in Oregon and Washington, the Aquatic Restoration Biological Opinions (ARBO II) from FWS and NMFS should be adhered to rather than the HIP III BOs from the Services.

The Corps is a cooperating agency in this consultation between the Service and BPA. The Corps will issue permits under Section 404 of the Clean Water Act (CWA) (33 U.S.C. 1251 et seq) and/or Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C 403) for activity categories described in BPA's proposed action and authorized under this BO (and NMFS' HIP III BO). The Corps has reviewed the BPA's HIP III BA and concurs with the effects analyisis regarding those actions requiring Corps permits and requests that these permit actions be included in the consultation. For HIP funded actions requiring Corps permits, the Corps will review applications to ensure the effects are within the range of those described in this BO. Any Corps permits issued for these activities will include a condition requiring the applicant to comply with all of BPA's conservation measures contained in the proposed action, and any reasonable and prudent measures and implementing terms and conditions resulting from this consultation.

The following describes the process that will be implemented for HIP III. BPA determines which projects it will fund and contracts with the project sponsors (i.e., state fish and wildlife agencies, Indian Tribes, soil and water conservation districts, irrigation districts, and other Federal agencies and non-profit entities) to implement the projects. As part of the contract and statement of work development process, the BPA EC staff will review the individual work elements in the statement of work to determine what, if any, ESA compliance will be needed prior to implementation of the work. If ESA compliance is needed, BPA EC staff will make a preliminary determination of whether the proposed work can be covered under the HIP III programmatic consultations by USFWS and NMFS. If so, the BPA EC staff will notify the project sponsor that they will need to complete a Project Notification/Completion form (Appendix A of this BO). The Project Notification/Completion form (PNC) that will be used for HIP III represents the combining of individual Notification and Completion forms that were utilized in the HIP I and HIP II consultations between NMFS and BPA.

To determine if the project needs Restoration Review Team (RRT) review, BPA EC staff will make a preliminary determination of the level of risk. The risk levels are ***low, medium,*** and ***high*** and shall take into consideration both project impact and stream response potential. If BPA EC staff determines the project is within the ***medium*** to ***high*** risk category, the project shall be submitted to the RRT for review. With the exception of the **Fish Passage Restoration** activity category, most projects that will fulfill all proposed conservation measures will not require RRT review. If RRT review is triggered, then procedures outlined in Appendix C of this BO shall be followed.

BPA will submit a PNC form to USFWS and/or NMFS (together the Services) in addition to the USACE, no later than 30-days before beginning in-water work on any action that will be funded or carried out under this programmatic BO. If the BPA EC staff is satisfied that the project can and will be implemented according to the HIP III proposed action and subsequent requirements in BOs from USFWS and NMFS, and BPA decides to move forward with project funding for implementation, the BPA EC staff will approve the project using internal procedural guidelines outlined in the HIP III BA (and Appendix A of this BO). After that is completed the project may proceed without further consultation with the Services. If, however, BPA or the project sponsor determines the project cannot be implemented according to the Services HIP III BOs, then one of the following must occur: 1) changes must be made to the project design so that it *can* be implemented according to the HIP III BOs; or, 2) a variance must be requested and approved by the FWS and/or NMFS; or, 3) BPA and the project sponsor must initiate individual (non-programmatic) Section 7 consultation with the Services on the identified action.

3.3.2 Variance Requests

Because of the wide range of activities that could be proposed within the categories included in BPAs HIP III proposed action, and the natural variability within and between watersheds, some projects may require minor variations from the measures specified herein (either from the general conservation measures applicable to all actions, or conservation measures specific to any of the eight action categories). Minor variances will be sought, as needed, from the appropriate NMFS Branch Chief or USFWS Field Office Supervisor (see Appendix B of this document). Minor variance requests will: (a) cite the relevant opinion by identifying number; (b) cite the relevant criterion by page number; (c) define the requested variance; (d) explain why the variance is necessary; and (e) provide a rationale why the variance will either provide a conservation benefit or, at a minimum, not cause additional adverse effects.

The Services will consider granting variances, especially when there is a clear conservation benefit or there are no additional adverse effects (especially incidental take) beyond that considered in the Services BOs. Variance requests can be made on the PNC form, which can then be submitted and approved by the Services via email correspondence.

If at any time there are uncertainties in implementing the proposed action’s conservation measures or interpreting the reasonable and prudent measures and terms and conditions of the HIP III BOs, or doubts about the consistency with the HIP III BOs, the project sponsor, in conjunction with BPA staff, and if necessary the RRT, will coordinate with the Services to address these concerns and resolve any outstanding issues. If the project sponsor or BPA EC staff determines that a proposed action is not consistent with the HIP III BOs, or if the Services do not approve a request for variance, the project sponsor and BPA will initiate individual Section 7 consultation with USFWS and/or NMFS on the identified action.

In addition, if, during completion of a habitat improvement project, BPA or the project sponsor becomes aware of new information or unforeseen circumstances such that the project cannot be completed according to the scope of effects or terms and conditions of the HIP III BOs, BPA will require that the project sponsor stop all project operations, except for efforts to avoid or minimize resource damage, pending completion of individual consultation on the project.

3.3.4 Documentation

1) Name(s), phone number(s), and address(es) of the person(s) responsible for oversight will be posted at the work site;
2) A description of hazardous materials that will be used, including inventory, storage, and handling procedures will be available on-site;
3) Procedures to contain and control a spill of any hazardous material generated, used or stored on-site, including notification of proper authorities, will be readily available on-site;
4) A standing order to cease work in the event of high flows (above those addressed in the design and implementation plans), or exceedance of incidental take or water quality limits, will be posted on-site.

3.3.5 Post-Project Reporting and Monitoring

Each project sponsor will submit a PNC form to BPA within 120 days of project completion. After the BPA environmental compliance lead and quality control staff reviews the form for completeness, the BPA will then submit reports to the Services by email.

In addition, all activities that require a site rehabilitation plan will be monitored annually for a minimum of three years after completion of the activity to ensure that the performance standards of the plan are being met. Documentation of the monitoring and any corrective actions will be maintained by the project sponsor. Information from the reports will be reviewed in an annual meeting between BPA and the Services' staff to determine whether changes need to be made to the HIP III BOs or its procedures.

3.3.6 Annual Program Report

BPA requires project notifications via email for each set of contract actions implemented. Appendix A of the BA describes BPA's internal standard operating procedures for submission and content of those email notifications. Environmental leads on the contract will submit completed forms to a BPA HIP reporting mailbox for QA/QC. The BPA mailbox manager will check the forms before forwarding to USFWS (hip3@fws.gov) and/or NMFS (hip.nwr@noaa.gov) for approval. There is a single standard reporting form: the Project Notification/Completion (PNC) form (which includes fish capture/mortality information). All activities that require a site rehabilitation plan will be monitored annually for a minimum of three years to ensure that the performance standards of the plan are being met. In addition, BPA will host an annual meeting and provide an annual monitoring report to the Services by April 15 each year that describes BPA's efforts to carry out the HIP and compliance with requirements under the Services BOs.

3.3.7 Compliance Requirements

For activities implemented under the HIP III BOs, BPA will include language in its contracts with project sponsors requiring that project sponsors implement all terms and conditions of the HIP III BOs, as well as any other pertinent environmental requirements. The BPA will include each applicable design criterion as a condition of funding for every action funded or carried out under the HIP that may impact a federally listed species or designated critical habitat.

To monitor compliance with the programmatic consultation terms and conditions, BPA will conduct random evaluations of activities authorized under the HIP III BOs. If BPA receives information indicating there may be a problem, BPA may specifically target an individual activity to determine if it is in compliance with the terms and conditions as authorized under the programmatic consultations. If BPA determines that a contractor is in violation of the programmatic consultation terms and conditions or has deviated from the authorization, BPA will notify the contractor and the Services. BPA may enforce this by withdrawing funding from a project if the violations are serious or ongoing.

If a contractor is in violation of the programmatic consultations conditions or has engaged in unauthorized take of a listed species, the Services may implement enforcement actions against the contractor under ESA regulations and procedures.

3.4 General Conservation Measures Applicable to all Actions

The activities covered under this programmatic consultation are intended to protect and restore fish and wildlife habitat with long-term benefits to ESA-listed species. However, project construction may have short-term adverse effects on ESA-listed species and associated critical habitat. To minimize these short-term adverse effects and make them predictable for the purposes of programmatic analysis, the BPA included in their proposed action the following general conservation measures (developed in coordination with USFWS and NMFS) that are applicable to all projects implemented under HIP III:

3.4.1 Project Design and Site Preparation

1) Climate change. Best available science regarding the future effects within the project area of climate change, such as changes in stream flows and water temperatures, will be considered during project design.

2) State and Federal Permits. All applicable regulatory permits and official project authorizations will be obtained before project implementation. These permits and authorizations include, but are not limited to, National Environmental Policy Act, National

Historic Preservation Act, and the appropriate state agency removal and fill permit, USACE Clean Water Act (CWA) 404 permits, and CWA section 401 water quality certifications.

3) Timing of in-water work. Appropriate state (Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), Idaho Department of Fish and Game (IDFG), and Montana Fish Wildlife and Parks (MFWP)) guidelines for timing of in-water work windows (IWW) will be followed.
   a) Oregon chub – if work occurs in occupied habitat, in-water work will not occur between June 1 and August 15.
   b) Bull trout - While utilizing the appropriate State designated in-water work period will lessen the risk to bull trout, this alone may not be sufficient to adequately protect local bull trout populations. This is especially true if work is occurring in spawning and rearing areas because eggs, alevin, and fry are in the substrate or closely associated habitats nearly year round. Some areas may not have designated in-water work windows for bull trout or if they do, they may conflict with work windows for salmon and steelhead. If this is the case, or if proposed work is to occur within bull trout spawning and rearing habitats, project proponents will contact the appropriate USFWS Field Office (see Appendix B in this BO) to insure that all reasonable implementation measures are considered and an appropriate in-water work window is being used to minimize project effects.
   c) Lamprey – the project sponsor and/or their contractors will avoid working in stream or river channels that contain Pacific Lamprey from March 1 to July 1 in low to mid elevation reaches (<5,000 feet). In high elevation reaches (>5,000 feet), the project sponsor will avoid working in stream or river channels from March 1 to August 1. If either timeframe is incompatible with other objectives, the area will be surveyed for nests and lamprey presence, and avoided if possible. If lampreys are known to exist, the project sponsor will utilize dewatering and salvage procedures outlined in US Fish and Wildlife Service (2010)[1].
   d) Exceptions to ODFW, WDFW, MFWP, or IDFG in-water work windows will be requested from NMFS and the FWS. An IWW variance request (pre-coordinated with staff biologists) will be e-mailed from an appropriate representative of the action agency to the NMFS Habitat Branch Chief and the FWS Field Office Supervisor for the project area. Work will not proceed outside of the IWW until the exception is approved by e-mails from NMFS and/or the FWS.

4) Oregon Chub Restrictions. Restoration projects, covered under this Section 7 programmatic consultation, which involve in-water work, will not occur within habitats known to be occupied by Oregon chub or within Oregon chub critical habitat. This information is available in GIS form and is updated annually by the ODFW Native Fish

[1] U.S. Fish and Wildlife Service. 2010. Best management practices to minimize adverse effects to Pacific lamprey. Available online at: http://www.fws.gov/pacific/Fisheries/sphabcon/lamprey/pdf/Best%20Management%20Practices%20for%20Pacific%20Lamprey%20April%202010%20Version.pdf

Program (current point-of-contact is Brian Bangs 541-757-4263, extension 224). Only one in-water work project per year may occur within 2 stream miles upstream of connected off-channel habitat occupied by Oregon chub or its critical habitat. These projects will be evaluated by the Oregon Fish and Wildlife Office in order to design the project to avoid or minimize effects to Oregon chub habitats downstream. If the project is likely to cause more than a 30 percent reduction (e.g. reduced water volume causing desiccation of vegetation used for spawning habitat, sedimentation reducing habitat area, increased flows resulting in habitat becoming unsuitable for chub) in a downstream habitat occupied by Oregon chub or its critical habitat, that project will not be covered by this programmatic section 7 consultation and will require an individual consultation.

At restoration project sites with suitable habitat for Oregon chub (low gradient valley bottom floodplain habitats), pre-project sampling will be conducted by qualified fisheries biologists as early as possible in the planning process to determine whether Oregon chub may be present. If Oregon chub are found at the proposed project site during this sampling, a separate individual Section 7 consultation will be initiated for that project.

It is possible that a previously unknown population of Oregon chub may be captured at a project site during pre-construction in-water work-site isolation. In the event this occurs, the USFWS and ODFW will be contacted immediately in order to recommend additional site-specific conservation measures. Additionally, the following conservation measures will be implemented if Oregon chub are captured during in-water work-site isolation:

a) All live Oregon chub captured shall be released as soon as possible, and as close as possible to the point of capture.
b) If it necessary for Oregon chub to be held, a healthy environment for the stressed fish must be provided, and the holding time must be minimized.

5) Contaminants. The project sponsor will complete a site assessment with the following elements to identify the type, quantity, and extent of any potential contamination for any action that involves excavation of more than 20 cubic yards of material:
   a) A review of available records, such as former site use, building plans, and records of any prior contamination events;
   b) A site visit to inspect the areas used for various industrial processes and the condition of the property;
   c) Interviews with knowledgeable people, such as site owners, operators, and occupants, neighbors, or local government officials; and
   d) A summary, stored with the project file that includes an assessment of the likelihood that contaminants are present at the site, based on items 3(a) through 3(c).

6) Site layout and flagging. Prior to construction, the action area will be clearly flagged to identify the following:
   a) Sensitive resource areas, such as areas below ordinary high water, spawning areas, springs, and wetlands;
   b) Equipment entry and exit points;

c) Road and stream crossing alignments;
d) Staging, storage, and stockpile areas; and
e) No-spray areas and buffers.

7) Temporary access roads and paths.
   a) Existing access roads and paths will be preferentially used whenever reasonable, and the number and length of temporary access roads and paths through riparian areas and floodplains will be minimized to lessen soil disturbance and compaction, and impacts to vegetation.
   b) Temporary access roads and paths will not be built on slopes where grade, soil, or other features suggest a likelihood of excessive erosion or failure. If slopes are steeper than 30%, then the road will be designed by a civil engineer with experience in steep road design.
   c) The removal of riparian vegetation during construction of temporary access roads will be minimized. When temporary vegetation removal is required, vegetation will be cut at ground level (not grubbed).
   d) At project completion, all temporary access roads and paths will be obliterated, and the soil will be stabilized and revegetated. Road and path obliteration refers to the most comprehensive degree of decommissioning and involves decompacting the surface and ditch, pulling the fill material onto the running surface, and reshaping to match the original contour.
   e) Temporary roads and paths in wet areas or areas prone to flooding will be obliterated by the end of the in-water work window.

8) Temporary stream crossings.
   a) Existing stream crossings will be preferentially used whenever reasonable, and the number of temporary stream crossings will be minimized.
   b) Temporary bridges and culverts will be installed to allow for equipment and vehicle crossing over perennial streams during construction.
   c) Equipment and vehicles will cross the stream in the wet only where:
      i. The streambed is bedrock; or
      ii. Mats or off-site logs are placed in the stream and used as a crossing.
   d) Vehicles and machinery will cross streams at right angles to the main channel wherever possible.
   e) The location of the temporary crossing will avoid areas that may increase the risk of channel re-routing or avulsion.
   f) Potential spawning habitat (i.e., pool tailouts) and pools will be avoided to the maximum extent possible.
   g) No stream crossings will occur at active spawning sites, when holding adult listed fish are present, or when eggs or alevins are in the gravel. The appropriate state fish and wildlife agency will be contacted for specific timing information.
   h) After project completion, temporary stream crossings will be obliterated and the stream channel and banks restored.
9) Staging, storage, and stockpile areas.

a) Staging areas (used for construction equipment storage, vehicle storage, fueling, servicing, and hazardous material storage) will be 150 feet or more from any natural water body or wetland, or on an adjacent, established road area in a location and manner that will preclude erosion into or contamination of the stream or floodplain.
b) Natural materials used for implementation of aquatic restoration, such as large wood, gravel, and boulders, may be staged within the 100-year floodplain.
c) Any large wood, topsoil, and native channel material displaced by construction will be stockpiled for use during site restoration at a specifically identified and flagged area.
d) Any material not used in restoration, and not native to the floodplain, will be removed to a location outside of the 100-year floodplain for disposal.

10) Equipment. Mechanized equipment and vehicles will be selected, operated, and maintained in a manner that minimizes adverse effects on the environment (e.g., minimally-sized, low pressure tires; minimal hard-turn paths for tracked vehicles; temporary mats or plates within wet areas or on sensitive soils). All vehicles and other mechanized equipment will be:
a) Stored, fueled, and maintained in a vehicle staging area placed 150 feet or more from any natural water body or wetland or on an adjacent, established road area;
b) Refueled in a vehicle staging area placed 150 feet or more from a natural waterbody or wetland, or in an isolated hard zone, such as a paved parking lot or adjacent, established road (this measure applies only to gas-powered equipment with tanks larger than 5 gallons);
c) Biodegradable lubricants and fluids should be used, if possible, on equipment operating in and adjacent to the stream channel and live water.
d) Inspected daily for fluid leaks before leaving the vehicle staging area for operation within 150 feet of any natural water body or wetland; and
e) Thoroughly cleaned before operation below ordinary high water, and as often as necessary during operation, to remain grease free.

11) Erosion control. Erosion control measures will be prepared and carried out, commensurate in scope with the action, that may include the following:
a) Temporary erosion controls.
    i) Temporary erosion controls will be in place before any significant alteration of the action site and appropriately installed downslope of project activity within the riparian buffer area until site rehabilitation is complete.
    ii) If there is a potential for eroded sediment to enter the stream, sediment barriers will be installed and maintained for the duration of project implementation.
    iii) Temporary erosion control measures may include fiber wattles, silt fences, jute matting, wood fiber mulch and soil binder, or geotextiles and geosynthetic fabric.
    iv) Soil stabilization utilizing wood fiber mulch and tackifier (hydro-applied) may be used to reduce erosion of bare soil if the materials are noxious weed free and nontoxic to aquatic and terrestrial animals, soil microorganisms, and vegetation.
    v) Sediment will be removed from erosion controls once it has reached 1/3 of the exposed height of the control.

vi) Once the site is stabilized after construction, temporary erosion control measures will be removed.

b) Emergency erosion controls. The following materials for emergency erosion control will be available at the work site:
   i) A supply of sediment control materials; and
   ii) An oil-absorbing floating boom whenever surface water is present.

12) Dust abatement. The project sponsor will determine the appropriate dust control measures (if necessary) by considering soil type, equipment usage, prevailing wind direction, and the effects caused by other erosion and sediment control measures. In addition, the following criteria will be followed:
   a) Work will be sequenced and scheduled to reduce exposed bare soil subject to wind erosion.
   b) Dust-abatement additives and stabilization chemicals (typically magnesium chloride, calcium chloride salts, or ligninsulfonate) will not be applied within 25 feet of water or a stream channel and will be applied so as to minimize the likelihood that they will enter streams. Applications of ligninsulfonate will be limited to a maximum rate of 0.5 gallons per square yard of road surface, assuming a 50:50 (ligninsulfonate to water) solution.
   c) Application of dust abatement chemicals will be avoided during or just before wet weather, and at stream crossings or other areas that could result in unfiltered delivery of the dust abatement materials to a waterbody (typically these would be areas within 25 feet of a waterbody or stream channel; distances may be greater where vegetation is sparse or slopes are steep).
   d) Spill containment equipment will be available during application of dust abatement chemicals.
   e) Petroleum-based products will not be used for dust abatement.

13) Spill prevention, control, and counter measures. The use of mechanized machinery increases the risk for accidental spills of fuel, lubricants, hydraulic fluid, or other contaminants into the riparian zone or directly into the water. Additionally, uncured concrete and form materials adjacent to the active stream channel may result in accidental discharge into the water. These contaminants can degrade habitat, and injure or kill aquatic food organisms and ESA-listed species. The project sponsor will adhere to the following measures:
   a) A description of hazardous materials that will be used, including inventory, storage, and handling procedures will be available on-site.
   b) Written procedures for notifying environmental response agencies will be posted at the work site.
   c) Spill containment kits (including instructions for cleanup and disposal) adequate for the types and quantity of hazardous materials used at the site will be available at the work site.
   d) Workers will be trained in spill containment procedures and will be informed of the location of spill containment kits.

e) Any waste liquids generated at the staging areas will be temporarily stored under an impervious cover, such as a tarpaulin, until they can be properly transported to and disposed of at a facility that is approved for receipt of hazardous materials.

14) Invasive species control. The following measures will be followed to avoid introduction of invasive plants and noxious weeds into project areas:
   a) Prior to entering the site, all vehicles and equipment will be power washed, allowed to fully dry, and inspected to make sure no plants, soil, or other organic material adheres to the surface.
   b) Watercraft, waders, boots, and any other gear to be used in or near water will be inspected for aquatic invasive species.
   c) Wading boots with felt soles are not to be used due to their propensity for aiding in the transfer of invasive species.

3.4.2 Construction Conservation Measures

Work Area Isolation & Fish Salvage.

Any work area within the wetted channel will be isolated from the active stream whenever ESA-listed fish are reasonably certain to be present, or if the work area is less than 300-feet upstream from known spawning habitats. When work area isolation is required, design plans will include all isolation elements, fish release areas, and, when a pump is used to dewater the isolation area and fish are present, a fish screen that meets NMFS's fish screen criteria (NMFS 2011[2], or most current). Work area isolation and fish capture activities will occur during periods of the coolest air and water temperatures possible, normally early in the morning versus late in the day, and during conditions appropriate to minimize stress and death of species present.

For salvage operations in known bull trout spawning and rearing habitat, electrofishing shall only occur from May 1 to July 31. No electrofishing will occur in any bull trout occupied habitat after August 15. Bull trout are very temperature sensitive and generally should not be electroshocked or otherwise handled when temperatures exceed 15 degrees celsius. Salvage activities should take place during periods of the coolest air and water temperatures possible, normally early in the morning versus late in the day, and during conditions appropriate to minimize stress to fish species present.

Salvage operations will follow the ordering, methodologies, and conservation measures specified below in Steps 1 through 6. Steps 1 and 2 will be implemented for all projects where work area isolation is necessary according to conditions above. Electrofishing (Step 3) can be implemented to ensure all fish have been removed following Steps 1 and 2, or when other means of fish capture may not be feasible or effective. Dewatering and rewatering (Steps 4 and 5) will be

[2] National Marine Fisheries Service. 2011. Anadromous salmonid passage facility design. Northwest Region. Available online at: http://www.nwr.noaa.gov/Salmon-Hydropower/FERC/upload/Fish-Passage-Design.pdf

implemented unless wetted in-stream work is deemed to be minimally harmful to fish, and is beneficial to other aquatic species. Dewatering will not be conducted in areas known to be occupied by lamprey, unless lampreys are salvaged using guidance set forth in US Fish and Wildlife Service (2010)[3].

1) Isolate

a. Block nets will be installed at upstream and downstream locations and maintained in a secured position to exclude fish from entering the project area.
b. Block nets will be secured to the stream channel bed and banks until fish capture and transport activities are complete. Block nets may be left in place for the duration of the project to exclude fish.
c. If block nets remain in place more than one day, the nets will be monitored at least daily to ensure they are secured to the banks and free of organic accumulation. If the project is within bull trout spawning and rearing habitat, the block nets must be checked every four hours for fish impingement on the net. Less frequent intervals must be approved through a variance request.
d. Nets will be monitored hourly anytime there is instream disturbance.

2) Salvage – As described below, fish trapped within the isolated work area will be captured to minimize the risk of injury, then released at a safe site:

a. Remove as many fish as possible prior to dewatering.
b. During dewatering, any remaining fish will be collected by hand or dip nets.
c. Seines with a mesh size to ensure capture of the residing ESA-listed fish will be used.
d. Minnow traps will be left in place overnight and used in conjunction with seining.
e. If buckets are used to transport fish:
    i. The time fish are in a transport bucket will be limited, and will be released as quickly as possible;
    ii. The number of fish within a bucket will be limited based on size, and fish will be of relatively comparable size to minimize predation;
    iii. Aerators for buckets will be used or the bucket water will be frequently changed with cold clear water at 15 minute or more frequent intervals.
    iv. Buckets will be kept in shaded areas or will be covered by a canopy in exposed areas.

---

[3] U.S. Fish and Wildlife Service. 2010. Best management practices to minimize adverse effects to Pacific lamprey. Available online at: http://www.fws.gov/pacific/Fisheries/sphabcon/lamprey/pdf/Best%20Management%20Practices%20for%20Pacific%20Lamprey%20April%202010%20Version.pdf

v. Dead fish will not be stored in transport buckets, but will be left on the stream bank to avoid mortality counting errors.

f. As rapidly as possible (especially for temperature-sensitive bull trout), fish will be released in an area that provides adequate cover and flow refuge. Upstream release is generally preferred, but fish released downstream will be sufficiently outside of the influence of construction.

g. Salvage will be supervised by a qualified fisheries biologist experienced with work area isolation and competent to ensure the safe handling of all fish.

3) Electrofishing – Electrofishing**.** Electrofishing will be used only after other salvage methods have been employed or when other means of fish capture are determined to not be feasible or effective.

a. If electrofishing will be used to capture fish for salvage, the salvage operation will be led by an experienced fisheries biologist and the following guidelines will be followed:

i. The NMFS's electrofishing guidelines (NMFS 2000)[4].

ii. Only direct current (DC) or pulsed direct current (PDC) will be used and conductivity must be tested.

1. If conductivity is less than 100 µs, voltage ranges from 900 to 1100 will be used.
2. For conductivity ranges between 100 to 300 µs, voltage ranges will be 500 to 800.
3. For conductivity greater than 300 µs, voltage will be less than 400.

iii. Electrofishing will begin with a minimum pulse width and recommended voltage and then gradually increase to the point where fish are immobilized.

iv. The anode will not intentionally contact fish.

v. Electrofishing shall not be conducted when the water conditions are turbid and visibility is poor. This condition may be experienced when the sampler cannot see the stream bottom in one foot of water.

vi. If mortality or obvious injury (defined as dark bands on the body, spinal deformations, de-scaling of 25% or more of body, and torpidity or inability to maintain upright attitude after sufficient recovery time) occurs during electrofishing, operations will be immediately discontinued, machine settings, water temperature and conductivity checked, and procedures adjusted or electrofishing postponed to reduce mortality.

[4] National Marine Fisheries Service. 2000. Guidelines for electrofishing waters containing salmonids listed under the Endangered Species Act. Portland, Oregon and Santa Rosa, California. Available online at http://www.nwr.noaa.gov/ESA-Salmon-Regulations-Permits/4d-Rules/upload/electro2000.pdf

4) Dewater. Dewatering, when necessary, will be conducted over a sufficient period of time to allow species to naturally migrate out of the work area and will be limited to the shortest linear extent practicable.
    a. Diversion around the construction site may be accomplished with a coffer dam and a by-pass culvert or pipe, or a lined, non-erodible diversion ditch. Where gravity feed is not possible, a pump may be used, but must be operated in such a way as to avoid repetitive dewatering and rewatering of the site. Impoundment behind the cofferdam must occur slowly through the transition, while constant flow is delivered to the downstream reaches.
    b. All pumps will have fish screens to avoid juvenile fish impingement or entrainment, and will be operated in accordance with NMFS's current fish screen criteria (NMFS 2011[5], or most recent version). If the pumping rate exceeds 3 cubic feet second (cfs), a NMFS Hydro fish passage review will be necessary.
    c. Dissipation of flow energy at the bypass outflow will be provided to prevent damage to riparian vegetation or stream channel.
    d. Safe reentry of fish into the stream channel will be provided, preferably into pool habitat with cover, if the diversion allows for downstream fish passage.
    e. Seepage water will be pumped to a temporary storage and treatment site or into upland areas to allow water to percolate through soil or to filter through vegetation prior to reentering the stream channel.

5) Re-watering. Upon project completion, the construction site will be slowly re-watered to prevent loss of surface flow downstream and to prevent a sudden increase in stream turbidity. During re-watering, the site will be monitored to prevent stranding of aquatic organisms below the construction site.

6) Salvage Notice. Monitoring and recording of fish presence, handling, and mortality must occur during the duration of the isolation, salvage, electrofishing, dewatering, and rewatering operations. Once operations are completed, a salvage report will document procedures used, any fish injuries or deaths (including numbers of fish affected), and causes of any deaths.

3.4.3 Construction and Post-Construction Conservation Measures for Aquatic Species

1) Fish passage. Fish passage will be provided for any adult or juvenile fish likely to be present in the action area during construction, unless passage did not exist before construction or the stream is naturally impassable at the time of construction. If the provision of temporary fish passage during construction will increase negative effects on aquatic species of interest or their habitat, a variance can be requested from the NMFS Branch Chief and the FWS Field Office

[5] National Marine Fisheries Service. 2011. Anadromous salmonid passage facility design. Northwest Region. Available online at: http://www.nwr.noaa.gov/Salmon-Hydropower/FERC/upload/Fish-Passage-Design.pdf

Supervisor (Appendix B of this BO). Pertinent information, such as the species affected, length of stream reach affected, proposed time for the passage barrier, and alternatives considered, will be included in the variance request.

2) Construction and discharge water.

   a) Surface water may be diverted to meet construction needs, but only if developed sources are unavailable or inadequate.
   b) Diversions will not exceed 10% of the available flow.
   c) All construction discharge water will be collected and treated using the best available technology applicable to site conditions.
   d) Treatments to remove debris, nutrients, sediment, petroleum hydrocarbons, metals and other pollutants likely to be present will be provided.

3) Minimize time and extent of disturbance. Earthwork (including drilling, excavation, dredging, filling and compacting) in which mechanized equipment is in stream channels, riparian areas, and wetlands will be completed as quickly as possible. Mechanized equipment will be used in streams only when project specialists believe that such actions are the only reasonable alternative for implementation, or would result in less sediment in the stream channel or damage (short- or long-term) to the overall aquatic and riparian ecosystem relative to other alternatives. To the extent feasible, mechanized equipment will work from the top of the bank, unless work from another location would result in less habitat disturbance.

4) Cessation of work. Project operations will cease under the following conditions:
   a) High flow conditions that may result in inundation of the project area, except for efforts to avoid or minimize resource damage;
   b) When allowable water quality impacts, as defined by the state CWA section 401 water quality certification, have been exceeded; or
   c) When "incidental take" limitations have been reached or exceeded.

5) Site restoration. When construction is complete:
   a) All streambanks, soils, and vegetation will be cleaned up and restored as necessary using stockpiled large wood, topsoil, and native channel material.
   b) All project related waste will be removed.
   c) All temporary access roads, crossings, and staging areas will be obliterated. When necessary for revegetation and infiltration of water, compacted areas of soil will be loosened.
   d) All disturbed areas will be rehabilitated in a manner that results in similar or improved conditions relative to pre-project conditions. This will be achieved through

redistribution of stockpiled materials, seeding, and/or planting with local native seed mixes or plants.

6) Revegetation. Long-term soil stabilization of disturbed sites will be accomplished with reestablishment of native vegetation using the following criteria:
    a) Planting and seeding will occur prior to or at the beginning of the first growing season after construction.
    b) An appropriate mix of species that will achieve establishment, shade, and erosion control objectives, preferably forb, grass, shrub, or tree species native to the project area or region and appropriate to the site will be used.
    c) Vegetation, such as willow, sedge and rush mats, will be salvaged from disturbed or abandoned floodplains, stream channels, or wetlands.
    d) Invasive species will not be used.
    e) Short-term stabilization measures may include the use of non-native sterile seed mix (when native seeds are not available), weed-free certified straw, jute matting, and other similar techniques.
    f) Surface fertilizer will not be applied within 50 feet of any stream channel, waterbody, or wetland.
    g) Fencing will be installed as necessary to prevent access to revegetated sites by livestock or unauthorized persons.
    h) Re-establishment of vegetation in disturbed areas will achieve at least 70% of pre-project conditions within 3 years.
    i) Invasive plants will be removed or controlled until native plant species are well-established (typically 3 years post-construction).

7) Site access. The project sponsor will retain the right of reasonable access to the site in order to monitor the success of the project over its life.

8) Implementation monitoring. Project sponsor staff or their designated representative will provide implementation monitoring to ensure compliance with the applicable biological opinion, including:

    a) General conservation measures are adequately followed; and
    b) Effects to listed species are not greater than predicted and incidental take limitations are not exceeded.

9) CWA section 401 water quality certification. The project sponsor or designated representative will complete and record water quality observations to ensure that in-water work is not degrading water quality. During construction, CWA section 401 water quality

certification provisions provided by the Oregon Department of Environmental Quality, Washington Department of Ecology, or Idaho Department of Environmental Quality will be followed.

3.5 Action-Specific Descriptions and Conservation Measures

3.5.1 Action Category 1. Fish Passage Restoration (Profile Discontinuities)

The BPA proposes to review and fund fish passage projects for ESA-listed salmon, steehead and bull trout (hereafter salmonids). The objective of fish passage restoration is to allow all life stages of salmonids access to historical habitat from which they have been excluded and focuses on restoring safe upstream and downstream fish passage to stream reaches that have become isolated by obstructions. Although passage actions are generally viewed as positive actions for native fish restoration, there may be occasions where restoring passage exposes native fish (isolated above or below a barrier) to negative influences (predation, competition, hybridization) from non-native species such as brook trout, brown trout and lake trout. Proposed passage projects that may increase bull trout or Oregon chub exposure to non-native species must be approved by the appropriate FWS Field Office Supervisor (see appendix B).

BPA grouped passage projects according the effects and review requirements in the following subcategories: **Profile Discontinuities** and **Transportation Infrastructure**. These subcategories represent a logical break between transportation related effects and effects due to physical fish barriers, classified by water velocity, water depth, and barrier height (profile discontinuities).

Profile Discontinuities Subcategory.

The BPA proposes to fund removal, modification, construction and maintenance of instream structures to improve fish passage. The objective of this activity category is to allow all life stages of ESA-listed salmonids access to historical habitats from which they have been excluded by non-functioning structures or instream profile discontinuities resulting from insufficient depth, or excessive jump heights and velocities.

The BPA proposes the following activities to improve fish passage; (a) Dams, Water Control or Legacy Structure Removal; (b) Consolidate, or Replace Existing Irrigation Diversions; (c) Headcut and Grade Stabilization; (d) Low Flow Consolidation; and (e) Providing Fish passage at an existing facility.

a. Dams, Water Control Structures, or Legacy Structures Removal.

Description. BPA proposes to fund and review fish passage projects, and restore more natural channel and flow conditions by removing small dams, channel-spanning weirs, earthen embankments, subsurface drainage features, spillway systems, tide gates, outfalls, pipes, instream flow redirection structures (*e.g.*, drop structure, gabion, groin), or similar devices used to control, discharge, or maintain water levels.

Small dams include instream structures that are 10 feet in height or less for streams with an active channel width of less than 50-feet and a slope less than 4%, or up to 16.4 feet in height and a slope greater than 4%.

If the structure being removed contains material (i.e. large wood, boulders, etc) that is typically found within the stream or floodplain at that site, the material can be reused to implement habitat improvements. Any such project must follow the design criteria outlined in the **Install Habitat-Forming Natural Material Instream Structures (Large Wood, Boulders, and Spawning Gravel)** activity category.

Guidelines for Review.

The following proposed activities are considered ***low risk*** and will not require RRT review: Removal of subsurface drainage features, tide gates, outfalls, pipes, small dams with a maximum total head measurement equal to or less than 3 feet, and instream flow redirection-structures.

The following proposed removal activities for the following structures are considered ***medium*** to ***high risk*** and will require RRT and NMFS Hydro review: small dams with a maximum total head measurement greater than 3 feet, channel spanning weirs, earthen embankments and spillway systems.

Prior to going to the RRT, Medium to High Risk projects shall address the **General Project and Data Summary Requirement** (**Appendix C)** in addition to the following:

1) A longitudinal profile of the stream channel thalweg for 20 channel widths upstream and downstream of the structure shall be used to determine the potential for channel degradation.
2) A minimum of three cross-sections – one downstream of the structure, one through the reservoir area upstream of the structure, and one upstream of the reservoir area outside of the influence of the structure) to characterize the channel morphology and quantify the stored sediment.
3) Sediment characterization to determine the proportion of coarse sediment (>2mm) in the reservoir area.
4) A survey of any downstream spawning areas that may be affected by sediment released by removal of the water control structure or dam. Reservoirs with a d35 greater than 2 mm (i.e., 65% of the sediment by weight exceeds 2 mm in diameter) may be removed without excavation of stored material, if the sediment contains no contaminants; reservoirs with a d35 less than 2 mm (i.e., 65% of the sediment by weight is less than 2 mm in diameter) will require partial removal of the fine sediment to create a pilot channel, in conjunction with stabilization of the newly exposed streambanks with native vegetation.

Conservation Measures.

1) Restore all structure banklines and fill in holes with native materials to restore contours of stream bank and floodplain. Compact the fill material adequately to prevent washing out of the soil during over bank flooding. Do not mine material from the stream channel to fill in "key" holes. When removal of buried (keyed) structures may result in significant disruption to riparian vegetation and/or the floodplain, consider leaving the buried structure sections within the streambank.
2) If the legacy structures (log, rock, or gabion weirs) were placed to provide grade control, evaluate the site for potential headcutting and incision due to structure removal by using the appropriate guidance.[6] If headcutting and channel incision are likely to occur due to structure removal, additional measures must be taken to reduce these impacts (see grade control options described under **Headcut and Grade Stabilization** activity category).
3) If the structure is being removed because it has caused an over-widening of the channel, consider implementing other HIP III restoration categories to decrease the width to depth ratio of the stream at that location to a level commensurate with representative upstream and downstream sections (within the same channel type).
4) Tide gates can only be removed not modified or replaced. Modification or replacement of tidegates will require a separate individual consultation with the Services.

b. Consolidate, or Replace Existing Irrigation Diversions

Description. The BPA proposes to fund and review the consolidation or replacement of existing diversions with pump stations or engineered riffles (including cross vanes, "W" weirs, or "A" frame weirs) to reduce the number of diversions on streams and thereby conserve water and improve habitat for fish, improve the design of diversions to allow for fish passage and adequate screening, or reduce the annual instream construction of push-up dams and instream structures. Small instream rock structures that facilitate proper pump station operations are allowed when designed in association with the pump station. Infiltration galleries and lay-flat stanchions are not part of the proposed action. Periodic maintenance of irrigation diversions will be conducted to ensure their proper functioning, *i.e.*, cleaning debris buildup, and replacement of parts.

The BPA HIP III will only cover irrigation efficiency actions within this activity category that use state approved regulatory mechanisms (e.g. Oregon ORS 537.455-.500, Washington RCW 90.42) for ensuring that water savings will be protected as instream water rights, or in cases where project implementers identify how the water conserved will remain instream to benefit fish without any significant loss of the instream flows to downstream diversions.

---

[6] Castro, J. 2003. Geomorphologic Impacts of Culvert Replacement and Removal: Avoiding Channel Incision. Oregon Fish and Wildlife Office, Portland, OR. Available at: http://library.fws.gov/pubs1/culvert-guidelines03.pdf

Unneeded or abandoned irrigation diversion structures will be removed where they are barriers to fish passage, have created wide shallow channels or simplified habitat, or are causing sediment concerns through deposition behind the structure or downstream scour according to **Dams, Water Control Structures, or Legacy Structures Removal** section.

Guidelines for Review.

The following proposed activities are considered ***low risk*** and will not require RRT review: Irrigation diversion structures less than 3 feet in height that are to be removed only.

This proposed activity is considered ***medium*** to ***high risk*** and will require RRT and NMFS Hydro review. Irrigation diversion structures greater than 3 feet in height that are to be removed or replaced. Prior to going to the RRT, medium to high risk projects shall address the **General Project and Data Summary Requirements (Appendix C)** in addition to the following:

1) A longitudinal profile of the stream channel thalweg for 20 channel widths upstream and downstream of the structure shall be used to determine the potential for channel degradation.
2) A minimum of three cross-sections – one downstream of the structure, one through the reservoir area upstream of the structure, and one upstream of the reservoir area outside of the influence of the structure) to characterize the channel morphology and quantify the stored sediment.

Conservation Measures.

1) Diversion structures will be designed to meet NMFS Anadromous Salmonid Passage Facility Design Guidelines (NMFS 2011 or more recent version)[7].
2) Placement of rock structures or engineered riffles shall follow criteria outlined in the **Headcut and Grade Stabilization** activity category).
3) Diversions will be designed so that diverted water withdrawal is equal to or less than the irrigator's state water right, or equal to the current rate of diversion, whichever is less.
4) Project design will include the installation of a totalizing flow meter device on all diversions for which installation of this device is possible. A staff gauge or other device capable of measuring instantaneous flow will be utilized on all other diversions.
5) Multiple existing diversions may be consolidated into one diversion if the consolidated diversion is located at the most downstream existing diversion point unless sufficient low flow conditions are available to support unimpeded passage. The design will clearly

[7] NMFS (National Marine Fisheries Service). 2011. Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, Oregon. Available at: http://www.nwr.noaa.gov/Publications/Reference-Documents/Passage-Refs.cfm

identify the low flow conditions within the stream reach relative to the cumulative diverted water right. If instream flow conditions are proven favorable for fish passage and habitat use then diversion consolidation may occur at the upstream structure.

6) If low flow conditions coupled with diversion withdrawals result in impassable conditions for fish, then irrigation system efficiencies will be implemented with water savings committed to improve reach passage conditions.

c. <u>Headcut and Grade Stabilization.</u>

Description. BPA proposes to fund and review the restoration of fish passage and grade control (i.e. headcut stabilization) with geomorphically appropriate structures constructed from rock or large wood (LW). Boulder weirs and roughened channels may be installed for grade control at culverts, mitigate headcuts, and to provide passage at small dams or other channel obstructions that cannot otherwise be removed. For wood dominated systems, grade control engineered log jams (ELJ)'s should be considered as an alternative.

Grade control ELJs are designed to arrest channel downcutting or incision and retain sediment, lower stream energy, and increase water elevations to reconnect floodplain habitat and diffuse downstream flood peaks. Grade control ELJs also serve to protect infrastructure that is exposed by channel incision and to stabilize over-steepened banks. Unlike hard weirs or rock grade control structures, a grade control ELJ is a complex broadcrested structure that dissipates energy more gradually.

Guidelines for Review.

The following proposed activities are considered ***low risk*** and will not require RRT review: Installation of boulder weirs, roughened channels and grade control structures that are less than 18 inches in height and include all of the conservation measures listed below.

This proposed activity is considered ***medium*** to ***high risk*** and will require RRT and NMFS hydro review. Installation of boulder weirs, roughened channels and grade control structures that are above 18 inches in height.

Prior to going to the RRT, medium to high risk projects shall address the **General Project and Data Summary Requirements (Appendix C)** in addition to the following:

1) A longitudinal profile of the stream channel thalweg for 20 channel widths upstream and downstream of the structure shall be used to determine the potential for channel degradation.
2) A minimum of three cross-sections – one downstream of the structure, one through the reservoir area upstream of the structure, and one upstream of the reservoir area outside of the influence of the structure) to characterize the channel morphology and quantify the stored sediment.

Conservation Measures.

1) All structures will be designed to the design benchmarks set in (NMFS 2011 or more recent version)[8].
2) Construction of passage structures over dams is limited to dams of less than seven feet in height.
3) Construction of passage structures is limited to facilitate passage at existing diversion dams, not in combination with new dams.
4) Install boulder weirs low in relation to channel dimensions so that they are completely overtopped during channel-forming flow events (approximately a 1.5-year flow event).
5) Boulder weirs are to be placed diagonally across the channel or in more traditional upstream pointing "V" or "U" configurations with the apex oriented upstream. The apex should be lower than the structure wings to support low flow consolidation.
6) Boulder weirs are to be constructed to allow upstream and downstream passage of all native fish species and life stages that occur in the stream. This can be accomplished by providing plunges no greater than 6" in height, allowing for juvenile fish passage at all flows.
7) Key weirs into the stream bed to minimize structure undermining due to scour, preferably at least 2.5x their exposure height. The weir should also be keyed into both banks, if feasible greater than 8 feet.
8) Include fine material in the weir material mix to help seal the weir/channel bed, thereby preventing subsurface flow. Geotextile material can be used as an alternative approach to prevent subsurface flow
9) Rock for boulder weirs shall be durable and of suitable quality to assure permanence in the climate in which it is to be used. Rock sizing depends on the size of the stream, maximum depth of flow, planform, entrenchment, and ice and debris loading.
10) Full spanning boulder weir placement shall be coupled with measures to improve habitat complexity (LW placement etc.) and protection of riparian areas.
11) The use of gabions, cable or other means to prevent the movement of individual boulders in a boulder weir is not allowed.
12) If geomorphic conditions are appropriate, consideration should be given towards use of a roughened channel or constructed riffle to minimize the potential for future development of passage (jump height) barrier.
13) Headcut stabilization shall incorporate the following measures:

[8] NMFS (National Marine Fisheries Service). 2011. Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, Oregon. Available at: http://www.nwr.noaa.gov/Publications/Reference-Documents/Passage-Refs.cfm

a. Armor head-cut with sufficiently sized and amounts of material to prevent continued up-stream movement. Materials can include both rock and organic materials which are native to the area.
b. Focus stabilization efforts in the plunge pool, the head cut, as well as a short distance of stream above the headcut.
c. Minimize lateral migration of channel around head cut ("flanking") by placing rocks and organic material at a lower elevation in the center of the channel cross section to direct flows to the middle of channel.
d. Provide fish passage over a stabilized head-cut through a series of log or rock weir structures or a roughened channel.
e. Headcut stabilization structure will be constructed utilizing streambed simulation bed material, which will be washed into place until there is apparent surface flow and minimal subsurface material to ensure fish passage immediately following construction if natural flows are sufficient.
f. Structures will be constructed with stream simulation materials and fines added and pressure washed into the placed matrix. Successful washing will be determined by minimization of voids within placed matrix such that ponding occurs with little to no percolation losses to minimize low flow fish passage effects immediately following construction.

d. Low Flow Consolidation

Description: BPA proposes to fund and review projects that; (a) modify diffused or braided flow conditions that impede fish passage; (b) modify dam aprons with shallow depth (less than 10 inches), or (c) utilize temporary placement of sandbags, hay bales, and ecology blocks to provide depths and velocities passable to upstream migrants.

Land use practices such as large scale agriculture, including irrigation, and urban and residential development have drastically changed the hydrology of affected watersheds. Reduced forest cover and increased impervious surface have resulted in increased runoff and peak flows and in less aquifer recharge, resulting in increased frequency, duration and magnitude of summer droughts. During recent droughts, temporary placement of sandbags, hay bales, and ecology blocks have been successful in providing short term fish passage through low flow consolidation techniques.

Guidelines for Review.

All of the proposed activities under the **Low Flow Consolidation** activity category are considered ***medium*** to ***high risk*** and will both require RRT and NMFS hydro review.

Prior to going to the RRT, medium to high risk projects shall address the **General Project and Data Summary Requirements (Appendix C)** in addition to the following:

Conservation Measures.

1) Fish Passage will be designed to the design benchmarks set in (NMFS 2011 or more recent version)[9].
2) Conceptual Design Review process with NMFS Hydropower Division will be implemented.
3) All material placed in the stream to aid low flow fish passage will be removed when stream flows increase, prior to anticipated high flows that could wash consolidation measures away or cause flow to go around them.

e. Provide Fish Passage at an Existing Facility

Description: BPA proposes to fund and review projects that; (a) re-engineer improperly designed fish passage or fish collection facilities; (b) periodic maintenance of fish passage or fish collection facilities to ensure proper functioning, *e.g*., cleaning debris buildup, replacement of parts; and (c) installation of a fish ladder at an existing facility.

Guidelines for Review.

The following proposed activities are considered ***low risk*** and will not require RRT review: Periodic Maintenance of Fish passage or Fish Collection Facilities.

All of the other the proposed activities under the **Provide Fish Passage at an Existing Facility** activity category that are not upkeep and maintenance are considered ***medium*** to ***high risk*** and will require both RRT and NMFS Hydropower review.

Prior to going to the RRT, medium to high risk projects shall address the **General Project and Data Summary Requirements (Appendix C)** in addition to the following:

Conservation Measures.

1) Fish Passage will be designed to the design benchmarks set in (NMFS 2011 or more recent version)[10].
2) Design consideration should be given for Pacific Lamprey passage[11]. Fish ladders that are primarily designed for salmonids are usually impediments to lamprey passage as they

[9] NMFS (National Marine Fisheries Service). 2011. Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, Oregon. Available at: http://www.nwr.noaa.gov/Publications/Reference-Documents/Passage-Refs.cfm

do not have adequate surfaces for attachment, velocities are often too high and there are inadequate places for resting. Providing for rounded corners, resting areas or providing a natural stream channel (stream simulation) or wetted ramp for passage over the impediment have been effective in facilitating lamprey passage.

Fish Passage Restoration (Transportation Infrastructure)

The BPA proposes to review and fund maintenance, removal, or replacement of bridges, culverts and fords to improve fish passage, prevent streambank and roadbed erosion, facilitate natural sediment and wood movement, and eliminate or reduce excess sediment loading.

The BPA proposes the following activities to improve fish passage: (a) Bridge and Culvert Removal or Replacement; (b) Bridge and Culvert Maintenance; and (c) Installation of Fords.

a. Bridge and Culvert Removal or Replacement

Description. For unimpaired fish passage it is desirable to have a crossing that is a larger than the channel bankfull width, allows for a functional floodplain, allows for a natural variation in bed elevation, and provides bed and bank roughness similar to the upstream and downstream channel. In general, bridges will be implemented over culverts because they typically do not constrict a stream channel to as great a degree as culverts and usually allow for vertical movement of the streambed (see #3 below). Bottomless culverts may provide a good alternative for fish passage where foundation conditions allow their construction and width criteria can be met.

Guidelines for Review.

The following proposed activities are considered ***low risk*** and will not require RRT review: Removal or replacement of culverts and bridges that meet all of the following conservation measures.

The following proposed activities are considered ***medium* to *high risk*** and will require RRT review: Removal and replacement of culverts and bridges that do not meet all of the following conservation measures will require a RRT review and a variance from NMFS and/or FWS.

Prior to going to the RRT, medium to high risk projects shall address the **General Project and Data Summary Requirements (Appendix C)** in addition to the following:

[11] 2010 (USFWS) Best Management Practices to Minimize Adverse Effects to Pacific Lamprey. http://www.fws.gov/pacific/Fisheries/sphabcon/lamprey/pdf/Best%20Management%20Practices%20for%20Pacific%20Lamprey%20April%202010%20Version.pdf

1) Designs shall include site sketches, drawings, aerial photographs, or other supporting specifications, calculations, or information that is commensurate with the scope of the action, that show the active channel, the 100-year floodplain, the functional floodplain, any artificial fill within the project area, the existing crossing to be replaced, and the proposed crossing.

Conservation measures.

1) Stream crossings shall be designed to the design benchmarks set in (NMFS 2011 or more recent version)[12] and restore floodplain function.
2) A crossing shall: (a) maintain the general scour prism, as a clear, unobstructed opening (i.e., free of any fill, embankment, scour countermeasure, or structural material); (b) be a single span structure that maintains a clear, unobstructed opening above the general scour elevation that is at least as wide as 1.5 times the active channel width; (c) be a multiple span structure that maintains a clear, unobstructed opening above the general scour elevation, except for piers or interior bents, that is at least as wide as 2.2 times the active channel width.[13] This criteria will restore any physical or biological processes associated with a fully functional floodplain that was degraded by the previous crossing.
3) Bridge scour and stream stability countermeasures may be applied below the general scour elevation, however, except as described above in (2), no scour countermeasure may be applied above the general scour elevation.
4) Remove all other artificial constrictions within the functional floodplain of the project area as follows: (a) remove existing roadway fill, embankment fill, approach fill, or other fills; (b) install relief conduits through existing fill; (c) remove vacant bridge supports below total scour depth, unless the vacant support is part of the rehabilitated or replacement stream crossing; and (d) reshape exposed floodplains and streambanks to match upstream and downstream conditions.
5) If the crossing will occur within 300 feet of active spawning area, only full span bridges or streambed simulation will be used.

---

[12] NMFS (National Marine Fisheries Service). 2011. Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, Oregon. Available at: http://www.nwr.noaa.gov/Publications/Reference-Documents/Passage-Refs.cfm

[13] For guidance on how to complete bridge scour and stream stability analysis, see Lagasse *et al*. 2001a (HEC-20), Lagasse *et al*. 2001b (HEC-23), Richardson and Davis 2001 (HEC-18), ODOT 2005, and AASHTO 2007.

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

6) Projects in stream channels with gradients above six percent will utilize a bridge or if a bridge is determined to not be feasible, the crossing will be designed using the stream simulation option.
7) Culverts shall not be longer than: 150 feet for stream simulation, 75 feet for no-slope and 500 feet for any other option. Maximum culvert width shall be 20 feet, for widths greater than 20 feet a bridge will be used.
8) Designs must demonstrate that the vertical and lateral stability of the stream channel are taken into consideration when designing a crossing.
9) Designs must demonstrate that culverts and bridges shall mimic the natural stream processes and allow for fish passage, sediment transport, and flood and debris conveyance.
10) Designs must demonstrate that the crossings: (a) avoid causing local scour of streambanks and reasonably likely spawning areas; (b) allow the fluvial transport of large wood, up to a site potential tree height in size, through the project area without becoming stranded on the bridge structure; (c) allow for likely channel migration patterns within the functional floodplain for the design life of the bridge; and otherwise align with well-defined, stable channels; and (d) allow for the passage of all aquatic organisms.
11) The proponent shall include suitable grade controls to prevent culvert failure caused by changes in stream elevation. Grade control structures to prevent headcutting above or below the culvert or bridge may be built using rock or wood as outlined in the **Headcut and Grade Stabilization** criteria under the **Profile Discontinuity** activity subcategory.

b. <u>Bridge and Culvert Maintenance</u>

Conservation measures:

1) Culverts will be cleaned by working from the top of the bank, unless culvert access using work area isolation would result in less habitat disturbance. Only the minimum amount of wood, sediment and other natural debris necessary to maintain culvert function will be removed; spawning gravel will not be disturbed.
2) All large wood, cobbles, and gravels recovered during cleaning will be placed downstream of the culvert.
3) Do all routine work in the dry. If this is not possible, follow work area isolation criteria outlined in the **General Conservation Measures Applicable to all Actions**.
4) Culverts or bridge abutments will not be filled with vegetation, debris, or mud.

c. <u>Installation of Fords</u>

Description. In many streams, crossings have degraded riparian corridors and in-stream habitat resulting in increased and chronic sedimentation and reduced riparian functions including shading and recruitment of LW. Fords will be installed to allow improved stream crossing conditions only. New fords shall not be installed when there was not a previously existing stream crossing and no new fords will be constructed in salmonid spawning areas (including spawning and rearing habitat for bull trout). For the purposes of this proposed action, fords are defined as crossings for vehicles, off-highway vehicles (OHVs), bikes, pack animals, and livestock.

Guidelines for Review.

The following proposed activities are considered ***low risk*** and will not require RRT review: Fords that meet all of the following conservation measures, occur in intermittent streams, or occur in reaches not occupied by listed salmonids (salmon, steelhead, bull trout).

The following proposed activities are considered ***medium* to *high risk*** and will require RRT review: Fords that do not meet all of the following conservation measures will require a RRT review and a variance from NMFS and/or FWS.

Prior to going to the RRT, medium to high risk projects shall address the **General Project and Data Summary Requirements (Appendix C)** in addition to the following:

1) Information detailing locations of ESA-listed salmonid spawning areas within the reach.
2) Designs must demonstrate that the ford accommodate reasonably foreseeable flood risks, including associated bedload and debris, and to prevent the diversion of streamflow out of the channel and down the trail if the crossing fails.

Conservation Measures:

1) Stream crossings shall be designed to the design benchmarks set in (NMFS 2011 or more recent version)[14].
2) The ford will not create barriers to the passage of adult and juvenile fish.
3) Ford stream crossings will involve the placement of river rock along the stream bottom.
4) Existing access roads or trails and stream crossings will be used whenever possible, unless new construction would result in less habitat disturbance and the old trail or crossing is retired.
5) The ford will not be located in an area that will result in disturbance or damage to a properly functioning riparian area.
6) Fords will be placed on bedrock or stable substrates whenever possible.
7) Fords will not be placed in areas where ESA-listed salmonids (salmon, steelhead, bull trout) spawn or are suspected of spawning, or within 300 feet of such areas if spawning areas may be disturbed. For bull trout this CM applies to areas identified as spawning and rearing habitat.

[14] NMFS (National Marine Fisheries Service). 2011. Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, Oregon. Available at: http://www.nwr.noaa.gov/Publications/Reference-Documents/Passage-Refs.cfm

8) Bank cuts, if any, will be stabilized with vegetation, and approaches and crossings will be protected with river rock (not crushed rock) when necessary to prevent erosion.
9) Fords will have a maximum width of 20 feet.
10) Fences will be installed (or are already existing and functioning) along with all new fords to limit access of livestock to riparian areas. Fenced off riparian areas will be maximized and planted with native vegetation. Fences will not inhibit upstream or downstream movement of fish or significantly impede bedload movement. Where appropriate, construct fences at fords to allow passage of large wood and other debris.
11) Vehicle fords will only be allowed in intermittent streams with no salmonid fish spawning.

3.5.2 Action Category 2. River, Stream, Floodplain and Wetland Restoration

The BPA proposes to review and fund river, stream, floodplain and wetland restoration actions with the objective to provide the appropriate habitat conditions required for foraging, rearing, and migrating ESA-listed fish.

Projects utilizing habitat restoration actions outlined within this activity category shall be linked to Limiting Factors identified within the appropriate sub basin plan, recovery plan or shall be prioritized by recommended restoration activities indentified within a localized region by a technical oversight and steering committee (i.e. the Columbia River Estuary). Individual projects may utilize a combination of the activities listed in the **River, Stream, Floodplain and Wetland Restoration** activity category.

The BPA proposes the following activities to improve fish passage: (a) Improve Secondary Channel and Wetland Habitats, (b) Set-back or Removal of Existing, Berms, Dikes, and Levees; (c) Protect Streambanks Using Bioengineering Methods; (d) Install Habitat-Forming Natural Material Instream Structures (Large Wood, Boulders, and Spawning Gravel); (e) Riparian Vegetation Planting; and (f) Channel Reconstruction.

a. Improve Secondary Channel and Wetland Habitats[15]

Description. The BPA proposes to review and fund projects that reconnect historical stream channels within floodplains, restore or modify hydrologic and other essential habitat features of historical river floodplain swales, abandoned side channels, spring-flow channels, wetlands, historical floodplain channels and create new self-sustaining side channel habitats which are maintained through natural processes.

Actions include the improvement and creation of secondary channels, off channel habitats and wetlands to increase the available area and access to rearing habitat; increase hydrologic

[15] For detailed descriptions of each technique refer to the WDFW Stream Habitat Restoration Guidelines: http://wdfw.wa.gov/publications/pub.php?id=00043

capacity, provide resting areas for fish and wildlife species at various levels of inundation; reduce flow velocities; and provide protective cover for fish and other aquatic species.

Reconnection of historical off- and side channels habitats that have been blocked includes the removal of plugs, which impede water movement through off- and side-channels. Excavating pools and ponds in the historic floodplain/channel migration zone to create connected wetlands; Reconnecting existing side channels with a focus on restoring fish access and habitat forming processes (hydrology, riparian vegetation); Wetland habits will be created to reestablish a hydrologic regime that has been disrupted by human activities, including functions such as water depth, seasonal fluctuations, flooding periodicity, and connectivity.

All activities intended for improving secondary channel habitats will provide the greatest degree of natural stream and floodplain function achievable and shall be implemented to address basin specified limiting factors. Up to two project adjustments, including adjusting the elevation of the created side channel habitat are included under this proposal. The long-term development of a restored side channel will depend on natural processes like floods and mainstem migration.

Guidelines for Review.

Secondary channel and wetland habitats projects are considered ***medium to high*** risk and will require that all conservation measures are met in addition to RRT review. If all conservation measures cannot be met then a variance and review from NMFS and/or FWS will be required.

Prior to going to the RRT, medium to high risk projects shall address the **General Project and Data Summary Requirements (Appendix C)** in addition to the following:

1) Designs must demonstrate a clear linkage to limiting factors identified within the appropriate sub basin plan, recovery plan or recommendations by a technical oversight and steering committee within a localized region.
2) Evidence of historical channel location, such as land use surveys, historical photographs, topographic maps, remote sensing information, or personal observation.
3) If new side channel habitat is proposed, designs must demonstrate sufficient hydrology and that the project will be self-sustaining over time. Self-sustaining means the restored or created habitat would not require major or periodic maintenance, but function naturally within the processes of the floodplain.
4) Designs must demonstrate that the proposed action will mimic natural conditions for gradient, width, sinuosity and other hydraulic parameters.
5) Designs must demonstrate that the proposed action will not result in the creation of fish passage issues or post construction stranding of juvenile or adult fish.

Conservation Measures:

1) Off- and side-channel improvements can include minor excavation ($\leq$ 10%) of naturally accumulated sediment within historical channels. There is no limit as to the amount of

excavation of anthropogenic fill within historic side channels as long as such channels can be clearly identified through field and/or aerial photographs.
2) Excavated material removed from off- or side-channels shall be hauled to an upland site or spread across the adjacent floodplain in a manner that does not restrict floodplain capacity. Hydric soils may be salvaged to provide appropriate substrate and/or seed source for hydrophytic plant community development. Hydric soils will only be obtained from wetland salvage sites.
3) Excavation depth will never exceed the maximum thalweg depth in the main channel.
4) Restoration of existing side channels including one-time dredging and an up to two times project adjustment including adjusting the elevation of the created side channel habitat.
5) Side channel habitat will be constructed to prevent fish stranding by providing perennial flow through the constructed channel.
6) All side channel and pool habitat work will occur in isolation from waters occupied by ESA-listed salmonid species until project completion, at which time a final opening may be made by excavation to waters occupied by ESA-listed salmonid or water will be allowed to return into the area.
7) Adequate precautions will be taken to prevent the creation of fish passage issues or stranding of juvenile or adult fish.

b. Set-back or Removal of Existing Berms, Dikes, and Levees.

Description: The BPA proposes to review and fund projects that reconnect estuary, stream and river channels with floodplains, increase habitat diversity and complexity, moderate flow disturbances, and provide refuge for fish during high flows by either removing existing berms, dikes or levees or increasing the distance that they are set back from active streams or wetlands. This action includes the removal of fill, such as dredge spoils from past channelization projects, road, trail, and railroad beds, dikes, berms, and levees to restore natural estuary and fresh-water floodplain functions. Such functions include overland flow during high flows, dissipation of flood energy, increased water storage to augment low flows, sediment and debris deposition, growth of riparian vegetation, nutrient cycling, and development of side channels and alcoves.

Techniques that are covered by this programmatic need to have the sole purpose of restoring floodplain and estuary functions or to enhance fish habitat. Covered actions in freshwater, estuarine, and marine areas include: 1) full and partial removal of levees, dikes, berms, and jetties; 2) breaching of levees, dikes, and berms; 3) lowering of levees, dikes, and berms; and, 4) setback of levees, dikes, and berms.

Guidelines for Review.

Set-back or removal of existing berms, dikes, and levees projects are considered ***medium to high*** risk and will require that all conservation measures are met and will require RRT review. If all conservation measures cannot be met then a variance and review from NMFS will be required.

Prior to going to the RRT, medium to high risk projects shall address the **General Project and Data Summary Requirements (Appendix C)** in addition to the following:

Designs must demonstrate a clear linkage to limiting factors identified within the appropriate sub-basin plan, recovery plan or recommendations by a technical oversight and steering committee within a localized region.

Conservation Measures:

1) To the greatest degree possible, nonnative fill material, originating from outside the floodplain of the action area will be removed from the floodplain to an upland site.
2) Where it is not possible to remove or set-back all portions of dikes and berms, or in areas where existing berms, dikes, and levees support abundant riparian vegetation, openings will be created with breaches.
3) Breaches shall be equal to or greater than the active channel width (as defined above) to reduce the potential for channel avulsion during flood events.
4) In addition to other breaches, the berm, dike, or levee shall always be breached at the downstream end of the project and/or at the lowest elevation of the floodplain to ensure the flows will naturally recede back into the main channel thus minimizing fish entrapment.
5) When necessary, loosen compacted soils once overburden material is removed.
6) Overburden or fill comprised of native materials, which originated from the project area, may be used within the floodplain to create set-back dikes and fill anthropogenic holes provided that does not impede floodplain function.
7) When full removal is not possible and a setback is required, the new structure locations should be prioritized to the outside of the meander belt width or to the outside or the channel meander zone margins.

c. <u>Protect Streambanks Using Bioengineering Methods</u>

Description. The BPA proposes to review and fund projects that restore eroding streambanks by bank shaping and installation of coir logs or other soil reinforcements – bioengineering techniques as necessary to support development of riparian vegetation and/or planting or installing large wood, trees, shrubs, and herbaceous cover as necessary to restore ecological function in riparian and floodplain habitats.

Streambank erosion often occurs within meandering alluvial rivers on the outside of meander bends. The rate of erosion and meander migration is often accelerated due to degradation of the stream side riparian vegetation and land use practices that have removed riparian woody species. Historically, as the river migrates into the adjacent riparian areas, LW would be recruited from the banks resulting in reduced near bank velocities and increased boundary roughness. Where a functional riparian area is lacking, the lateral bank erosion may occur at an unnaturally accelerated rate. The goal of streambank restoration is to reestablish long term riparian processes through re-vegetation and riparian buffer strips. Structural bank protection may be used to provide short term stability to banklines allowing for vegetation establishment.

The primary proposed structural streambank stabilization action is the use of large wood and vegetation to increase bank strength and resistance to erosion in an ecological approach to engineering streambank stabilization.

The following bioengineering techniques[16] are proposed for use either individually or in combination: (a) Woody plantings and variations (*e.g.*, live stakes, brush layering, facines, brush mattresses); (b) herbaceous cover, for use on small streams or adjacent wetlands; (c) deformable soil reinforcement, consisting of soil layers or lifts strengthened with biodegradable coir fabric and plantings that are penetrable by plant roots; (d) coir logs (long bundles of coconut fiber), straw bales and straw logs used individually or in stacks to trap sediment and provide a growth medium for riparian plants; (e) bank reshaping and slope grading, when used to reduce a bank slope angle without changing the location of its toe, to increase roughness and cross section, and to provide more favorable planting surfaces; (f) tree and LW rows, live siltation fences, brush traverses, brush rows and live brush sills in floodplains, used to reduce the likelihood of avulsion in areas where natural floodplain roughness is poorly developed or has been removed and (g) floodplain flow spreaders, consisting of one or more rows of trees and accumulated debris used to spread flow across the floodplain; and (h) use of LW as a primary structural component.

Guidelines for Review.

Projects protecting streambanks using bioengineering methods are considered ***low risk*** and will not require RRT review if the following conditions are met: Streambank projects with 1) bankfull flow less than 500 cfs; 2) height of bank less than 5 feet; and, 3) bankfull velocity less than 5 ft/sec.

The following proposed activities are considered ***medium*** to ***high risk*** and will require RRT review: Streambank projects with 1) bankfull flow greater than 500 cfs; 2) height of bank greater than 5 feet; and, 3) bankfull velocity greater than 5 ft/sec.

Prior to going to the RRT, medium to high risk projects shall address the **General Project and Data Summary Requirements (Appendix C)** in addition to the following:

[16] For detailed descriptions of each technique refer to the WDFW Integrated Streambank Protection Guidelines: http://wdfw.wa.gov/publications/00046/,the USACE's EMRRP Technical Notes, Stream Restoration: http://el.erdc.usace.army.mil/publications.cfm?Topic=technote&Code=emrrp, or the NRCS National Engineering Handbook Part 654, Stream Restoration: http://policy.nrcs.usda.gov/viewerFS.aspx?id=3491

Designs must demonstrate a clear linkage to limiting factors identified within the appropriate sub basin plan, recovery plan or recommendations by a technical oversight and steering committee within a localized region.

Conservation Measures:

1) Without changing the location of the bank toe, damaged streambanks will be restored to a natural slope, pattern, and profile suitable for establishment of permanent woody vegetation. This may include sloping of unconsolidated bank material to a stable angle of repose, or the use of benches in consolidated, cohesive soils. The purpose of bank shaping is to provide a more stable platform for the establishment of riparian vegetation, while also reducing the depth to the water table, thus promoting better plant survival.
2) Streambank restoration projects shall include the placement of a riparian buffer strip consisting of a diverse assemblage of species native to the action area or region, including trees, shrubs, and herbaceous species. Do not use invasive species.
3) Large wood will be used as an integral component of all streambank protection treatments unless restoration can be achieved with soil bioengineering techniques alone.
4) LW will be placed to maximize near bank hydraulic complexity and interstitial habitats through use of various LW sizes and configurations of the placements.
5) Structural placement of LW should focus on providing bankline roughness for energy dissipation vs. flow re-direction that may affect the stability of the opposite bankline.
6) Large wood will be intact, hard, and undecayed to partly decaying with untrimmed root wads to provide functional refugia habitat for fish. Use of decayed or fragmented wood found lying on the ground may be used for additional roughness and to add complexity to LW placements but will not constitute the primary structural components.
7) Wood that is already within the stream or suspended over the stream may be repositioned to allow for greater interaction with the stream.
8) LW anchoring will not utilize cable or chain. Manila, sisal or other biodegradable ropes may be used for lashing connections. If hydraulic conditions warrant use of structural connections then rebar pinning or bolting may be used. The utilization of structural connections should be used minimally and only to ensure structural longevity in high energetic systems such as (high gradient systems with lateral confinement and limited floodplain). Need for structural anchorage shall be demonstrated in the design documentation.
9) Rock will not be used for streambank restoration, except as ballast to stabilize large wood unless it is necessary to prevent scouring or downcutting of an existing flow control structure (*e.g.*, a culvert or bridge support, headwall, utility lines, or building). In this case rock may be used as the primary structural component for construction of vegetated riprap with large woody debris. Scour holes may be filled with rock to prevent damage to structure foundations but will not extend above the adjacent bed of the river. This does not include scour protection for bridge approach fills.
10) The rock may not impair natural stream flows into or out of secondary channels or riparian wetlands.

11) Any action that requires additional excavation or structural changes to a road, culvert, bridge foundation or that may affect fish passage is covered under the **Fish Passage Restoration** activity category.
12) Fencing will be installed as necessary to prevent access and grazing damage to revegetated sites and project buffer strips.
13) Riparian buffer strips associated with streambank protection shall extend from the project bankline towards the floodplain a minimum distance of 35 feet.

d. Install Habitat-Forming Natural Material Instream Structures (Large Wood, Boulders, and Spawning Gravel)[17]

Description. The BPA proposes to review and fund projects that include placement of natural habitat forming structures to provide instream spawning, rearing and resting habitat for salmonids and other aquatic species. Projects will provide high flow refugia; increase interstitial spaces for benthic organisms; increase instream structural complexity and diversity including rearing habitat and pool formation; promote natural vegetation composition and diversity; reduce embeddedness in spawning gravels and promote spawning gravel deposition; reduce siltation in pools; reduce the width/depth ratio of the stream; mimic natural input of LW (*e.g.*, whole conifer and hardwood trees, logs, root wads); decrease flow velocities; and deflect flows into adjoining floodplain areas to increase channel and floodplain function. In areas where natural gravel supplies are low (immediately below reservoirs, for instance), gravel placement can be used to improve spawning habitat.

Anthropogenic activities that have altered riparian habitats, such as splash damming and the removal of large wood and logjams, have reduced instream habitat complexity in many rivers and have eliminated or reduced features like pools, hiding cover, and bed complexity. Salmonids need habitat complexity for rearing, feeding, and migrating. To offset these impacts large wood, boulders and spawning gravel will be placed in stream channels either individually or in combination.

Large wood will be placed to increase coarse sediment storage, increase habitat diversity and complexity, retain gravel for spawning habitat, improve flow heterogeneity, provide long-term nutrient storage and substrate for aquatic macroinvertebrates, moderate flow disturbances, increase retention of leaf litter, and provide refugia for fish during high flows. Engineered log jams create a hydraulic shadow, a low-velocity zone downstream that allows sediment to settle

[17] For detailed descriptions of each technique refer to the WDFW Stream Habitat Restoration Guidelines: http://wdfw.wa.gov/publications/pub.php?id=00043, WDFW Integrated Streambank Protection Guidelines: http://wdfw.wa.gov/publications/00046/,the USACE's EMRRP Technical Notes, Stream Restoration: http://el.erdc.usace.army.mil/publications.cfm?Topic=technote&Code=emrrp, or the NRCS National Engineering Handbook Part 654, Stream Restoration: http://policy.nrcs.usda.gov/viewerFS.aspx?id=3491

out. Scour holes develop adjacent to the log jam which can provide valuable fish and wildlife habitat by redirecting flow and providing stability to a streambank or downstream gravelbar.

Boulder placements increase habitat diversity and complexity, improve flow heterogeneity, provide substrate for aquatic vertebrates, moderate flow disturbances, and provide refuge for fish during high flows. The placement of individual large boulders and boulder clusters to increase structural diversity is important to provide holding and rearing habitat for ESA-listed salmonids where similar natural rock has been removed. This treatment will be used in streams that have been identified as lacking structural diversity and that are naturally and/or historically have had boulders.

The quality and quantity of available spawning gravel has been impacted by many anthropogenic features and activities. For example, dams and culverts can block the downstream movement of gravel and result in gravel starved reaches. Channelization, hard streambank stabilization, and diking restrict a stream from meandering and recruiting gravel. Elimination of riparian buffers and grazing up to the stream's edge introduces fines that often cause embedded or silted-in spawning gravel. Spawning gravel will be placed to improve spawning substrate by compensating for an identified loss of a natural gravel supply and may be placed in conjunction with other projects, such as simulated log jams and boulders.

All activities intended for installing habitat-forming instream structures will provide the greatest degree of natural stream and floodplain function achievable through application of an integrated, ecological approach and linkage to basin defined limiting factors. Instream structures capable of enhancing habitat forming processes and migratory corridors will be installed only within previously degraded stream reaches, where past disturbances have removed habitat elements such as LW, boulders, or spawning gravel.

Guidelines for Review.

The following proposed activities are considered ***low risk*** and will not require RRT review: Installation of habitat forming structures that meet all of the following conservation measures.

The following proposed activities are considered ***medium*** to ***high risk*** and will require RRT review: Installation of habitat forming structures that do not meet all of the following conservation measures will require a RRT review and a variance from NMFS.

Prior to going to the RRT, medium to high risk projects shall address the **General Project and Data Summary Requirements (Appendix C)** in addition to the following:

1) Designs must demonstrate a clear linkage to limiting factors identified within the appropriate sub basin plan, recovery plan or recommendations by a technical oversight and steering committee within a localized region.

2) Designs must demonstrate that the large wood placements mimic natural accumulations of large wood in the channel, estuary, or marine environment and addresses basin defined limiting factors.
3) Designs must demonstrate that boulder placements will be limited to stream reaches with an intact, well-vegetated riparian area, including trees and shrubs where those species would naturally occur, or that are part of riparian area restoration action; and a stream bed that consists predominantly of coarse gravel or larger sediments.
4) Designs must demonstrate that boulder sizing is appropriate for the size of the stream, maximum depth of flow, planform, entrenchment, and ice and debris loading.
5) For systems where boulders were not historically a component of the project stream reach, it must be demonstrated how this use of this technique will address limiting factors and provide the appropriate post restoration habitats.
6) Designs must demonstrate that LW and boulder placements will not result in a fish passage barrier.
7) Designs must demonstrate that spawning gravel augmentation is limited to areas where the natural supply has been eliminated or significantly reduced through anthropogenic means.

Conservation Measures (Large Wood).

1) LW placements for other purposes than habitat restoration or enhancement are excluded from this consultation.
2) LW will be placed in channels that have an intact, well-vegetated riparian buffer area that is not mature enough to provide large wood, or in conjunction with riparian rehabilitation or management.
3) LW may partially or completely span the channel in first order streams if the active channel top width is less than 20 feet.
4) When available and if the project is located within the appropriate morphology and sized stream, trees with rootwads attached should be a minimum length of 1.5 times the bankfull channel width, while logs without rootwads should be a minimum of 2.0 times the bankfull width.
5) Stabilizing or key pieces of large wood that will be relied on to provide streambank stability or redirect flows must be intact, hard, and undecayed to partly decaying, and should have untrimmed root wads to provide functional refugia habitat for fish. Use of decayed or fragmented wood found lying on the ground or partially sunken in the ground is not acceptable for key pieces but may be incorporated to add habitat complexity.
6) The partial burial of LW and boulders may constitute the dominant means of placement and key boulders (footings) or LW can be buried into the stream bank or channel.
7) If LW anchoring is required, a variety of methods may be used. These include buttressing the wood between riparian trees, the use of manila, sisal or other biodegradable ropes for lashing connections or if hydraulic conditions warrant use of structural connections then rebar pinning or bolting may be used. The utilization of structural connections should be used minimally and only to ensure structural longevity in high energetic systems such as

(high gradient systems with lateral confinement and limited floodplain). Need for structural anchorage shall be demonstrated in the design documentation.
8) Rock may be used for ballast but is limited to that needed to anchor the LW.

Conservation Measures (Boulder Placement)

1) Boulder placements for other purposes than habitat restoration or enhancement are excluded from this consultation.
2) The cross-sectional area of boulder placements may not exceed 25% of the cross-sectional area of the low flow channel, or be installed to shift the stream flow to a single flow pattern in the middle or to the side of the stream.
3) Boulders will be machine-placed (no end dumping allowed) and will rely on the size of boulder for stability.
4) Boulders will be installed low in relation to channel dimensions so that they are completely overtopped during channel-forming flow events (approximately a 1.5-year flow event).
5) Permanent anchoring, including rebar or cabling, may not be used.

Conservation Measures (Spawning Gravel)

1) Spawning gravel to be placed in streams must be obtained from an upland source outside of the channel and riparian area and properly sized gradation for that stream, clean, and non-angular. When possible use gravel of the same lithology as found in the watershed. After spawning gravel placement, allow the stream to naturally sort and distribute the material.
2) A maximum of 100 cubic yards of spawning sized gravel can be imported or relocated and placed upstream of each structure when in combination with other restoration activities that address the underlying systematic problem. For example a combined project consisting of: planting streambank vegetation, placing instream LW and supplementing spawning gravel.
3) Imported gravel must be free of invasive species and non-native seeds.

e. <u>Riparian Vegetation Planting</u>

Description. The BPA proposes to fund vegetation planting to recover watershed processes and functions associated with native plant communities and that will help restore natural plant species composition and structure. Under this activity category, project proponents would plant trees, shrubs, herbaceous plants, and aquatic macrophytes to help stabilize soils. Large trees such as cottonwoods and conifers will be planted in areas where they historically occurred but are currently either scarce or absent. Native plant species and seeds will be obtained from local sources to ensure plants are adapted to local climate and soil chemistry.

Vegetation management strategies will be utilized that are consistent with local native succession and disturbance regimes and specify seed/plant source, seed/plant mixes, and soil preparation.

Planting will address the abiotic factors contributing to the sites' succession, *i.e*., weather and disturbance patterns, nutrient cycling, and hydrologic condition. Only certified noxious weed-free seed (99.9%), hay, straw, mulch, or other vegetation material for site stability and revegetation projects will be utilized.

Guidelines for Review.

The proposed activities are considered low risk and will not require RRT review: Riparian vegetation planting that meet all of the following conservation measures

Conservation Measures.

1) An experienced silviculturist, botanist, ecologist, or associated technician shall be involved in designing vegetation treatments.
2) Species to be planted must be of the same species that naturally occurs in the project area.
3) Tree and shrub species as well as sedge and rush mats to be used as transplant material shall come from outside the bankfull width, typically in abandoned flood plains, and where such plants are abundant.
4) Sedge and rush mats should be sized as to prevent their movement during high flow events.
5) Concentrate plantings above the bankfull elevation.
6) Species distribution shall mimic natural distribution in the riparian and floodplain areas.

f. Channel Reconstruction

Description. The BPA proposes to review and fund channel reconstruction projects to improve aquatic and riparian habitat diversity and complexity, reconnect stream channels to floodplains, reduce bed and bank erosion, increase hyporheic exchange, provide long-term nutrient storage, provide substrate for macroinvertebrates, moderate flow disturbance, increase retention of organic material, and provide refuge for fish and other aquatic species by reconstructing stream channels and floodplains that are compatible within the appropriate watershed context and geomorphic setting.

The reconstructed stream system shall be composed of a naturally sustainable and dynamic planform, cross-section, and longitudinal profile that incorporates unimpeded passage and temporary storage of water, sediment, organic material, and species. Stream channel adjustment over time is to be expected in naturally dynamic systems and is a necessary component to restore a wide array of stream functions. It is expected that for most projects that there will be a primary channel with secondary channels that are activated at various flow levels to increase floodplain connectivity and to improve aquatic habitat through a range of flows. This proposed action is not intended to artificially stabilize streams into a single location or into a single channel for the purposes of protecting infrastructure or property.

Channel reconstruction consists of re-meandering or movement of the primary active channel, and may include structural elements such as streambed simulation materials, streambank restoration, and hydraulic roughness elements. For bed stabilization and hydraulic control structures, constructed riffles shall be preferentially used in pool-riffle stream types, while roughened channels and boulder weirs shall be preferentially used in step-pool and cascade stream types. Material selection (large wood, rock, gravel) shall also mimic natural stream system materials.

Due to the complexity of channel reconstruction projects, there shall be separate procedural guidelines, data and information requirements, that will be refined, amended, and updated through an iterative collaborative process with BPA, NMFS, and USFWS.

The channel reconstruction activity is considered ***high risk*** and will require RRT and NMFS Hydro review.

High Risk projects in the Channel Reconstruction activity shall address the **General Project and Data Summary Requirements (Appendix C),** the following **Conservation Measures**, and include a **Monitoring and Adaptive Management Plan.**

Conservation Measures:

Because of the complexity of channel reconstruction projects, there shall be an interdisciplinary design team minimally consisting of a biologist, engineer, and hydrologist.

Data requirements for RRT & NMFS review and analysis include:

1) Designs must demonstrate a clear linkage to limiting factors identified within the appropriate sub-basin plan, recovery plan or recommendations by a technical oversight and steering committee within a localized region.
2) Detailed construction drawings
3) Designs must demonstrate that channel reconstruction will identify, correct to the extent possible, and then account for in the project development process, the conditions that lead to the degraded condition.
4) Designs must demonstrate that the proposed action will mimic natural conditions for gradient, width, sinuosity and other hydraulic parameters.
5) Designs must demonstrate that structural elements shall fit within the geomorphic context of the stream system.
6) Designs must demonstrate sufficient hydrology and that the project will be self-sustaining over time. Self-sustaining means the restored or created habitat would not require major or periodic maintenance, but function naturally within the processes of the floodplain.
7) Designs must demonstrate that the proposed action will not result in the creation of fish passage issues or post construction stranding of juvenile or adult fish.

3.5.3 Action Category 3. Invasive and Non-Native Plant Control

The BPA proposes to fund management of vegetation using physical control and through the use of herbicides to control or eliminate non-native, invasive plant species that compete with or displace native plant communities and recover watershed processes and functions associated with native plant communities.

a. Manage Vegetation Using Physical Control

BPA proposes to use two mechanisms for vegetation management by physical control: (a) Manual control includes hand pulling and grubbing with hand tools; bagging plant residue for burning or other proper disposal; mulching with organic materials; shading or covering unwanted vegetation; controlling brush and pruning using hand and power tools such as chain saws and machetes; using grazing goats. When possible, manual control (e.g., hand pulling, grubbing, cutting) will be used in sensitive areas to avoid adverse effects to listed species or water quality. (b) Mechanical control includes techniques such as mowing, tilling, disking, or plowing. Mechanical control may be carried out over large areas or be confined to smaller areas (known as scalping). Ground-disturbing mechanical activity will be restricted in established buffer zones adjacent to streams, lakes, ponds, wetlands and other identified sensitive habitats based on percent slope. For slopes less than 20%, a buffer width of 35 feet will be used. For slopes over 20%, no ground-disturbing mechanical equipment will be used.

Guidelines for Review.

The proposed activities are considered low risk and will not require RRT review.

Conservation Measures.

1) For mechanical control that will disturb the soil, an untreated area will be maintained within the immediate riparian buffer area to prevent any potential adverse effects to stream channel or water quality conditions. The width of the untreated riparian buffer area will vary depending on site-specific conditions and type of treatment.
2) Ground-disturbing mechanical activity will be restricted in established buffer zones adjacent to streams, lakes, ponds, wetlands and other identified sensitive habitats based on percent slope. For slopes less than 20%, a buffer width of 35 feet will be used. For slopes over 20%, no ground-disturbing mechanical equipment will be used.
3) When possible, manual control (*e.g*., hand pulling, grubbing, cutting) will be used in sensitive areas to avoid adverse effects to listed species or water quality.
4) All noxious weed material will be disposed of in a manner that will prevent its spread. Noxious weeds that have developed seeds will be bagged and burned.

b. Manage Vegetation Using Herbicides

The BPA proposes to fund management of vegetation using chemical herbicides to recover watershed processes and functions associated with native plant communities.

Herbicides will be applied in liquid or granular form using wand or boom sprayers mounted on or towed by trucks, backpack equipment containing a pressurized container with an agitation device, injection, hand wicking cut surfaces, and ground application of granular formulas. Herbicides will be mixed with water as a carrier (no petroleum-based carriers will be used) and may also contain a variety of additives (see adjuvant paragraph below) to promote saturation and adherence, to stabilize, or to enhance chemical reactions. Aerial treatment is not proposed to be covered under this consultation, nor is treatment of aquatic weeds except for knotweed (*Polygonum cuspidatum*).

Conservation Measures.

1) *Maximum herbicide treatment area.* The area treated with herbicides above bankfull elevation, within riparian areas, will not exceed 10 acres above bankfull elevation and 2 acres below bankfull elevation, per 1.6-mile reach of a stream, per year.

2) *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 to non-target species. The applicator will be responsible for preparing and carrying out the herbicide transportation and safety plan, as follows.

3) *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; (m) all individuals involved, including any contracted applicators, will be instructed on the plan.

4) *Herbicides.* BPA proposes the use of the following herbicides in the typical application rates (see Tables 2 and 3) for invasive plant control. These products were previously evaluated in risk assessments by the US Forest Service http://www.fs.fed.us/foresthealth/pesticide/risk).

Table 3. Herbecides Proposed for Use by BPA.

Common Name	Trade Name	Typical Application Rates (ai/ac)	Maximum Label Application Rate (ai/ac)	General Geographic Application Areas
2,4-D (amine)	Many	0.5 - 1.5 lbs.	4.0 lbs	Upland & Riparian
Aminopyralid	Milestone®	0.11 - 0.22 lbs	0.375 lb	Upland & Riparian
Chlorsulfuron	Telar®	0.25 - 1.33 oz	3.0 oz	Upland
Clethodim	Select®	0.125 – 0.5 lbs	0.50 lb	Upland
Clopyralid	Transline®	0.1 - 0.375 lbs	0.5 lb	Upland & Riparian
Dicamba	Banvel® only	0.25 - 7.0 lbs	8.0 lbs	Upland & Riparian
Glyphosate 1 Glyphosate 2	Many Many	0.5 - 2.0 lbs 0.5 - 2.0 lbs	3.75 lbs 3.75 lbs	Upland & Riparian Upland
Imazapic	Plateau®	0.063 – 0.189 lbs	0.189 lb	Upland & Riparian
Imazapyr	Arsenal® Habitat®	0.5 – 1.5 lbs.	1.5 lbs	Upland & Riparian
Metsulfuron methyl	Escort®	0.33 - 2.0 oz	4.0 oz	Upland
Picloram	Tordon®	0.125 - 0.50 lb	1 lb	Upland
Sethoxydim	Poast®	0.1875 – 0.375 lb	0.375 lb	Upland
Sulfometuron methyl	Oust®	0.023 - 0.38 oz	2.25 oz	Upland
Triclopyr (TEA)	Garlon 3A®	1.0 - 2.5 lbs	9.0 lbs	Upland & Riparian

5) *2,4-D.* As a result of the National Consultation[18], this herbicide shall comply with all relevant reasonable and prudent alternatives from the 2011 Biological Opinion (NMFS 2011a):

[18] On June 30, 2011, NMFS issued a final biological opinion addressing the effects of this herbicide on ESA-listed Pacfic salmonids. The opinion has concluded that EPA's proposed registration of certain uses of 2,4-D, including aquatic uses of 2,4-D BEE are likely to jeopardize the continued existence of the 28 endangered and threatened Pacific salmonids. http://www.nmfs.noaa.gov/pr/consultation/pesticides.htm

a. Do not apply when wind speeds are below 2 mph or exceed 10 mph, except when winds in excess of 10 mph will carry drift away from salmonid-bearing waters.
b. Do not apply when a precipitation event, likely to produce direct runoff to salmonid bearing waters from the treated area, is forecasted by NOAA/NWS (National Weather Service) or other similar forecasting service within 48 h following application.
c. Control of invasive plants within the riparian habitat shall be by individual plant treatments for woody species, and spot treatment of less than 1/10 acre for herbaceous species per project per year.

6) *Adjuvants.* The following adjuvants are proposed for use (Table 2-2). Polyethoxylated tallow amine (POEA) surfactant and herbicides that contain POEA (e.g., Roundup) have been removed from the proposed action.
7) *Herbicide carriers.* Herbicide carriers (solvents) are limited to water or specifically labeled vegetable oil.
8) *Herbicide mixing.* Herbicides will be mixed more than 150 feet from any natural waterbody to minimize the risk of an accidental discharge and no more than three different herbicides may be mixed for any one application.
9) *Herbicide application rates.* Herbicides will be applied at the lowest effective label rates, including the typical and maximum rates given (Table 2-2). For broadcast spraying, application of herbicide or surfactant will not exceed the typical label rates.

Table 4. Adjuvants Proposed for Use by BPA.

Adjuvant Type	Trade Name	Labeled Mixing Rates per Gallon of Application Mix	General Geographic Application Areas
Colorants	Dynamark™ U.V. (red)	0.1 fl oz	Riparian
	Aquamark™ Blue	0.1 fl oz	Riparian
	Dynamark™ U.V. (blu)	0.5 fl oz	Upland
	Hi-Light® (blu)	0.5 fl oz	Upland
Surfactants	Activator 90®	0.16 – 0.64 fl oz	Upland
	Agri-Dex®	0.16 – 0.48 fl oz	Riparian
	Entry II®	0.16 – 0.64 fl oz	Upland
	Hasten®	0.16 – 0.48 fl oz	Riparian
	LI 700®	0.16 – 0.48 fl oz	Riparian
	R-11®	0.16 – 1.28 fl oz	Riparian
	Super Spread MSO®	0.16 – 0.32 fl oz	Riparian
	Syl-Tac®	0.16 – 0.48 fl oz	Upland
Drift Retardants	41-A®	0.03 – 0.06 fl oz	Riparian
	Valid®	0.16 fl oz	Upland

10) *Herbicide application methods.* Liquid or granular forms of herbicides to be applied by a licensed applicator 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.
11) *Emergent Knotweed Application.* No aquatic application of chemicals is covered by this consultation except for treating emergent knotweed. Only aquatic labeled glyphosate formulations will be used. The only application methods for emergent knotweed are stem injection (formulation up to 100% for emergent stems greater than 0.75 inches in diameter), wicking or wiping (diluted to 50% formulation), and hand-held spray bottle application of glyphosate (up to the percentage allowed by label instructions when applied to foliage using low pressure hand-held spot spray applicators).

12) *Water Transportation.* Most knotweed patches are expected to have overland access. However, some sites may be reached only by water travel, either by wading or inflatable raft (or kayak). The following measures will be used to reduce the risk of a spill during water transport: (a) No more than 2.5 gallons of glyphosate will be transported per person or raft, and typically it will be one gallon or less. (b) Glyphosate will be carried in 1 gallon or smaller plastic containers. The containers will be wrapped in plastic bags and then sealed in a dry-bag. If transported by raft, the dry-bag will be secured to the watercraft.

13) *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.

Tables 5 and 6 identify BPA's proposed minimum weather and wind speed restrictions (to be used in the absence of more stringent label instructions and restrictions). During application, applicators will monitor weather conditions hourly at sites where spray methods are being used.

14) *Herbicide Reporting***.** Herbicide use will follow the same approval process as other activities under the HIP III BOs, with the submittal of the Proposed Herbicide Use Table (BA, **Appendix A**) to BPA. If herbicide use is the only activity proposed under the HIP III BOs, submittal of a 120-day implementation report is not required.

Table 5. Herbicide Buffer Widths (from High Water Mark) to Minimize Impacts on Non-Target Resources.

Herbicide	Broadcast Application[19]		Backpack Sprayer/Bottle[20] Spot Spray Foliar/Basal		Hand Application[21] Wicking/Wiping/Injection
	Min buffer from high water mark (ft)	Max/ Min wind speed (mph)	Min buffer from high water mark (ft)	Max/ Min wind speed (mph)	Min buffer from high water mark (wind speed not a factor)
2,4-D (amine)	100	10/2	50	5/2	15 feet for aquatic labeled formulations.
Aminopyralid	100	10/2	15	5/2	Up to high water mark.
Chlorsulfuron	100	10/2	15	5/2	Up to high water mark.
Clethodim	NA	NA	50	5/2	Do not use within 50 feet of any surface water.
Clopyralid	100	10/2	15	5/2	Up to high water mark.
Dicamba (Banvel only)	100	10/2	15	5/2	Up to high water mark.
Glyphosate 1	100	10/2	15	5/2	Up to water's edge for aquatic labeled formulations. See knotweed General Herbicide Conservation Measures for emergent application restrictions.
Glyphosate 2	100	10/2	100	5/2	100 feet
Imazapic	100	10/2	15	5/2	Up to water's edge for aquatic labeled formulations.
Imazapyr	100	10/2	15	5/2	Up to water's edge for aquatic labeled formulations; otherwise, up to the high water mark.
Metsulfuron	100	10/2	15	5/2	Up to high water mark.
Picloram	100	8/2	100	5/2	Do not use within 100 feet of any surface water.
Sethoxydim	100	10/2	50	5/2	Do not use within 50 feet of any surface water.
Sulfometuron	100	10/2	15	5/2	Up to high water mark.
Triclopyr (TEA)	100	10/2	50	5/2	Up to high water mark for cut-stump application of aquatic labeled formulations; 15 feet for other

[19] Ground-based only broadcast application methods via truck/ATV with motorized low-pressure, high-volume sprayers using spray guns, broadcast nozzles, or booms.
[20] Spot and localized foliar and basal/stump applications using a hand-pump backpack sprayer or field-mixed or pre-mixed hand-operated spray bottle.
[21] Hand applications to a specific portion of the target plant using wicking, wiping or injection techniques. This technique implies that herbicides do not touch the soil during the application process.

					applications.
Herbicide Mixtures	100	Most conservative of listed herbicides.	15	Most conservative of listed herbicides.	Most conservative of listed herbicides.

Table 6. Adjuvant Buffer Widths to Minimize Impacts on Non-Target Resources.

Adjuvant	**Broadcast Application**[22]	**Backpack Sprayer/Bottle**[23] **Spot Spray Foliar/Basal**	**Hand Application**[24] **Wicking/Wiping/Injection**
	Minimum buffer (ft)	**Minimum buffer (ft)**	**Minimum buffer (ft)** **(wind speed not a factor)**
Dynamark (red)	100	15	Up to water's edge when using herbicides labeled for aquatic uses.
Dynamark (yel)	100	15	Up to water's edge when using herbicides labeled for aquatic uses.
Dynamark (blu)	100	>50 <50 Do not use	>50 Herbicide dependent from Table 2-3. <50 Do not use.
Hi-Light (blu)	100	>50 <50 Do not use	>50 Herbicide dependent from Table 2-3. <50 Do not use.
Activator 90®	100	15	Up to water's edge for aquatic labeled formulations.
Agri-Dex	100	15	Up to water's edge for aquatic labeled formulations.
Entry II	100	<100 Do not use	<100 Do not use.
Hasten	100	15	Up to water's edge for aquatic labeled formulations.
LI 700	100	15	Up to water's edge for aquatic labeled formulations.
R-11	100	>50 <50 Do not use	>50 Herbicide dependent from Table 2-3. <50 Do not use.

[22] Ground-based only broadcast application methods via truck/ATV with motorized low-pressure, high-volume sprayers using spray guns, broadcast nozzles, or booms.
[23] Spot and localized foliar and basal/stump applications using a hand-pump backpack sprayer or field-mixed or pre-mixed hand-operated spray bottle.
[24] Hand applications to a specific portion of the target plant using wicking, wiping or injection techniques. This technique implies that herbicides do not touch the soil during the application process.

Super Spread MSO	100	15	Up to water's edge for aquatic labeled formulations.
Syl-Tac	100	<50	<50 Do not use.
41-A	100	15	Up to water's edge when using herbicides labeled for aquatic uses.
Valid	100	50	<50 Do not use.

3.5.4 Action Category 4. Piling Removal

Description. The following steps will be used to minimize creosote release, sediment disturbance, and total suspended solids: (a) Installation of a floating surface boom to capture floating surface debris; (b) keeping all equipment (e.g., bucket, steel cable, vibratory hammer) out of the water, grip piles above the waterline, and complete all work during low water and low current conditions; (c) dislodging the piling with a vibratory hammer, whenever feasible—never intentionally break a pile by twisting or bending; (d) slowly lifting the pile from the sediment and through the water column; (e) placing the pile in a containment basin on a barge deck, pier, or shoreline without attempting to clean or remove any adhering sediment (a containment basin for the removed piles and any adhering sediment may be constructed of durable plastic sheeting with sidewalls supported by hay bales or another support structure to contain all sediment, and return flow may be directed back to the waterway); (f) filling the holes left by each piling with clean, native sediments; (g) disposing of all removed piles, floating surface debris, any sediment spilled on work surfaces, and all containment supplies at a permitted upland disposal site.

Conservation Measures.

1) Pollution Minimization**.** The following steps will be used to minimize creosote release, sediment disturbance, and total suspended solids:
   a) Installation of a floating surface boom to capture floating surface debris.
   b) Keeping all equipment (e.g., bucket, steel cable, vibratory hammer) out of the water, grip piles above the waterline, and complete all work during low water and low current conditions
   c) Dislodging the piling with a vibratory hammer, whenever feasible—never intentionally break a pile by twisting or bending
   d) Slowly lifting the pile from the sediment and through the water column.
   e) Placing the pile in a containment basin on a barge deck, pier, or shoreline without attempting to clean or remove any adhering sediment (a containment basin for the removed piles and any adhering sediment may be constructed of durable plastic sheeting with sidewalls supported by hay bales or another support structure to contain all sediment, and return flow may be directed back to the waterway)
   f) Filling the holes left by each piling with clean, native sediments.
   g) Disposing of all removed piles, floating surface debris, any sediment spilled on work surfaces, and all containment supplies at a permitted upland disposal site.

2) Broken piles. If a pile breaks above the surface of uncontaminated sediment, or less than 2 feet below the surface, every attempt short of excavation will be made to remove it entirely. If the pile cannot be removed without excavation, saw the stump off at least 3 feet below the surface of the sediment. If a pile breaks above contaminated sediment, saw the stump off at the sediment line; if a pile breaks within contaminated sediment, make no further effort to remove it and cover the hole with a cap of clean substrate appropriate for the site. If dredging is likely in the area of piling removal, use a global positioning device (GPS) to note the location of all broken piles for future use in site debris characterization.

3.5.5 Action Category 5. Road and Trail Erosion Control, Maintenance, and Decommissioning

a. Road Maintenance

Description. BPA proposes to fund road maintenance activities, including: (a) creating barriers to human access: gates, fences, boulders, logs, tank traps, vegetative buffers, and signs, (b) surface maintenance, such as building and compacting the road prism, grading, and spreading rock or surfacing material, (c) drainage maintenance and repair of inboard ditch lines, waterbars, sediment traps (d) removing and hauling or stabilizing pre-existing cut and fill material or slide material (e) snowplowing (f) relocating portions of roads and trails to less sensitive areas outside of riparian buffer areas. The proposed activity does not include asphalt resurfacing, widening roads, or new construction or relocation of any permanent road inside a riparian buffer area except for a bridge approach in accordance to the section on **Transportation Infrastructure.**

Road grading and shaping will maintain, not destroy, the designed drainage of the road, unless modification is necessary to improve drainage problems that were not anticipated during the design phase. Road maintenance will not be attempted when surface material is saturated with water and erosion problems could result.

Conservation Measures

1) Dust-abatement additives and stabilization chemicals (typically magnesium chloride or calcium chloride salts) will not be applied within 25 feet of water or a stream channel and will be applied so as to minimize the likelihood that they will enter streams.
    a. Additives and stabilization chemicals (typically magnesium chloride or calcium chloride salts) will not be applied within 25 feet of water or a stream channel and will be applied so as to minimize the likelihood that they will enter streams.
    b. Spill containment equipment will be available during chemical dust abatement application.
    c. Oil, oil-based, petroleum-based products will not be used for dust abatement.
    d. Dust-abatement application will be avoided during or just before wet weather and at stream crossings or other locations that could result in direct delivery to a waterbody, typically within 25 feet of a waterbody or stream channel.

e. Spill containment equipment will be available during chemical dust abatement application.

2) Application will be avoided during or just before wet weather and at stream crossings or other locations that could result in direct delivery to a water body (typically within 25 feet of a water body or stream channel).
3) Waste material generated from road maintenance activities and slides will be disposed on stable, nonfloodplain sites approved by a geotechnical engineer or other qualified personnel.
4) Disturbance of existing vegetation in ditches and at stream crossings will be minimized to the greatest extent possible.
5) Ditches and culverts will be promptly cleaned of materials resulting from slides or other debris.
6) Berms will not be left along the outside edge of roads, unless an outside berm was specifically designed to be a part of the road, and low-energy drainage is provided.
7) Ditch back slopes will not be undercut, to avoid slope destabilization and erosion acceleration.
8) When blading and shaping roads, excess material will not be sidecast onto the fill. All excess material that cannot be bladed into the surface will be hauled to an appropriate site. Haul and prohibition of sidecasting will not be required for organic material like trees, needles, branches, and clean sod; however, fine organics like sod and grass will not be cast into water.
9) Slides and rock failures including fine material of more than approximately ½ yard at one site will be hauled to disposal sites. Fine materials (1 inch or smaller) from slides, ditch maintenance, or blading may be worked into the road. Scattered clean rocks (1 inch or larger) may be raked or bladed off the road except within 300 feet of perennial or 100 feet of intermittent streams.
10) Road grading material will not be sidecast along roads within ¼ mile of perennial streams and from roads onto fill slopes having a slope greater than 45%.
11) Road maintenance will not be attempted when surface material is saturated with water and erosion problems could result.
12) Large woody (LW >9 m in length and >50 cm in diameter) present on roads will be moved intact to downslope of the road, subject to site-specific considerations. Movement down-slope will be subject to the guidance of a natural resource specialist with experience in fish biology.
13) Snowplowing will be performed in accordance with the following criteria:
    a. No chemical additives such as salt or de-icing chemicals will be used in conjunction with snowplowing.
    b. Drainage holes will be placed in snow berms to provide drainage
    c. A minimum of two inches of snow will be left on gravel roads during plowing; paved roads may be scraped to the surface
    d. No gravel or surfacing material will be bladed off the road.
    e. No deliberate sidecasting of snow into or over drainage structures will be permitted

f. Plowing will not be allowed on gravel roads during thaw periods when the road is wet.

b. Road Decommissioning

Description. BPA proposes to decommission and obliterate roads that are no longer needed, e.g., logging roads. Water bars will be installed, road surfaces will be insloped or outsloped, asphalt and gravel will be removed from road surfaces, culverts and bridges will be altered or removed, streambanks will be recontoured at stream crossings, cross drains will be installed, fill or sidecast materials will be removed, road prism will be reshaped, and sediment catch basins will be created.

Conservation Measures

1) All surfaces will be revegetated to reduce surface erosion of bare soils.
2) Recontour the affected area to mimic natural floodplain contours and gradient to the extent possible.
3) Surface drainage patterns will be recreated, and dissipaters, chutes or rock will be placed at remaining culvert outlets.
4) Conduct activities during dry-field conditions (generally May 15 – October 15) when the soil is more resistant to compaction and soil moisture is low.
5) Slide and waste material will be disposed in stable, non-floodplain sites unless materials are to restore natural or near-natural contours, and approved by a geotechnical engineer or other qualified personnel.

3.5.6 Action Category 6. In-channel Nutrient Enhancement

Description. BPA proposes to fund the application of nutrients throughout a waterway corridor by placement of salmon carcasses into waterways, placement of carcass analogs (processed fish cakes) into waterways or placement of inorganic fertilizers into waterways.

Conservation Measures

1) In Oregon, projects are permitted through Oregon Department of Environmental Quality (ODEQ). Carcasses from the treated watershed or those that are certified disease free by an ODFW pathologist will be used.
2) In Washington, WDFW publication entitled "Salmon Carcass Analogs, and Delayed Release Fertilizers to Enhance Stream Productivity in Washington State" (WDFW 2004), will be followed.
3) Carcasses will be of species native to the watershed and placed during the normal migration and spawning times, as would naturally occur in the watershed.
4) Eutrophic or naturally oligotrophic systems will not be supplemented with nutrients.

5) Each waterway will be individually assessed for available light, water quality, stream gradient and life history of the fish present, and adaptive management will be used to derive the maximum benefits of nutrient enhancement.

3.5.7 Action Category 7. Irrigation and Water Delivery/Management Actions

The BPA proposes to fund the following activities for Irrigation and Water Delivery Management Actions: (a) Convert Delivery System to Drip or Sprinkler Irrigation, (b) Convert Water Conveyance from Open Ditch to Pipeline or Line Leaking Ditches and Canals, (c) Convert from Instream Diversions to Groundwater Wells for Primary Water Sources, (d) Install or Replace Return Flow Cooling Systems, (e) Install Irrigation Water Siphon Beneath Waterway, (f) Livestock Watering Facilities, and (g) Install New or Upgrade/Maintain Existing Fish Screens.

The criteria, plans and specifications, and operation and maintenance protocols of the following activity categories shall use the most recent versions of NRCS guidance.

The BPA HIP III will only cover irrigation efficiency actions within this activity category that use state approved regulatory mechanisms (e.g. Oregon ORS 537.455-.500, Washington RCW 90.42) for ensuring that water savings will be protected as instream water rights, or in cases where project implementers identify how the water conserved will remain instream to benefit fish without any significant loss of the instream flows to downstream diversions.

a. Convert Delivery System to Drip or Sprinkler Irrigation

Description. Flood or other inefficient irrigation systems will be converted to drip or sprinkler irrigation; education will be provided to irrigators on ways to make their systems more efficient. This proposed activity will involve the installation of pipe, possibly trenched and buried into the ground, and possibly pumps to pressurize the system.

b. Convert Water Conveyance from Open Ditch to Pipeline or Line Leaking Ditches and Canals

Description. Open ditch irrigation water conveyance systems will be replaced with pipelines to reduce evaporation and transpiration losses. Leaking irrigation ditches and canals will be converted to pipeline or lined with concrete, bentonite, or appropriate lining materials.

c. Convert from Instream Diversions to Groundwater Wells for Primary Water Source

Description. Wells will be drilled as an alternative water source to surface water withdrawals. Water from the wells will be pumped into ponds or troughs for livestock, or used to irrigate agricultural fields. Instream diversion infrastructure will be removed or downsized, if feasible. If an instream diversion is downsized, it will be covered under this programmatic consultation only by following all criteria outlined in the **Consolidate, or Replace Existing Irrigation**

Diversions section. New wells will be located more than ¼ mile from the stream and will not be hydraulically connected to the stream.

d. Install or Replace Return Flow Cooling Systems

Description. Above-ground pipes and open ditches that return tailwater from flood-irrigated fields back to the river will be replaced. Return flow cooling systems will be constructed by trenching and burying a network of perforated PVC pipes that will collect irrigation tailwater below ground, eliminating pools of standing water in the fields and exposure of the water to direct solar heating. No instream work is involved except for installing the drain pipe outfall; most work will be in uplands or in riparian buffer areas that are already plowed or grazed.

e. Install Irrigation Water Siphon Beneath Waterway

Description. Siphons transporting irrigation water will be installed beneath waterways where irrigation ditch water currently enters a stream and commingles with stream water, with subsequent withdrawal of irrigation water back into an irrigation ditch system downstream. Periodic maintenance of the siphon will be conducted. Work may entail use of heavy equipment, power tools, and/or hand tools.

Conservation Measures

1) Directional drilling to create siphon pathway will be employed whenever possible.
2) Trenching will occur in dry stream beds only; work area isolation will be employed in perennial streams.
3) Stream widths will be maintained at bankfull width or greater.
4) No part of the siphon structure will block fish passage.
5) No concrete will be placed within the bankfull width.
6) Siphon surface structures will be set back from the top of the streambank at least ten feet.
7) Minimum cover over a siphon structure within the streambed shall be three feet of natural substrate.
8) Waterway will be reconstructed to a natural streambed configuration upon completion.

f. Livestock watering facilities

Description. Watering facilities will consist of various low-volume pumping or gravity-feed systems to move the water to a trough or pond at an upland site. Either above-ground or underground piping will be installed between the troughs or ponds and the water source. Water sources may include springs and seeps, streams, or groundwater wells. Pipes will generally range from 0.5 to 4 inches, but may exceed 4 inches in diameter. Placement of the pipes in the ground will typically involve minor trenching using a backhoe or similar equipment. The off-channel watering facility will (a) avoid steep slopes; (b) ensure that each livestock water development has a float valve or similar device limiting use to demand, a return flow system, a fenced overflow area, or similar means to minimize water withdrawal and potential runoff and erosion. All pumping and gravity-feed systems within habitat occupied by listed salmonids (salmon, steelhead, bull trout) will have fish screens to avoid juvenile fish entrainment, and will be operated in accordance with NMFS's current fish screen criteria (NMFS 2011 or most recent version). If pumping rate exceeds 3 cfs, a NMFS Hydro fish passage review will be necessary.

g. Install New or Upgrade/Maintain Existing Fish Screens (Review may be required).

Description. Irrigation diversion intake and return points will be designed or replaced to prevent fish and other aquatic organisms of all life stages from swimming or being entrained into the irrigation system. Fish screens for surface water that is diverted by gravity or by pumping at a rate that exceeds 3 cfs will be submitted to NMFS for review and approval. All other diversions will have a fish screen that utilizes an automated cleaning device with a minimum effective surface area of 2.5 square feet per cfs, and a nominal maximum approach velocity of 0.4 feet per second (fps), or no automated cleaning device, a minimum effective surface area of 1 square foot per cfs, and a nominal maximum approach rate of 0.2 fps; and a round or square screen mesh that is no larger than 2.38 mm (0.094") in the narrow dimension, or any other shape that is no larger than 1.75 mm (0.069") in the narrow dimension. Each fish screen will be installed, operated, and maintained according to NMFS' fish screen criteria (NMFS 2011). Periodic maintenance, which may include temporary removal, of fish screens will be conducted to ensure their proper functioning, e.g., cleaning debris buildup, and replacement of parts.

State resource agencies may submit one PNC form for all anticipated fish screen installation, repairs, and maintenance for each field season. The PNC shall contain proposed locations (GIS map) and specific activities. PNCs shall contain actual locations, specific activities undertaken, and a statement of compliance with NMFS fish screen criteria (NMFS 2011).

3.5.8 Action Category 8. Fisheries, Hydrologic, and Geomorphologic Surveys

Description. BPA proposes to fund the collection of information in uplands, floodplains, and streambeds regarding existing on-ground conditions relative to habitat type, condition, and impairment; species presence, abundance, and habitat use; and conservation, protection, and rehabilitation opportunities or effects. Electro-shocking and fish handling for research purposes is not included, as this work must have an ESA Section 10 research permit.

Work may entail use of trucks, survey equipment, and crews using hand tools, and includes the following activities:

1) Measuring/assessing and recording physical measurements by visual estimates or with survey instruments.
2) Installing rebar or other markers along transects or at reference points.
3) Installing piezometers and staff gauges to assess hydrologic conditions and installing recording devices for stream flow and temperature.

4) Conducting snorkel surveys to determine species of fish in streams and observing interactions of fish with their habitats
5) Excavating cultural resource test pits.
6) Installing PIT detector arrays.

3.5.9 Action Category 9. Special Actions (For Terrestrial Species)

BPA proposes to enhance upland terrestrial habitats until native plant communities or other natural habitat features become established; to eliminate or reduce livestock degradation of streams, streambanks, lakeshores, riparian/wetland vegetation, and unstable upland slopes; reduce soil compaction and erosion thereby improving riparian habitat function; and to secure LW material to augment not replace, natural habitat features and processes by (a) Install/Develop Wildlife Structures, (b) Fencing Construction for Livestock Control, (c) Plant Vegetation and (d) Tree Removal for LW projects.

Install/Develop Wildlife Structures

Description. This activity involves the installation or development of a variety of structures that mimic natural features and provide support for wildlife foraging, breeding, and or resting/refuge. These can include bat roosting/breeding structures, avian nest boxes, hardwood snags, brush/ cover piles, coarse woody debris, and raptor perches. Work may entail use of power tools and/or crews with hand tools.

Construct Fencing for Grazing Control

Description. Permanent or temporary livestock exclusion fences or cross-fences will be installed to assist in grazing management. Individual fence posts will be pounded or dug using hand tools or augers on backhoes or similar equipment. Fence posts will be set in the holes, backfilled, and fence wire strung or wooden rails placed. Installation may involve the removal of native or non-native vegetation along the proposed fence line. Occasionally rustic wood X-shaped fence that does not require setting posts will be used. No grazing will be allowed within riparian area fenced enclosures.

Plant Vegetation

Description. Plant trees, shrubs, herbaceous plants, and aquatic macrophytes to help stabilize soils. Develop a vegetation plan that is responsive to the biological and physical factors at the site. Plant large trees such as cottonwoods and conifers in areas where they historically occurred but are currently either scarce or absent. Obtain plants and seeds from local sources to ensure plants are adapted to local climate and soil chemistry.

Pastures and rangelands will be planted or seeded with native or adapted perennial and biannual vegetation. The ground will be scarified as necessary to promote seed germination. In areas with severe erosion or high erosion potential, trees, shrubs, vines, grasses, and legumes will be planted to stabilize soils. Because noxious weeds, nonnative invasive plants, and aggressive, weedy species can take over disturbed lands and degrade range values, vegetation will be controlled through the use of herbicide applications, mechanical removal, and hand pulling.

Prepare planting sites by cutting, digging, grubbing roots, scalping sod, de-compacting soil as needed, and removing existing vegetation. Place woody debris, wood chips, or soil at select locations to alter microsites. Plants will be fertilized, mulched, and stems wrapped to protect from rodent girdling. Buds will be capped to protect plants from herbivores. Work may entail use of heavy equipment, power tools, and/or hand tools.

Conservation Measures

1) Vegetation plans shall require the use of native species and specify seed/plant source, seed/plant mixes, soil preparation, etc.
2) Vegetation Plans shall include vegetation management strategies that are consistent with local native succession and disturbance regime.
3) Vegetation Plans shall address the abiotic factors contributing to the sites' succession, i.e., weather and disturbance patterns, nutrient cycling, and hydrologic condition.

Tree Removal for LW Projects

Description. Live conifers and other trees can be felled or pulled/pushed over in a Northwest Forest Plan (USDA and USDI 1994b) Riparian Reserve or PACFISH/INFISH (USDA-Forest Service 1995; USDA and USDI 1994a) riparian habitat conservation areas (RHCA), and upland areas (e.g., late successional reserves or adaptive management areas for northern spotted owl and marbled murrelet critical habitat) for in-channel LW placement only when conifers and trees are fully stocked. Tree felling shall not create excessive stream bank erosion or increase the likelihood of channel avulsion during high flows. Trees may be removed by cable, ground-based equipment, or helicopter. Danger trees and trees killed through fire, insects, disease, blow-down and other means can be felled and used for in-channel placement regardless of live-tree stocking levels. Trees may be felled or pushed/pulled directly into a stream or floodplain. Trees may be stock piled for future instream restoration projects. The project manager for an aquatic restoration action will coordinate with an action-agency wildlife biologist in tree-removal planning efforts.

Conservation Measures

The purpose of these criteria is to ensure that there would be no removal or adverse modification of suitable habitat for marbled murrelet or spotted owl.

1) The following Conservation Measures apply to tree removal within the range of marbled murrelets and the spotted owl in Douglas-fir dominated stands less than 80 years old that are not functioning as foraging habitat within a spotted owl home range and do not contain murrelet nesting structure. It does not apply to tree selection in older stands or hardwood-dominated stands unless stated otherwise.
    a) A wildlife biologist must be fully involved in all tree-removal planning efforts, and be involved in making decisions on whether individual trees are suitable for nesting or have other important listed bird habitat value.
    b) Outside of one site potential tree height of streams, trees can be removed to a level not less than a Relative Density (RD) of approximately 35 (stand scale), which is considered as fully occupying a site. This equates to approximately 60 trees per acre in the overstory and a tree spacing averaging 26 feet. Additionally 40% canopy cover would be maintained when in spotted owl or marbled murrelet CH, when within 300 feet of occupied or unsurveyed murrelet nesting structure, and when dispersal habitat is limited in the area.
    c) Tree species removed should be relatively common in the stand (i.e., not "minor" tree species).
    d) Snags and trees with broad, deep crowns ("wolf" trees), damaged tops or other abnormalities that may provide a valuable wildlife habitat component can not be removed.
    e) No gaps (openings) greater than 0.5 acre will be created in spotted owl CH. No gaps greater than ¼ acre will be created in murrelet CH. No gaps shall be created in Riparian Reserves that contain ESA-listed fish habitat.

2) The following conservation measures applies to tree removal within the range of marbled murrelet and the spotted owl in Douglas-fir dominated stands greater than 80 years old or that are functioning as foraging habitat within a spotted owl home range, and/or do contain marbled murrelet nesting structure.
    a) Individual trees or small groups of trees should come from the periphery of permanent openings (roads etc.) or from the periphery of non-permanent openings (e.g., plantations, along recent clear-cuts etc.). Groups of trees greater than 4 trees shall 1) not be removed from within marbled murrelet suitable stands or stands buffering (300 ft.) MM suitable stands, 2) not be buffering (300 ft.) individual trees with marbled murrelet nesting structure. A minimum distance of one potential tree height feet should be maintained between individual or group removals.
    b) Trees up to 36" dbh may be felled in any stands with agreement from an FWSwildlife biologist that the trees are not providing marbled murrelet nesting structures or providing cover for nest sites. No known spotted owl nest trees or alternate nest trees are to be removed. Potential spotted owl nest trees may only be removed in limited instances when it is confirmed with the FWS wildlife biologist that nest trees will not be limited in the stand post removal.
    c) In order to minimize the creation of canopy gaps or edges, groups of adjacent trees selected should not create openings greater than ¼ acre within 0.5 miles of

marbled murrelet occupied habitat or when within murrelet CH. Within spotted owl critical habitat, stands greater than 80 years old or within stands providing foraging habitat to spotted owl home ranges, gaps will be restricted to 0.5 acre openings or less. Gaps shall not be created in Riparian Reserves where ESA-listed fish occur.

4.0 Status of the Species and Critical Habitat

4.1 Bull Trout

4.1.1 Species Description

a) Taxonomy

The bull trout is a native char found in the coastal and intermountain west of North America. Dolly Varden (*Salvelinus malma)* and bull trout were previously considered a single species and were thought to have coastal and interior forms. However, Cavender (1978) described morphometric, meristic and osteological characteristics of the two forms, and provided evidence of specific distinctions between the two. In 1980, the American Fisheries Society formally recognized bull trout and Dolly Varden as separate species (Robins et al. 1980). Despite an overlap in the geographic range of bull trout and Dolly Varden in the Puget Sound area and along the British Columbia coast, there is little evidence of introgression (Hass and McPhail 1991). The Columbia River Basin is considered the region of origin for the bull trout. From the Columbia, dispersal to other drainage systems was accomplished by marine migration and headwater stream capture. Behnke (1980) postulated dispersion to drainages east of the continental divide may have occurred through the North and South Saskatchewan Rivers (Hudson Bay drainage) and the Yukon River system. Marine dispersal may have occurred from Puget Sound north to the Fraser, Skeena and Taku Rivers of British Columbia.

b) Species Description

Bull trout have unusually large heads and mouths for salmonids. Their body colors can vary tremendously depending on their environment, but are often brownish green with lighter (often ranging from pale yellow to crimson) colored spots running along their dorsa and flanks, with spots being absent on the dorsal fin, and light colored to white under bellies. They have white leading edges on their fins, as do other species of char. Bull trout have been measured as large as 103 centimeters (41 inches) in length, with weights as high as 14.5 kilograms (32 pounds) (Fishbase 2009). Bull trout may be migratory, moving throughout large river systems, lakes, and even the ocean in coastal populations, or they may be resident, remaining in the same stream their entire lives (USFWS 2011). Migratory bull trout are typically larger than resident bull trout (USFWS 1998)

c) Current legal status, including listing history

Listing History

The coterminous United States population of the bull trout (*Salvelinus confluentus*) was listed as threatened on November 1, 1999 (64 FR 58910). The threatened bull trout generally occurs in the Klamath River Basin of south-central Oregon; the Jarbidge River in Nevada; the Willamette River Basin in Oregon; Pacific Coast drainages of Washington, including Puget Sound; major rivers in Idaho, Oregon, Washington, and Montana, within the Columbia River Basin; and the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (Bond 1992, p. 4; Brewin and Brewin 1997, pp. 209-216; Cavender 1978, pp. 165-166; Leary and Allendorf 1997, pp. 715-720).

Throughout its range, the bull trout are threatened by the combined effects of habitat degradation, fragmentation, and alterations associated with dewatering, road construction and maintenance, mining, grazing, the blockage of migratory corridors by dams or other diversion structures, poor water quality, entrainment (a process by which aquatic organisms are pulled through a diversion or other device) into diversion channels, and introduced non-native species (64 FR 58910). Although all salmonids are likely to be affected by climate change, bull trout are especially vulnerable given that spawning and rearing are constrained by their location in upper watersheds and the requirement for cold water temperatures (Battin et al. 2007; Rieman et al. 2007b; Porter and Nelitz. 2009, pages 4-8). Poaching and incidental mortality of bull trout during other targeted fisheries are additional threats.

Distinct Population Segments and Population Units

The bull trout was initially listed as three separate Distinct Population Segments (DPSs) (63 FR 31647; 64 FR 17110). The preamble to the final listing rule for the United States coterminous population of the bull trout discusses the consolidation of these DPSs with the Columbia and Klamath population segments into one listed taxon and the application of the jeopardy standard under section 7 of the Act relative to this species (64 FR 58910):

4.1.2 Critical Habitat Description

d) Current legal status of the critical habitat

Current Designation

The Service published a final critical habitat designation for the coterminous United States population of the bull trout on October 18, 2010 (70 FR 63898); the rule became effective on November 17, 2010. A justification document was also developed to support the rule and is available on our website (http://www.fws.gov/pacific/bulltrout). The scope of the designation involved the species' coterminous range, which includes the Jarbidge River, Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments (also considered as interim recovery units)[25]. Rangewide, the Service designated reservoirs/lakes and stream/shoreline miles as bull trout critical habitat (Table 7). Designated bull trout critical habitat is of two primary use types: 1) spawning and rearing, and 2) foraging, migration, and overwintering (FMO).

Table 7. Stream/Shoreline Distance and Reservoir/Lake Area Designated as Bull Trout Critical Habitat.

State	Stream/Shoreline Miles	Stream/Shoreline Kilometers	Reservoir /Lake Acres	Reservoir/ Lake Hectares
Idaho	8,771.6	14,116.5	170,217.5	68,884.9
Montana	3,056.5	4,918.9	221,470.7	89,626.4
Nevada	71.8	115.6	-	-
Oregon	2,835.9	4,563.9	30,255.5	12,244.0
*Oregon/Idaho	107.7	173.3	-	-
Washington	3,793.3	6,104.8	66,308.1	26,834.0
Washington (marine)	753.8	1,213.2	-	-
Washington/Idaho	37.2	59.9	-	-
Washington/Oregon	301.3	484.8	-	-
Total	19,729.0	31,750.8	488,251.7	197,589.2
*Pine Creek Drainage which falls within Oregon				

The 2010 revision increases the amount of designated bull trout critical habitat by approximately 76 percent for miles of stream/shoreline and by approximately 71 percent for acres of lakes and reservoirs compared to the 2005 designation.

The final rule also identifies and designates as critical habitat approximately 1,323.7 km (822.5 miles) of streams/shorelines and 6,758.8 ha (16,701.3 acres) of lakes/reservoirs of unoccupied habitat to address bull trout conservation needs in specific geographic areas in several areas not occupied at the time of listing. No unoccupied habitat was included in the 2005 designation. These unoccupied areas were determined by the Service to be essential for restoring functioning migratory bull trout populations based on currently available scientific information. These unoccupied areas often include lower main stem river environments that can provide seasonally important migration habitat for bull trout. This type of habitat is essential in areas where bull trout habitat and population loss over time necessitates reestablishing bull trout in currently unoccupied habitat areas to achieve recovery.

[25] The Service's 5 year review (USFWS 2008, pg. 9) identified six draft recovery units. Until the bull trout draft recovery plan is finalized, the current five interim recovery units are in affect for purposes of section 7 jeopardy analysis and recovery. The adverse modification analysis does not rely on recovery units.

The final rule continues to exclude some critical habitat segments based on a careful balancing of the benefits of inclusion versus the benefits of exclusion. Critical habitat does not include: 1) waters adjacent to non-Federal lands covered by legally operative incidental take permits for habitat conservation plans (HCPs) issued under section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (Act), in which bull trout is a covered species on or before the publication of this final rule; 2) waters within or adjacent to Tribal lands subject to certain commitments to conserve bull trout or a conservation program that provides aquatic resource protection and restoration through collaborative efforts, and where the Tribes indicated that inclusion would impair their relationship with the Service; or 3) waters where impacts to national security have been identified (75 FR 63898). Excluded areas are approximately 10 percent of the stream/shoreline miles and 4 percent of the lakes and reservoir acreage of designated critical habitat. Each excluded area is identified in the relevant Critical Habitat Unit (CHU) text, as identified in paragraphs (e)(8) through (e)(41) of the final rule. It is important to note that the exclusion of waterbodies from designated critical habitat does not negate or diminish their importance for bull trout conservation. Because exclusions reflect the often complex pattern of land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments.

e) The primary constituent elements (PCEs)

Conservation Role and Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable core area populations (75 FR 63898:63943 [October 18, 2010]). The core areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses. CHUs generally encompass one or more core areas and may include FMO areas, outside of core areas, that are important to the survival and recovery of bull trout.

Thirty-two CHUs within the geographical area occupied by the species at the time of listing are designated under the revised rule. Twenty-nine of the CHUs contain all of the physical or biological features identified in this final rule and support multiple life-history requirements. Three of the mainstem river units in the Columbia and Snake River basins contain most of the physical or biological features necessary to support the bull trout's particular use of that habitat, other than those physical biological features associated with Primary Constituent Elements (PCEs) 5 and 6, which relate to breeding habitat.

The primary function of individual CHUs is to maintain and support core areas, which 1) contain bull trout populations with the demographic characteristics needed to ensure their persistence and contain the habitat needed to sustain those characteristics (Rieman and McIntyre 1993, p. 19); 2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage movement of migratory fish (MBTSG 1998, pp. 48-49; Rieman and McIntyre 1993, pp. 22-23); 3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations (Hard 1995, pp. 314-315; Healey and Prince 1995, p.

182; MBTSG 1998, pp. 48-49; Rieman and McIntyre 1993, pp. 22-23); and 4) are distributed throughout the historic range of the species to preserve both genetic and phenotypic adaptations (Hard 1995, pp. 321-322; MBTSG 1998, pp. 13-16; Rieman and Allendorf 2001, p. 763; Rieman and McIntyre 1993, p. 23).

Primary Constituent Elements for Bull Trout

Within the designated critical habitat areas, the PCEs for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering. Based on our current knowledge of the life history, biology, and ecology of this species and the characteristics of the habitat necessary to sustain its essential life-history functions, we have determined that the PCEs, as described within 70 FR 63898 are essential for the conservation of bull trout. A summary of those PCEs follows.

1. Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

2. Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

3. An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

4. Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

5. Water temperatures ranging from 2 °C to 15 °C (36 °F to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.

6. In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.

7. A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

8. Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

9. Sufficiently low levels of occurrence of non-native predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

The revised PCE's are similar to those previously in effect under the 2005 designation. The most significant modification is the addition of a ninth PCE to address the presence of nonnative predatory or competitive fish species. Although this PCE applies to both the freshwater and marine environments, currently no non-native fish species are of concern in the marine environment, though this could change in the future.

Note that only PCEs 2, 3, 4, 5, and 8 apply to marine nearshore waters identified as critical habitat. Also, lakes and reservoirs within the CHUs also contain most of the physical or biological features necessary to support bull trout, with the exception of those associated with PCEs 1 and 6. Additionally, all except PCE 6 apply to FMO habitat designated as critical habitat.

Critical habitat includes the stream channels within the designated stream reaches and has a lateral extent as defined by the bankfull elevation on one bank to the bankfull elevation on the opposite bank. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge that generally has a recurrence interval of 1 to 2 years on the annual flood series. If bankfull elevation is not evident on either bank, the ordinary high-water line must be used to determine the lateral extent of critical habitat. The lateral extent of designated lakes is defined by the perimeter of the waterbody as mapped on standard 1:24,000 scale topographic maps. The Service assumes in many cases this is the full-pool level of the waterbody. In areas where only one side of the waterbody is designated (where only one side is excluded), the mid-line of the waterbody represents the lateral extent of critical habitat.

In marine nearshore areas, the inshore extent of critical habitat is the mean higher high-water (MHHW) line, including the uppermost reach of the saltwater wedge within tidally influenced freshwater heads of estuaries. The MHHW line refers to the average of all the higher high-water heights of the two daily tidal levels. Marine critical habitat extends offshore to the depth of 10 meters (m) (33 ft) relative to the mean low low-water (MLLW) line (zero tidal level or average of all the lower low-water heights of the two daily tidal levels). This area between the MHHW line and minus 10 m MLLW line (the average extent of the photic zone) is considered the habitat most consistently used by bull trout in marine waters based on known use, forage fish availability, and ongoing migration studies and captures geological and ecological processes important to maintaining these habitats. This area contains essential foraging habitat and migration corridors such as estuaries, bays, inlets, shallow subtidal areas, and intertidal flats.

Adjacent shoreline riparian areas, bluffs, and uplands are not designated as critical habitat. However, it should be recognized that the quality of marine and freshwater habitat along streams, lakes, and shorelines is intrinsically related to the character of these adjacent features, and that human activities that occur outside of the designated critical habitat can have major effects on physical and biological features of the aquatic environment.

Activities that cause adverse effects to critical habitat are evaluated to determine if they are likely to “destroy or adversely modify” critical habitat by no longer serving the intended conservation role for the species or retaining those PCEs that relate to the ability of the area to at least periodically support the species. Activities that may destroy or adversely modify critical habitat are those that alter the PCEs to such an extent that the conservation value of critical habitat is appreciably reduced (75 FR 63898:63943; USFWS 2004, Vol. 1. pp. 140-193, Vol. 2. pp. 69-114). The Service’s evaluation must be conducted at the scale of the entire critical habitat area designated, unless otherwise stated in the final critical habitat rule (USFWS and NMFS 1998, pp. 4-39). Thus, adverse modification of bull trout critical habitat is evaluated at the scale of the final designation, which includes the critical habitat designated for the Klamath River, Jarbidge River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments. However, we consider all 32 CHUs to contain features or areas essential to the conservation of the bull trout (75 FR 63898:63901, 63944). Therefore, if a proposed action would alter the physical or biological features of critical habitat to an extent that appreciably reduces the conservation function of one or more critical habitat units for bull trout, a finding of adverse modification of the entire designated critical habitat area may be warranted (75 FR 63898:63943).

Current Critical Habitat Condition Rangewide

The condition of bull trout critical habitat varies across its range from poor to good. Although still relatively widely distributed across its historic range, the bull trout occurs in low numbers in many areas, and populations are considered depressed or declining across much of its range (67 FR 71240). This condition reflects the condition of bull trout habitat. The decline of bull trout is primarily due to habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management practices, impoundments, dams, water diversions, and the introduction of nonnative species (63 FR 31647, June 10 1998; 64 FR 17112, April 8, 1999).

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and their habitat, and continue to do so. Among the many factors that contribute to degraded PCEs, those which appear to be particularly significant and have resulted in a legacy of degraded habitat conditions are as follows: 1) fragmentation and isolation of local populations due to the proliferation of dams and water diversions that have eliminated habitat, altered water flow and temperature regimes, and impeded migratory movements (Dunham and Rieman 1999, p. 652; Rieman and McIntyre 1993, p. 7); 2) degradation of spawning and rearing habitat and upper watershed areas, particularly alterations in sedimentation rates and water temperature, resulting from forest and rangeland practices and intensive development of roads (Fraley and Shepard 1989, p. 141; MBTSG 1998, pp. ii - v, 20-45); 3) the introduction and spread of nonnative fish species, particularly brook trout and lake trout, as a result of fish stocking and degraded habitat conditions, which compete with bull trout for limited resources and, in the case of brook trout, hybridize with bull trout (Leary et al. 1993, p. 857; Rieman et al. 2006, pp. 73-76); 4) in the Coastal-Puget Sound region where amphidromous bull trout occur, degradation of mainstem river FMO habitat, and the degradation and loss of marine nearshore foraging and migration habitat due to urban and residential development; and 5) degradation of FMO habitat resulting from reduced prey base, roads, agriculture, development, and dams.

Effects of Climate Change on Bull Trout Critical Habitat

One objective of the final rule was to identify and protect those habitats that provide resiliency for bull trout use in the face of climate change. Over a period of decades, climate change may directly threaten the integrity of the essential physical or biological features described in PCEs 1, 2, 3, 5, 7, 8, and 9. Protecting bull trout strongholds and cold water refugia from disturbance and ensuring connectivity among populations were important considerations in addressing this potential impact. Additionally, climate change may exacerbate habitat degradation impacts both physically (e.g., decreased base flows, increased water temperatures) and biologically (e.g., increased competition with non-native fishes).

Many of the PCEs for bull trout may be affected by the presence of toxics and/or increased water temperatures within the environment. The effects will vary greatly depending on a number of factors which include which toxic substance is present, the amount of temperature increase, the likelihood that critical habitat would be affected (probability), and the severity and intensity of any effects that might occur (magnitude).

4.1.3 Life History

The iteroparous reproductive strategy of bull trout has important repercussions for the management of this species. Bull trout require passage both upstream and downstream, not only for repeat spawning but also for foraging. Most fish ladders, however, were designed specifically for anadromous semelparous salmonids (fishes that spawn once and then die, and require only one-way passage upstream). Therefore, even dams or other barriers with fish passage facilities may be a factor in isolating bull trout populations if they do not provide a downstream passage route. Additionally, in some core areas, bull trout that migrate to marine waters must pass both upstream and downstream through areas with net fisheries at river mouths. This can increase the likelihood of mortality to bull trout during these spawning and foraging migrations.

Growth varies depending upon life-history strategy. Resident adults range from 6 to 12 inches total length, and migratory adults commonly reach 24 inches or more (Goetz 1989; Pratt 1985). The largest verified bull trout is a 32-pound specimen caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982).

Bull trout typically spawn from August through November during periods of increasing flows and decreasing water temperatures. Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989; Pratt 1992; Rieman and McIntyre 1996). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992). After hatching, fry remain in the substrate, and time from egg deposition to emergence may surpass 200 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Pratt 1992; Ratliff and Howell 1992).

Early life stages of fish, specifically the developing embryo, require the highest inter-gravel dissolved oxygen (IGDO) levels, and are the most sensitive life stage to reduced oxygen levels. The oxygen demand of embryos depends on temperature and on stage of development, with the greatest IGDO required just prior to hatching.

A literature review conducted by the Washington Department of Ecology (WDOE 2002) indicates that adverse effects of lower oxygen concentrations on embryo survival are magnified as temperatures increase above optimal (for incubation). In a laboratory study conducted in Canada, researchers found that low oxygen levels retarded embryonic development in bull trout (Giles and Van der Zweep 1996 in Stewart et al. 2007). Normal oxygen levels seen in rivers used by bull trout during spawning ranged from 8 to 12 mg/L (in the gravel), with corresponding instream levels of 10 to 11.5 mg/L (Stewart et al. 2007). In addition, IGDO concentrations, water velocities in the water column, and especially the intergravel flow rate, are interrelated variables that affect the survival of incubating embryos (ODEQ 1995). Due to a long incubation period of 220+ days, bull trout are particularly sensitive to adequate IGDO levels. An IGDO level below 8 mg/L is likely to result in mortality of eggs, embryos, and fry.

Population Structure

Bull trout exhibit both resident and migratory life history strategies. Both resident and migratory forms may be found together, and either form may produce offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. The resident form tends to be smaller than the migratory form at maturity and also produces fewer eggs (Fraley and Shepard 1989; Goetz 1989). Migratory bull trout spawn in tributary streams where juvenile fish rear 1 to 4 years before migrating to either a lake (adfluvial form), river (fluvial form) (Fraley and Shepard 1989; Goetz 1989), or saltwater (anadromous form) to rear as subadults and to live as adults (Cavender 1978; McPhail and Baxter 1996; WDFW et al. 1997). Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. They are iteroparous (they spawn more than once in a lifetime). Repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Fraley and Shepard 1989; Leathe and Graham 1982; Pratt 1992; Rieman and McIntyre 1996).

Migratory forms of bull trout may develop when habitat conditions allow movement between spawning and rearing streams and larger rivers, lakes or nearshore marine habitat where foraging opportunities may be enhanced (Brenkman and Corbett 2005; Frissell 1993; Goetz et al. 2004). For example, multiple life history forms (e.g., resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River (Baxter 2002). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem Snake River. Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. Benefits to migratory bull trout include greater growth in the more productive waters of larger streams, lakes, and marine waters; greater fecundity resulting in increased reproductive potential; and dispersing the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss (Frissell 1999; MBTSG 1998; Rieman and McIntyre 1993). In the absence of the migratory bull trout life form, isolated populations cannot be replenished when disturbances make local habitats temporarily unsuitable. Therefore, the range of the species is diminished, and the potential for a greater reproductive contribution from larger size fish with higher fecundity is lost (Rieman and McIntyre 1993).

Whitesel et al. (2004) noted that although there are multiple resources that contribute to the subject, Spruell et al. (2003) best summarized genetic information on bull trout population structure. Spruell et al. (2003) analyzed 1,847 bull trout from 65 sampling locations, four located in three coastal drainages (Klamath, Queets, and Skagit Rivers), one in the Saskatchewan River drainage (Belly River), and 60 scattered throughout the Columbia River Basin. They concluded that there is a consistent pattern among genetic studies of bull trout, regardless of whether examining allozymes, mitochondrial DNA, or most recently microsatellite loci. Typically, the genetic pattern shows relatively little genetic variation within populations, but substantial divergence among populations. Microsatellite loci analysis supports the existence of at least three major genetically differentiated groups (or evolutionary lineages) of bull trout (Spruell et al. 2003). They were characterized as:

i. "Coastal", including the Deschutes River and all of the Columbia River drainage downstream, as well as most coastal streams in Washington, Oregon, and British Columbia. A compelling case also exists that the Klamath Basin represents a unique evolutionary lineage within the coastal group.

ii. "Snake River", which also included the John Day, Umatilla, and Walla Walla rivers. Despite close proximity of the John Day and Deschutes Rivers, a striking level of divergence between bull trout in these two systems was observed.

iii. "Upper Columbia River" which includes the entire basin in Montana and northern Idaho. A tentative assignment was made by Spruell et al. (2003) of the Saskatchewan River drainage populations (east of the continental divide), grouping them with the upper Columbia River group.

Spruell et al. (2003) noted that within the major assemblages, populations were further subdivided, primarily at the level of major river basins. Taylor et al. (1999) surveyed bull trout populations, primarily from Canada, and found a major divergence between inland and coastal populations. Costello et al. (2003) suggested the patterns reflected the existence of two glacial refugia, consistent with the conclusions of Spruell and the biogeographic analysis of Haas and McPhail (2001). Both Taylor et al. (1999) and Spruell et al. (2003) concluded that the Deschutes River represented the most upstream limit of the coastal lineage in the Columbia River Basin.

Population Dynamics

Although bull trout are widely distributed over a large geographic area, they exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993). Increased habitat fragmentation reduces the amount of available habitat and increases isolation from other populations of the same species (Saunders et al. 1991). Burkey (1989) concluded that when species are isolated by fragmented habitats, low rates of population growth are typical in local populations and their probability of extinction is directly related to the degree of isolation and fragmentation. Without sufficient immigration, growth for local populations may be low and probability of extinction high (Burkey 1989, 1995).

Metapopulation concepts of conservation biology theory have been suggested relative to the distribution and characteristics of bull trout, although empirical evidence is relatively scant (Rieman and McIntyre 1993, Dunham and Rieman 1999, Rieman and Dunham 2000). A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meffe and Carroll 1994). For inland bull trout, metapopulation theory is likely most applicable at the watershed scale where habitat consists of discrete patches or collections of habitat capable of supporting local populations; local populations are for the most part independent and represent discrete reproductive units; and long-term, low-rate dispersal patterns among component populations influences the persistence of at least some of the local populations (Rieman and Dunham 2000). Ideally, multiple local populations distributed throughout a watershed provide a mechanism for spreading risk because the simultaneous loss of all local populations is unlikely. However, habitat alteration, primarily through the construction of impoundments, dams, and water diversions has fragmented habitats, eliminated migratory corridors, and in many cases isolated bull trout in the headwaters of tributaries (Rieman and Clayton 1997a, Dunham and Rieman 1999, Spruell et al. 1999, Rieman and Dunham 2000).

Human-induced factors as well as natural factors affecting bull trout distribution have likely limited the expression of the metapopulation concept for bull trout to patches of habitat within the overall distribution of the species (Dunham and Rieman 1999). However, despite the theoretical fit, the relatively recent and brief time period during which bull trout investigations have taken place does not provide certainty as to whether a metapopulation dynamic is occurring (e.g., a balance between local extirpations and recolonizations) across the range of the bull trout or whether the persistence of bull trout in large or closely interconnected habitat patches (Dunham and Rieman 1999) is simply reflective of a general deterministic trend towards extinction of the species where the larger or interconnected patches are relics of historically wider distribution (Rieman and Dunham 2000). Recent research (Whiteley et al. 2003) does, however, provide genetic evidence for the presence of a metapopulation process for bull trout, at least in the Boise River Basin of Idaho.

f) Ecology / Habitat Characteristics

Habitat Characteristics

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993). Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Howell and Buchanan 1992; Pratt 1992; Rich 1996; Rieman and McIntyre 1993; Rieman and McIntyre 1995; Sedell and Everest 1991; Watson and Hillman 1997). Watson and Hillman (1997) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993), bull trout should not be expected to simultaneously occupy all available habitats (Rieman et al. 1997b).

Migratory corridors link seasonal habitats for all bull trout life histories. The ability to migrate is important to the persistence of bull trout (Mike Gilpin in litt. 1997; Rieman et al. 1997b; Rieman and McIntyre 1993). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed or stray to nonnatal streams. Local populations that are extirpated by catastrophic events may also become reestablished by bull trout migrants. However, it is important to note that the genetic structuring of bull trout indicates there is limited gene flow among bull trout populations, which may encourage local adaptation within individual populations, and that reestablishment of extirpated populations may take a long time (Rieman and McIntyre 1993; Spruell et al. 1999). Migration also allows bull trout to access more abundant or larger prey, which facilitates growth and reproduction. Additional benefits of migration and its relationship to foraging are discussed below under “Diet.”

Cold water temperatures play an important role in determining bull trout habitat quality, as these fish are primarily found in colder streams (below 15 °C or 59 °F), and spawning habitats are generally characterized by temperatures that drop below 9 °C (48 °F) in the fall (Fraley and Shepard 1989; Pratt 1992; Rieman and McIntyre 1993).

Thermal requirements for bull trout appear to differ at different life stages. Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed (Baxter et al. 1997; Pratt 1992; Rieman et al. 1997b; Rieman and McIntyre 1993). Optimum incubation temperatures for bull trout eggs range from 2 °C to 6 °C (35 °F to 39 °F) whereas optimum water temperatures for rearing range from about 6 °C to 10 °C (46 °F to 50 °F) (Buchanan and Gregory 1997; Goetz 1989; McPhail and Murray 1979). In Granite Creek, Idaho, Bonneau and Scarnecchia (1996) observed that juvenile bull trout selected the coldest water available in a plunge pool, 8 °C to 9 °C (46 °F to 48 °F), within a temperature gradient of 8 °C to 15 °C (4 °F to 60 °F). In a landscape study relating bull trout distribution to maximum water temperatures, Dunham et al. (2003) found that the probability of juvenile bull trout occurrence does not become high (i.e., greater than 0.75) until maximum temperatures decline to 11 °C to 12 °C (52 °F to 54 °F).

Although bull trout are found primarily in cold streams, occasionally these fish are found in larger, warmer river systems throughout the Columbia River basin (Buchanan and Gregory 1997; Fraley and Shepard 1989; Rieman et al. 1997b; Rieman and McIntyre 1993; Rieman and McIntyre 1995). Availability and proximity of cold water patches and food productivity can influence bull trout ability to survive in warmer rivers (Myrick et al. 2002). For example, in a study in the Little Lost River of Idaho where bull trout were found at temperatures ranging from 8 °C to 20 °C (46 °F to 68 °F), most sites that had high densities of bull trout were in areas where primary productivity in streams had increased following a fire (Bart L. Gamett, Salmon-Challis National Forest, pers. comm. June 20, 2002).

All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Pratt 1992; Rich 1996; Sedell and Everest 1991; Sexauer and James 1997; Thomas 1992; Watson and Hillman 1997). Maintaining bull trout habitat requires stability of stream channels and maintenance of natural flow patterns (Rieman and McIntyre 1993). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997). These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and young juveniles in the gravel from winter through spring (Fraley and Shepard 1989; Pratt 1992; Pratt and Huston 1993). Pratt (1992) indicated that increases in fine sediment reduce egg survival and emergence.

Diet

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. A single optimal foraging strategy is not necessarily a consistent feature in the life of a fish, because this strategy can change as the fish progresses from one life stage to another (i.e., juvenile to subadult). Fish growth depends on the quantity and quality of food that is eaten (Gerking 1994), and as fish grow, their foraging strategy changes as their food changes, in quantity, size, or other characteristics. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macrozooplankton, and small fish (Boag 1987; Donald and Alger 1993; Goetz 1989). Subadult and adult migratory bull trout feed on various fish species (Brown 1994; Donald and Alger 1993; Fraley and Shepard 1989; Leathe and Graham 1982). Bull trout of all sizes other than fry have been found to eat fish half their length (Beauchamp and VanTassell 2001). In nearshore marine areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) (Goetz et al. 2004; WDFW et al. 1997).

Bull trout migration and life history strategies are closely related to their feeding and foraging strategies. Migration allows bull trout to access optimal foraging areas and exploit a wider variety of prey resources. Optimal foraging theory can be used to describe strategies fish use to choose between alternative sources of food by weighing the benefits and costs of capturing one source of food over another. For example, prey often occur in concentrated patches of abundance ("patch model" ; Gerking 1994). As the predator feeds in one patch, the prey population is reduced, and it becomes more profitable for the predator to seek a new patch rather than continue feeding on the original one. This can be explained in terms of balancing energy acquired versus energy expended. For example, in the Skagit River system, anadromous bull trout make migrations as long as 121 miles between marine foraging areas in Puget Sound and headwater spawning grounds, foraging on salmon eggs and juvenile salmon along their migration route (WDFW et al. 1997). Anadromous bull trout also use marine waters as migration corridors to reach seasonal habitats in non-natal watersheds to forage and possibly overwinter (Brenkman and Corbett 2005; Goetz et al. 2004).

4.1.4 Status

Distribution

The historical range of bull trout includes major river basins in the Pacific Northwest at about 41 to 60 degrees North latitude, from the southern limits in the McCloud River in northern California and the Jarbidge River in Nevada to the headwaters of the Yukon River in the Northwest Territories, Canada (Cavender 1978, Bond 1992). To the west, the bull trout's range includes Puget Sound, various coastal rivers of British Columbia, Canada, and southeast Alaska (Bond 1992). Bull trout occur in portions of the Columbia River and tributaries within the basin, including its headwaters in Montana and Canada. Bull trout also occur in the Klamath River basin of south-central Oregon. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta and Montana and in the MacKenzie River system in Alberta and British Columbia, Canada (Cavender 1978, Brewin et al. 1997).

Each of the following interim recovery units (below) is necessary to maintain the bull trout's distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species' resilience to changing environmental conditions. No new local populations have been identified and no local populations have been lost since listing.

Jarbidge River Interim Recovery Unit

This interim recovery unit currently contains a single core area with six local populations. Less than 500 resident and migratory adult bull trout, representing about 50 to 125 spawning adults, are estimated to occur in the core area. The current condition of the bull trout in this interim recovery unit is attributed to the effects of livestock grazing, roads, incidental mortalities of released bull trout from recreational angling, historic angler harvest, timber harvest, and the introduction of non-native fishes (USFWS 2004b). The draft bull trout recovery plan (USFWS 2004b) identifies the following conservation needs for this interim recovery unit: 1) maintain the current distribution of the bull trout within the core area, 2) maintain stable or increasing trends in abundance of both resident and migratory bull trout in the core area, 3) restore and maintain suitable habitat conditions for all life history stages and forms, and 4) conserve genetic diversity and increase natural opportunities for genetic exchange between resident and migratory forms of the bull trout. An estimated 270 to 1,000 spawning bull trout per year are needed to provide for the persistence and viability of the core area and to support both resident and migratory adult bull trout (USFWS 2004b).

Klamath River Interim Recovery Unit

This interim recovery unit currently contains three core areas and seven local populations. The current abundance, distribution, and range of the bull trout in the Klamath River Basin are greatly reduced from historical levels due to habitat loss and degradation caused by reduced water quality, timber harvest, livestock grazing, water diversions, roads, and the introduction of non-native fishes (USFWS 2002b). Bull trout populations in this interim recovery unit face a high risk of extirpation (USFWS 2002b). The draft Klamath River bull trout recovery plan (USFWS 2002b) identifies the following conservation needs for this interim recovery unit: 1) maintain the current distribution of bull trout and restore distribution in previously occupied areas, 2) maintain stable or increasing trends in bull trout abundance, 3) restore and maintain suitable habitat conditions for all life history stages and strategies, 4) conserve genetic diversity and provide the opportunity for genetic exchange among appropriate core area populations. Eight to 15 new local populations and an increase in population size from about 2,400 adults currently to 8,250 adults are needed to provide for the persistence and viability of the three core areas (USFWS 2002b).

Columbia River Interim Recovery Unit

The Columbia River interim recovery unit includes bull trout residing in portions of Oregon, Washington, Idaho, and Montana. Bull trout are estimated to have occupied about 60 percent of the Columbia River Basin, and presently occur in 45 percent of their estimated historical range (Quigley and Arbelbide 1997, p.1177). This interim recovery unit currently contains 97 core areas and 527 local populations. About 65 percent of these core areas and local populations occur in central Idaho and northwestern Montana. The Columbia River interim recovery unit has declined in overall range and numbers of fish (63 FR 31647). Although some strongholds still exist with migratory fish present, bull trout generally occur as isolated local populations in headwater lakes or tributaries where the migratory life history form has been lost. Though still widespread, there have been numerous local extirpations reported throughout the Columbia River basin. In Idaho, for example, bull trout have been extirpated from 119 reaches in 28 streams (Idaho Department of Fish and Game in litt. 1995). The draft Columbia River bull trout recovery plan (USFWS 2002d) identifies the following conservation needs for this interim recovery unit: 1) maintain or expand the current distribution of the bull trout within core areas, 2) maintain stable or increasing trends in bull trout abundance, 3) restore and maintain suitable habitat conditions for all bull trout life history stages and strategies, and 4) conserve genetic diversity and provide opportunities for genetic exchange.

The condition of the bull trout within the 97 core areas in the Columbia River IRU varies from poor to good. All core areas have been subject to the combined effects of habitat degradation and fragmentation caused by the following activities: dewatering; road construction and maintenance; mining; grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment into diversion channels; and introduced non-native species. The Service completed a core area conservation assessment for the 5-year status review and determined that, of the 97 core areas in this interim recovery unit, 38 are at high risk of extirpation, 35 are at risk, 20 are at potential risk, 2 are at low risk, and 2 are at unknown risk (USFWS 2005).

Coastal-Puget Sound Interim Recovery Unit

Bull trout in the Coastal-Puget Sound interim recovery unit exhibit anadromous, adfluvial, fluvial, and resident life history patterns. The anadromous life history form is unique to this interim recovery unit. This interim recovery unit currently contains 14 core areas and 67 local populations (USFWS 2004a). Bull trout are distributed throughout most of the large rivers and associated tributary systems within this interim recovery unit. Bull trout continue to be present in nearly all major watersheds where they likely occurred historically, although local extirpations have occurred throughout this interim recovery unit. Many remaining populations are isolated or fragmented and abundance has declined, especially in the southeastern portion of the interim recovery unit. The current condition of the bull trout in this interim recovery unit is attributed to the adverse effects of dams, forest management practices (e.g., timber harvest and associated road building activities), agricultural practices (e.g., diking, water control structures, draining of wetlands, channelization, and the removal of riparian vegetation), livestock grazing, roads, mining, urbanization, poaching, incidental mortality from other targeted fisheries, and the introduction of non-native species. The draft Coastal-Puget Sound bull trout recovery plan (USFWS 2004a) identifies the following conservation needs for this interim recovery unit: 1) maintain or expand the current distribution of bull trout within existing core areas, 2) increase bull trout abundance to about 16,500 adults across all core areas, and 3) maintain or increase connectivity between local populations within each core area.

St. Mary-Belly River Interim Recovery Unit

This interim recovery unit currently contains six core areas and nine local populations (USFWS 2002c). Currently, bull trout are widely distributed in the St. Mary-Belly River drainage and occur in nearly all of the waters that it inhabited historically. Bull trout are found only in a 1.2-mile reach of the North Fork Belly River within the United States. Redd count surveys of the North Fork Belly River documented an increase from 27 redds in 1995 to 119 redds in 1999. This increase was attributed primarily to protection from angler harvest (USFWS 2002c). The current condition of the bull trout in this interim recovery unit is primarily attributed to the effects of dams, water diversions, roads, mining, and the introduction of non-native fishes (USFWS 2002c). The draft St. Mary-Belly bull trout recovery plan (USFWS 2002c) identifies the following conservation needs for this interim recovery unit: 1) maintain the current distribution of the bull trout and restore distribution in previously occupied areas, 2) maintain stable or increasing trends in bull trout abundance, 3) restore and maintain suitable habitat conditions for all life history stages and forms, 4) conserve genetic diversity and provide the opportunity for genetic exchange, and 5) establish good working relations with Canadian interests because local bull trout populations in this interim recovery unit are comprised mostly of migratory fish, whose habitat is mostly in Canada.

Reasons for Listing

Bull trout distribution, abundance, and habitat quality have declined rangewide (Bond 1992, Schill 1992, Thomas 1992, Ziller 1992, Rieman and McIntyre 1993, Newton and Pribyl 1994, McPhail and Baxter 1996). Several local extirpations have been documented, beginning in the 1950s (Rode 1990, Ratliff and Howell 1992, Donald and Alger 1993, Goetz 1994, Newton and Pribyl 1994, Berg and Priest 1995, Light et al. 1996, Buchanan et al. 1997, WDFW 1998). Bull trout were extirpated from the southernmost portion of their historic range, the McCloud River in California, around 1975 (Moyle 1976, Rode 1990). Bull trout have been functionally extirpated (i.e., few individuals may occur there but do not constitute a viable population) in the Coeur d'Alene River basin in Idaho and in the Lake Chelan and Okanogan River basins in Washington (63 FR 31647).

These declines result from the combined effects of habitat degradation and fragmentation, the blockage of migratory corridors; poor water quality, angler harvest and poaching, entrainment (process by which aquatic organisms are pulled through a diversion or other device) into diversion channels and dams, and introduced nonnative species. Specific land and water management activities that depress bull trout populations and degrade habitat include the effects of dams and other diversion structures, forest management practices, livestock grazing, agriculture, agricultural diversions, road construction and maintenance, mining, and urban and rural development (Beschta et al. 1987; Chamberlain et al. 1991; Furniss et al. 1991; Meehan 1991; Nehlsen et al. 1991; Sedell and Everest 1991; Craig and Wissmar 1993; Frissell 1993; Henjum et al. 1994; McIntosh et al. 1994; Wissmar et al. 1994; MBTSG 1995a-e, 1996a-f; Light et al. 1996; USDA and USDI 1995).

New Threats

Climate Change

Global climate change, and the related warming of global climate, have been well documented (IPCC 2007, ISAB 2007, WWF 2003). Evidence of global climate change/warming includes widespread increases in average air and ocean temperatures and accelerated melting of glaciers, and rising sea level. Given the increasing certainty that climate change is occurring and is accelerating (IPCC 2007, Battin et al. 2007), we can no longer assume that climate conditions in the future will resemble those in the past.

Patterns consistent with changes in climate have already been observed in the range of many species and in a wide range of environmental trends (ISAB 2007, Hari et al. 2006, Rieman et al. 2007). In the northern hemisphere, the duration of ice cover over lakes and rivers has decreased by almost 20 days since the mid-1800's (WWF 2003). The range of many species has shifted poleward and elevationally upward. For cold-water associated salmonids in mountainous regions, where their upper distribution is often limited by impassable barriers, an upward thermal shift in suitable habitat can result in a reduction in range, which in turn can lead to a population decline (Hari et al. 2006).

In the Pacific Northwest, most models project warmer air temperatures and increases in winter precipitation and decreases in summer precipitation. Warmer temperatures will lead to more precipitation falling as rain rather than snow. As the seasonal amount of snow pack diminishes, the timing and volume of stream flow are likely to change and peak river flows are likely to increase in affected areas. Higher air temperatures are also likely to increase water temperatures (ISAB 2007). For example, stream gauge data from western Washington over the past 5 to 25 years indicate a marked increasing trend in water temperatures in most major rivers.

Climate change has the potential to profoundly alter the aquatic ecosystems upon which the bull trout depends via alterations in water yield, peak flows, and stream temperature, and an increase in the frequency and magnitude of catastrophic wildfires in adjacent terrestrial habitats (Bisson et al. in press).

All life stages of the bull trout rely on cold water. Increasing air temperatures are likely to impact the availability of suitable cold water habitat. For example, ground water temperature is generally correlated with mean annual air temperature, and has been shown to strongly influence the distribution of other chars. Ground water temperature is linked to bull trout selection of spawning sites, and has been shown to influence the survival of embryos and early juvenile rearing of bull trout (Rieman et al. in press). Increases in air temperature are likely to be reflected in increases in both surface and groundwater temperatures.

Climate change is likely to affect the frequency and magnitude of fires, especially in warmer drier areas such as are found on the eastside of the Cascade Mountains. Bisson et al. (in press) note that the forest that naturally occurred in a particular area may or may not be the forest that will be responding to the fire regimes of an altered climate. In several studies related to the effect of large fires on bull trout populations, bull trout appear to have adapted to past fire disturbances through mechanisms such as dispersal and plasticity. However, as stated earlier, the future may well be different than the past and extreme fire events may have a dramatic effect on bull trout and other aquatic species, especially in the context of continued habitat loss, simplification and fragmentation of aquatic systems, and the introduction and expansion of exotic species (Bisson et al. in press).

Migratory bull trout can be found in lakes, large rivers and marine waters. Effects of climate change on lakes are likely to impact migratory adfluvial bull trout that seasonally rely upon lakes for their greater availability of prey and access to tributaries. Climate-warming impacts to lakes will likely lead to longer periods of thermal stratification and coldwater fish such as adfluvial bull trout will be restricted to these bottom layers for greater periods of time. Deeper thermoclines resulting from climate change may further reduce the area of suitable temperatures in the bottom layers and intensify competition for food (WWF 2003).

Bull trout require very cold water for spawning and incubation. Suitable spawning habitat is often found in accessible higher elevation tributaries and headwaters of rivers. However, impacts on hydrology associated with climate change are related to shifts in timing, magnitude and distribution of peak flows that are also likely to be most pronounced in these high elevation stream basins (Battin et al. 2007). The increased magnitude of winter peak flows in high elevation areas is likely to impact the location, timing, and success of spawning and incubation for the bull trout and Pacific salmon species. Although lower elevation river reaches are not expected to experience as severe an impact from alterations in stream hydrology, they are unlikely to provide suitably cold temperatures for bull trout spawning, incubation and juvenile rearing.

As climate change progresses and stream temperatures warm, thermal refugia will be critical to the persistence of many bull trout populations. Thermal refugia are important for providing bull trout with patches of suitable habitat during migration through or to make feeding forays into areas with greater than optimal temperatures.

There is still a great deal of uncertainty associated with predictions relative to the timing, location, and magnitude of future climate change. It is also likely that the intensity of effects will vary by region (ISAB 2007) although the scale of that variation may exceed that of States. For example, several studies indicate that climate change has the potential to impact ecosystems in nearly all streams throughout the State of Washington (ISAB 2007, Battin et al. 2007, Rieman et al. 2007). In streams and rivers with temperatures approaching or at the upper limit of allowable water temperatures, there is little if any likelihood that bull trout will be able to adapt to or avoid the effects of climate change/warming. There is little doubt that climate change is and will be an important factor affecting bull trout distribution. As its distribution contracts, patch size decreases and connectivity is truncated, bull trout populations that may be currently connected may face increasing isolation, which could accelerate the rate of local extinction beyond that resulting from changes in stream temperature alone (Rieman et al. 2007). Due to variations in land form and geographic location across the range of the bull trout, it appears that some populations face higher risks than others. Bull trout in areas with currently degraded water temperatures and/or at the southern edge of its range may already be at risk of adverse impacts from current as well as future climate change.

4.1.5 Analytical Framework for the Jeopardy and Adverse Modification Determinations for Bull Trout

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this BO relies on four components: (1) the *Status of the Species*, which evaluates bull trout range-wide condition, the factors responsible for that condition, and its survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of bull trout in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of bull trout; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on bull trout; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on bull trout.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the bull trout current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of bull trout in the wild.

As discussed in this section, *Status of the Species*, interim recovery units have been designated for the bull trout for purposes of recovery planning and application of the jeopardy standard. Per Service national policy (Director's March 6, 2006, memorandum), it is important to recognize that the establishment of recovery units does not create a new listed entity. Jeopardy analyses must always consider the impacts of a proposed action on the survival and recovery of the species that is listed. While a proposed Federal action may have significant adverse consequences to one or more recovery units, this would only result in a jeopardy determination if these adverse consequences reduce appreciably the likelihood of both the survival and recovery of the listed entity; in this case, the coterminous U.S. population of the bull trout.

The joint Service and National Marine Fisheries Service (NMFS) *Endangered Species Consultation Handbook* (USFWS and NMFS 1998), which represents national policy of both agencies, further clarifies the use of recovery units in the jeopardy analysis:

When an action appreciably impairs or precludes the capacity of a recovery unit from providing both the survival and recovery function assigned to it, that action may represent jeopardy to the species. When using this type of analysis, include in the BO a description of how the action affects not only the recovery unit's capability, but the relationship of the recovery unit to both the survival and recovery of the listed species as a whole.

The jeopardy analysis in this BO conforms to the above analytical framework. The jeopardy analysis in this BO places an emphasis on consideration of the range-wide survival and recovery needs of bull trout and the role of the action area in the survival and recovery of the bull trout as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

This BO 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.

In accordance with policy and regulation, the adverse modification analysis in this BO relies on four components: (1) the *Status of Critical Habitat*, which evaluates the range-wide condition of designated critical habitat for the bull trout in terms of primary constituent elements (PCEs), the factors responsible for that condition, and the intended recovery function of the critical habitat overall; (2) the *Environmental Baseline*, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, the effects of the proposed Federal action on bull trout critical habitat are evaluated in the context of the range-wide condition of the critical habitat, taking into account any cumulative effects, to determine if the critical habitat range-wide would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the bull trout.

The analysis in this BO places an emphasis on using the intended range-wide recovery function of bull trout critical habitat and the role of the action area relative to that intended function as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

4.1.6 Conservation

Conservation Needs

The conservation needs of bull trout are often generally expressed as the four “Cs”: cold, clean, complex, and connected habitat. Cold stream temperatures, clean water quality that is relatively free of sediment and contaminants, complex channel characteristics (including abundant large wood and undercut banks), and large patches of such habitat that are well connected by unobstructed migratory pathways are all needed to promote conservation of bull trout at multiple scales ranging from the coterminous to local populations (a local population is a group of bull trout that spawn within a particular stream or portion of a stream system). The recovery planning process for bull trout (USFWS 2002a; 2004a; 2004b) has also identified the following conservation needs: 1) maintenance and restoration of multiple, interconnected populations in diverse habitats across the range of each interim recovery unit, 2) preservation of the diversity of life-history strategies, 3) maintenance of genetic and phenotypic diversity across the range of each interim recovery unit, and 4) establishment of a positive population trend. It has also been recognized that bull trout populations need to be protected from catastrophic fires across the range of each interim recovery unit (Rieman et al. 2003).

Central to the survival and recovery of bull trout is the maintenance of viable core areas (USFWS 2002a; 2004a; 2004b). A core area is defined as a geographic area occupied by one or more local bull trout populations that overlap in their use of rearing, foraging, migratory, and overwintering habitat. Each of the interim recovery units listed above consists of one or more core areas. There are 121 core areas recognized across the coterminous range of the bull trout (USFWS 2002a; 2004a; 2004b).

1) *Maintenance and restoration of multiple, interconnected populations in diverse habitats across the range of each interim recovery unit*

Multiple local populations distributed and interconnected throughout a watershed provide a mechanism for spreading risk from stochastic events (Hard 1995, Healy and Prince 1995, Rieman and Allendorf 2001, Rieman and McIntyre 1993, Spruell et al. 1999). Current patterns in bull trout distribution and other empirical evidence, when interpreted in view of emerging conservation theory, indicate that further declines and local extinctions are likely (Dunham and Rieman 1999, Rieman and Allendorf 2001, Rieman et al. 1997b, Spruell 2003). Based in part on guidance from Rieman and McIntyre (1993), bull trout core areas with fewer than five local populations are at increased risk of extirpation; core areas with between 5 to 10 local populations are at intermediate risk of extirpation; and core areas which have more than 10 interconnected local populations are at diminished risk of extirpation.

Maintaining and restoring connectivity between existing populations of bull trout is important for the persistence of the species (Rieman and McIntyre 1993). Migration and occasional spawning between populations increases genetic variability and strengthens population variability (Rieman and McIntyre 1993). Migratory corridors allow individuals access to unoccupied but suitable habitats, foraging areas, and refuges from disturbances (Saunders et al. 1991).

Because bull trout in the coterminous United States are distributed over a wide geographic area consisting of various environmental conditions, and because they exhibit considerable genetic differentiation among populations, the occurrence of local adaptations is expected to be extensive. Some readily observable examples of differentiation between populations include external morphology and behavior (e.g., size and coloration of individuals; timing of spawning and migratory forays). Conserving many populations across the range of the species is crucial to adequately protect genetic and phenotypic diversity of bull trout (Hard 1995, Healy and Prince 1995, Leary et al. 1993, Rieman and Allendorf 2001, Rieman and McIntyre 1993, Spruell et al. 1999, Taylor et al. 1999). Changes in habitats and prevailing environmental conditions are increasingly likely to result in extinction of bull trout if genetic and phenotypic diversity is lost.

2) *Preservation of the diversity of life-history strategies*

The bull trout has multiple life history strategies, including migratory forms, throughout its range (Rieman and McIntyre 1993). Migratory forms appear to develop when habitat conditions allow movement between spawning and rearing streams and larger rivers or lakes where foraging opportunities may be enhanced (Frissell 1997). For example, multiple life history forms (e.g., resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River (Baxter 2002). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem of the Snake River. Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. Benefits to migratory bull trout include greater growth in the more productive waters of larger streams and lakes, greater fecundity resulting in increased reproductive potential, and dispersing the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss (Frissell 1997, MBTSG 1998, Rieman and McIntyre 1993).

3) *Maintenance of genetic and phenotypic diversity across the range of each interim recovery unit*

Healy and Prince (1995) reported that, because phenotypic diversity is a consequence of the genotype interacting with the habitat, the conservation of phenotypic diversity is achieved through conservation of the sub-population within its habitat. They further note that adaptive variation among salmonids has been observed to occur under relatively short time frames (e.g., changes in genetic composition of salmonids raised in hatcheries; rapid emergence of divergent phenotypes for salmonids introduced to new environments). Healy and Prince (1995) conclude that while the loss of a few sub-populations within an ecosystem might have only a small effect on overall genetic diversity, the effect on phenotypic diversity and, potentially, overall population viability could be substantial (Healy and Prince 1995). This concept of preserving variation in phenotypic traits that is determined by both genetic and environmental (i.e., local habitat) factors has also been identified by Hard (1995) as an important component in maintaining intraspecific adaptability (i.e., phenotypic plasticity) and ecological diversity within a genotype (Hard 1995). He argues that adaptive processes are not entirely encompassed by the interpretation of molecular genetic data; in other words, phenotypic and genetic variation in adaptive traits may exist without detectable variation at the molecular genetic level, particularly for neutral genetic markers. Therefore, the effective conservation of genetic diversity necessarily involves consideration of the conservation of biological units smaller than taxonomic species (or DPSs). Reflecting this theme, the maintenance of local sub-populations has been specifically emphasized as a mechanism for the conservation of bull trout (Rieman and McIntyre 1993, Taylor et al. 1999).

4) Establishment of a positive population trend

A stable or increasing population is a key criterion for recovery under the requirements of the Endangered Species Act. Measures of the trend of a population (the tendency to increase, decrease, or remain stable) include population growth rate or productivity. Estimates of population growth rate (*i.e.*, productivity over the entire life cycle) that indicate a population is consistently failing to replace itself, indicate increased extinction risk. Therefore, the reproductive rate should indicate the population is replacing itself, or growing.

Since data of the total population size are rarely available, the productivity or population growth rate is usually estimated from temporal trends in indices of abundance at a particular life stage. For example, redd counts are often used as an index of a spawning adult population. The direction and magnitude of a trend in the index can be used as a surrogate for the growth rate of the entire population. For instance, a downward trend in an abundance indicator may signal the need for increased protection, regardless of the actual size of the population. A population which is below recovered abundance levels but moving toward recovery would be expected to exhibit an increasing trend in the indicator.

The population growth rate is an indicator of extinction probability. The probability of going extinct cannot be measured directly; it can, however, be estimated as the consequence of the population growth rate and the variability in that rate. For a population to be considered viable, its natural productivity should be sufficient to replace itself from generation to generation. Evaluations of population status will also have to take into account uncertainty in estimates of population growth rate or productivity. For a population to contribute to recovery, its growth rate must indicate that the population is stable or increasing for a period of time (USFWS 2002e, p16)

5) Protect Bull Trout from Catastrophic Fires

Bull trout evolved under historic fire regimes in which disturbance to streams from forest fires resulted in a mosaic of diverse habitats. However, forest management and fire suppression over the past century have increased homogeneity of terrestrial and aquatic habitats, increasing the likelihood of large, intense forest fires in some areas. Because the most severe effects of fire on native fish populations can be expected where populations have become fragmented by human activities or natural events, an effective strategy to ensure persistence of native fishes against the effects of large fires may be to restore aquatic habitat structure and life history complexity of populations in areas susceptible to large fires (Gresswell 1999).

Rieman and Clayton (1997a) discussed relations among the effects of fire and timber harvest, aquatic habitats, and sensitive species. They noted that spatial diversity and complexity of aquatic habitats strongly influence the effects of large disturbances on salmonids (Rieman and Clayton 1997a). For example, Rieman et al. (1997b) studied bull trout and redband trout responses to large, intense fires that burned three watersheds in the Boise National Forest in Idaho. Although the fires were the most intense on record, there was a mix of severely burned to unburned areas left after the fires. Fish were apparently eliminated in some stream reaches, whereas others contained relatively high densities of fish. Within a few years after the fires and after areas within the watersheds experienced debris flows, fish had become reestablished in many reaches, and densities increased. In some instances, fish densities were higher than those present before the fires or in streams that were not burned (Rieman and Clayton 1997a). These responses were attributed to spatial habitat diversity that supplied refuge areas for fish during the fires, and the ability of bull trout and the redband trout to move among stream reaches. For bull trout, the presence of migratory fish within the system was also important (Rieman and Clayton 1997a, Rieman et al. 1997b).

In terms of conserving bull trout, the appropriate strategy to reduce the effects of fires on bull trout habitat is to emphasize the restoration of watershed processes that create and maintain habitat diversity, provide bull trout access to habitats, and protect or restore migratory life-history forms of bull trout. Both passive (e.g., encouraging natural riparian vegetation and floodplain processes to function appropriately) and active (e.g., reducing road density, removing barriers to fish movement, and improving habitat complexity) actions offer the best approaches to protect bull trout from the effects of large fires.

Changes in Status since Listing within the Coastal-Puget Sound Interim Recovery Unit

Although the status of bull trout in Coastal-Puget Sound interim recovery unit has been improved by certain actions, it continues to be degraded by other actions, and it is likely that the overall status of the bull trout in this population segment has not improved since its listing on November 1, 1999. Improvement has occurred largely through changes in fishing regulations and habitat-restoration projects. Fishing regulations enacted in 1994 either eliminated harvest of bull trout or restricted the amount of harvest allowed, and this likely has had a positive influence on the abundance of bull trout. Improvement in habitat has occurred following restoration projects intended to benefit either bull trout or salmon, although monitoring the effectiveness of these projects seldom occurs. On the other hand, the status of this population segment has been adversely affected by a number of Federal and non-Federal actions, some of which were addressed under section 7 of the Act. Most of these actions degraded the environmental baseline; all of those addressed through formal consultation under section 7 of the Act permitted the incidental take of bull trout.

Section 10(a)(1)(B) permits have been issued for Habitat Conservation Plans (HCP) completed in the Coastal-Puget Sound population segment. These include: 1) the City of Seattle's Cedar River Watershed HCP, 2) Simpson Timber HCP, 3) Tacoma Public Utilities Green River HCP, 4) Plum Creek Cascades HCP, 5) Washington State Department of Natural Resources HCP, 6) West Fork Timber HCP (Nisqually River), and 7) Forest Practices HCP. These HCPs provide landscape-scale conservation for fish, including bull trout. Many of the covered activities associated with these HCPs will contribute to conserving bull trout over the long-term; however, some covered activities will result in short-term degradation of the baseline. All HCPs permit the incidental take of bull trout.

Changes in Status since Listing within the Columbia River Interim Recovery Unit

The overall status of the Columbia River interim recovery unit has not changed appreciably since its listing on June 10, 1998. Populations of bull trout and their habitat in this area have been affected by a number of actions addressed under section 7 of the Act. Most of these actions resulted in degradation of the environmental baseline of bull trout habitat, and all permitted or analyzed the potential for incidental take of bull trout. The Plum Creek Cascades HCP, Plum Creek Native Fish HCP, and Forest Practices HCP addressed portions of the Columbia River interim recovery unit of bull trout.

Changes in Status since Listing within the Klamath River Interim Recovery Unit

Improvements in the Threemile, Sun, and Long Creek local populations have occurred through efforts to remove or reduce competition and hybridization with non-native salmonids, changes in fishing regulations, and habitat-restoration projects. Population status in the remaining local populations (Boulder-Dixon, Deming, Brownsworth, and Leonard Creeks) remains relatively unchanged. Grazing within bull trout watersheds throughout the recovery unit has been curtailed. Efforts at removal of non-native species of salmonids appear to have stabilized the Threemile and positively influenced the Sun Creek local populations. The results of similar efforts in Long Creek are inconclusive. Mark and recapture studies of bull trout in Long Creek indicate a larger migratory component than previously expected.

Although the status of specific local populations has been slightly improved by recovery actions, the overall status of Klamath River bull trout continues to be depressed. Factors considered threats to bull trout in the Klamath Basin at the time of listing – habitat loss and degradation caused by reduced water quality, past and present land use management practices, water diversions, roads, and non-native fishes – continue to be threats today.

Changes in Status since Listing within the Saint Mary-Belly River Interim Recovery Unit

The overall status of bull trout in the Saint Mary-Belly River interim recovery unit has not changed appreciably since its listing on November 1, 1999. Extensive research efforts have been conducted since listing, to better quantify populations of bull trout and their movement patterns.

Limited efforts in the way of active recovery actions have occurred. Habitat occurs mostly on Federal and Tribal lands (Glacier National Park and the Blackfeet Nation). Known problems due to instream flow depletion, entrainment, and fish passage barriers resulting from operations of the U.S. Bureau of Reclamation's Milk River Irrigation Project (which transfers Saint Mary-Belly River water to the Missouri River Basin) and similar projects downstream in Canada constitute the primary threats to bull trout and to date they have not been adequately addressed under section 7 of the Act. Plans to upgrade the aging irrigation delivery system are being pursued, which has potential to mitigate some of these concerns but also the potential to intensify dewatering. A major fire in August 2006 severely burned the forested habitat in Red Eagle and Divide Creeks, potentially affecting three of nine local populations and degrading the baseline.

State Conservation Actions

Idaho*:* Conservation actions by the State of Idaho include: (1) the development of a management plan for bull trout in 1993 (Conley 1993); (2) the approval of the State of Idaho Bull Trout Conservation Plan (Idaho Plan) in July 1996 (Batt 1996); (3) the development of 21 problem assessments involving 59 key watersheds; (4) the implementation of conservation actions identified in the problem assessments; and, (5) the implementation of more restrictive angling regulations.

Montana: Conservation actions by the State of Montana include: (1) development of the Montana Bull Trout Restoration Plan issued in 2000 (MBTRT 2000), which defines strategies for ensuring the long-term persistence of bull trout in Montana; (2) formation of the Montana Bull Trout Restoration Team (MBTRT) and Montana Bull Trout Scientific Group (MBTSG) to produce a plan for maintaining, protecting, and increasing bull trout populations; (3) the development of watershed groups to initiate localized bull trout restoration efforts; (4) funding of habitat restoration projects, recovery actions, and genetic studies throughout the state; (5) the abolition of brook trout stocking programs; and, (6) restrictive angling regulations.

Nevada: Conservation actions by the State of Nevada include: (1) the preparation of a Bull Trout Species Management Plan that recommends management alternatives to ensure that human activities will not jeopardize the future of bull trout in Nevada (Johnson 1990); (2) implementation of more restrictive State angling regulations in an attempt to protect bull trout in the Jarbidge River in Nevada; and, (3) the abolition of a rainbow trout stocking in the Jarbidge River.

Oregon: Since 1990, the State of Oregon has taken extensive action to address the conservation of bull trout, including: (1) Establishing bull trout working groups in the Klamath, Deschutes, Hood, Willamette, Odell Lake, Umatilla and Walla Walla, John Day, Malheur, and Pine Creek river basins for the purpose of developing bull trout conservation strategies; (2) establishment of more restrictive harvest regulations in 1990; (3) reduced stocking of hatchery-reared rainbow trout and brook trout into areas where bull trout occur; (4) angler outreach and education efforts are also being implemented in river basins occupied by bull trout; (5) research to further examine life history, genetics, habitat needs, and limiting factors of bull trout in Oregon; (6)

reintroduction of bull trout fry from the McKenzie River watershed to the adjacent Middle Fork of the Willamette River, which is historic but currently unoccupied, isolated habitat; (7) the Oregon Department of Environmental Quality (DEQ) established a water temperature standard such that surface water temperatures may not exceed 10 degrees Celsius (50 degrees Fahrenheit) in waters that support or are necessary to maintain the viability of bull trout in the State (Oregon 1996); (8) expansion of the Oregon Plan for Salmon and Watersheds (Oregon 1997) to include all at-risk wild salmonids throughout the State; and, (9) reintroduction of bull trout to the Clackamas River, and important recovery action for the Willamette River Basin as identified in the Service's 2002 draft recovery plan.

Washington: Conservation actions by the State of Washington include: (1) establishment of the Salmon Recovery Act (ESHB 2496) and Watershed Management Act (ESHB 2514) by the Washington State legislature to assist in funding and planning salmon recovery efforts; (2) abolition of brook trout stocking in streams or lakes connected to bull trout-occupied waters; (3) changing angling regulations in Washington prohibit the harvest of bull trout, except for a few areas where stocks are considered "healthy"; (4) collecting and mapping updated information on bull trout distribution, spawning and rearing areas, and potential habitat; and, (5) adopting new emergency forest practice rules based on the "Forest and Fish Report" process. These rules address riparian areas, roads, steep slopes, and other elements of forest practices on non-Federal lands.

Tribal Conservation Activities

Many Tribes throughout the range of the bull trout are participating on bull trout conservation working groups or recovery teams in their geographic areas of interest. Some tribes are also implementing projects which focus on bull trout or that address anadromous fish but benefit bull trout (e.g., habitat surveys, passage at dams and diversions, habitat improvement, and movement studies).

4.2 Oregon Chub

4.2.1 Species Description

The Oregon chub was first described in scientific literature in 1908 (Snyder 1908), however it was not identified as a unique species until 1991 (Markle et al. 1991). The Oregon chub is a small minnow (Family: Cyprinidae) with an olive-colored back grading to silver on the sides and white on the belly. Scales are relatively large with fewer than forty occurring along the lateral line and scales near the back are outlined with dark pigment (Markle et al. 1991). While young of the year range in length from 7 to 32 millimeters (mm) (0.3 to 1.3 inches), adults can be up to 90 mm (3.5 inches) in length (Pearsons 1989). The species is distinguished from its closest relative, the Umpqua chub (*Oregonichthys kalawatseti*), by Oregon chub's longer caudal peduncle (the narrow part of a fish's body to which the tail is attached), mostly scaled breast, and more terminal mouth position (Markle et al. 1991).

The Service listed the Oregon chub as an endangered species in 1993 (USFWS 1993) and a final recovery plan for the Oregon chub was published in 1998 (USFWS 1998). The Oregon chub recovery plan established the following criteria for downlisting the species from endangered to threatened status:

> Establish and manage 10 populations of at least 500 adults each; (2) All of these populations must exhibit a stable or increasing trend for 5 years; and (3) At least three populations must be located in each of the three sub-basins of the Willamette River identified in the plan (Mainstem Willamette River, Middle Fork, and Santiam River).

The recovery plan established the following criteria for delisting (i.e., removing the species from the List of Endangered and Threatened Wildlife):

> Establish and manage 20 populations of at least 500 adults each; (2) All of these populations must exhibit a stable or increasing trend for 7 years; (3) At least four populations must be located in each of the three sub-basins (Mainstem Willamette River, Middle Fork, and Santiam River); and (4) Management of these populations must be guaranteed in perpetuity.

In 2008, the Service completed a 5-year review of the Oregon chub, concluding that downlisting criteria had been met and the species should be downlisted to threatened status (USFWS 2008a). The final rule designating critical habitat (USFWS 2010a, b) and the final rule to downlist Oregon chub were published in 2010 (USFWS 2010c). The Service recently announced the initiation of another 5-year review of the status of Oregon chub (USFWS 2013).

4.2.2 Critical Habitat Description

Critical habitat was designated for Oregon chub in 2010 (USFWS 2010b, c). In the final rule, the Service determined that 25 units totaling approximately 53.5 hectares (ha) (132.1 acres) in Benton, Lane, Linn and Marion Counties met the proposed definition of critical habitat (Figure 1). Land ownership of the proposed critical habitat is as follows: 13.3 ha (32.9 acres) private, 12.2 ha (30.11 acres) state, 26.8 ha (66.3 acres) Federal and 1.2 ha (2.8 acres) other public lands.

The Primary Constituent Elements (PCEs) of Oregon chub critical habitat are the habitat components that provide the following:

1. Off-channel water bodies such as beaver ponds, oxbows, side-channels, stable backwater sloughs, low-gradient tributaries, and flooded marshes, including at least 500 continuous square meters (m^2) (0.12 acres) of aquatic surface area at depths between approximately 0.5 and 2.0 meters (m) (1.6 and 6.6 feet)
2. Aquatic vegetation covering a minimum of 250 m^2 (0.06 acres) (or between approximately 25 and 100 percent) of the total surface area of the habitat. This vegetation is primarily submergent for purposes of spawning, but also includes emergent and floating vegetation, and algae, which are important for cover throughout the year. Areas with sufficient vegetation are likely to also have the following characteristics.
    a. Gradient less than 2.5 percent;

   b. No or very low water velocity in late spring and summer;
   c. Silty, organic substrate; and
   d. Abundant minute organisms such as rotifers, copepods, cladocerans, and chironomid larvae.

3. Late spring and summer subsurface water temperatures between 15 and 25 °C (59 and 78 °F), with natural diurnal and seasonal variation.

4. No or negligible levels of non-native aquatic predatory or competitive species. Negligible is defined for the purpose of this rule as a minimal level of non-native species that will still allow the Oregon chub to continue to survive and recover.

4.2.3 Life History

Oregon chub reach maturity at about 2 years of age (Scheerer and McDonald 2003, p. 78) and in wild populations can live up to 9 years. Most individuals over 5 years old are females (Scheerer and McDonald 2003, p. 68). Oregon chub spawn from May through August; individuals are not known to spawn more than once a year. Spawning activity has only been observed at water temperatures exceeding 16 °C (61 °F). Males over 35 mm (1.4 inches) have been observed exhibiting spawning behavior (Pearsons 1989, p. 4). Egg masses have been found to contain 147-671 eggs (Pearsons 1989, p.17).

Oregon chub are found in slack water off-channel habitats such as beaver (*Castor Canadensis*) ponds, oxbows, side channels, backwater sloughs, low gradient tributaries, and flooded marshes. These habitats usually have little or no water flow, are dominated by silty and organic substrate, and contain considerable aquatic vegetation providing cover for hiding and spawning (Pearsons 1989, p. 27; Markle *et al.* 1991, p. 289; Scheerer and McDonald 2000, p. 1). The average depth of habitat utilized by Oregon chub is less than 1.8 m (6 ft), and summer water temperatures typically exceed 16 °C (61 °F).

Adult chub seek dense vegetation for cover and frequently travel in the mid-water column in beaver channels or along the margins of aquatic plant beds. Larval chub congregate in shallow near-shore areas in the upper layers of the water column, whereas juveniles venture farther from shore into deeper areas of the water column (Pearsons 1989, p. 16). In the winter months, Oregon chub can be found buried in the detritus or concealed in aquatic vegetation (Pearsons 1989, p. 16). Fish of similar size school and feed together. In the early spring, Oregon chub are most active in the warmer, shallow areas of the ponds.

Oregon chub are obligatory sight feeders (Davis and Miller 1967, p. 32). They feed throughout the day and stop feeding after dusk (Pearsons 1989, p. 23). Chub feed mostly on water column fauna. The diet of Oregon chub adults collected in a May sample consisted primarily of minute crustaceans including copepods, cladocerans, and chironomid larvae (Markle *et al.* 1991, p. 288). The diet of juvenile chub also consists of minute organisms such as rotifers and cladocerans (Pearsons 1989, p. 2).

Of the known Oregon chub populations, the sites with the highest diversity of native fish, amphibian, and reptile species have the largest populations of Oregon chub (Scheerer and

McDonald 2000, p. 24). Beavers appear to be especially important in creating and maintaining habitats that support these diverse native species assemblages (Scheerer and Apke 1998, p. 45).

4.2.4 Status

Distribution

The Oregon chub is endemic to the Willamette River drainage of western Oregon. Historical records show Oregon chub were found as far downstream as Oregon City and as far upstream as Oakridge. At the time of listing in 1993, there were only eight known populations of Oregon chub. These locations represented a small fraction (estimated as two percent based on stream miles) of the species' formerly extensive distribution within the Willamette River drainage.

Since the time of listing, several Oregon chub populations have been extirpated, a number of new populations have been discovered, and there have been a number of successful introductions (Bangs *et al.* 2012). In 2012, the ODFW confirmed the continued existence of Oregon chub at 61 locations in the North and South Santiam River, McKenzie River, Middle Fork and Coast Fork Willamette River, and several tributaries to the mainstem Willamette River downstream of the Coast Fork/Middle Fork Willamette River confluence (Bangs *et al.* 2012). These included 42 naturally occurring and 19 introduced populations. Twelve new populations of Oregon chub were also discovered in connected sloughs in the Middle Fork Willamette and Mainstem Willamette drainages (Bangs *et al.* 2012). Thirty-six of these Oregon chub populations have an estimated abundance of over 500 fish; and 20 of these populations have also exhibited a stable or increasing trend over the last seven years (Bangs *et al.* 2012). The current status of Oregon chub populations meets the goals of the recovery plan for delisting. The distribution of these sites is shown in Table 8.

Table 8. Distribution of Oregon Chub Populations Meeting Recovery Criteria for Delisting

Subbasin	# of populations	# of large populations (>500 fish)	# of large populations with stable/increasing trend	Total chub in subbasin	Size range of populations
Santiam	17	11	5	29,070	10 to 5,730
Mainstem Willamette (+ McKenzie)	25	9	6	146,509	4 to 82,800
Middle Fork Willamette	33	15	9	44,999	1 to 13,460
Coast Fork Willamette	4	1	0	962	2 to 700

Although certain populations of Oregon chub have remained relatively stable from year to year, substantial fluctuations in population abundance are normal. For instance, the largest known population at Ankeny National Wildlife Refuge had an estimated abundance of 21,790 chub in 2010 and increased to 96,810 chub in 2011.

Threats

Historically, the mainstem of the Willamette River was a braided channel with many side channels, meanders, oxbows, and overflow ponds that provided habitat for the chub. Periodic flooding of the river created new habitat and transported the chub into new areas to create new populations. The construction of flood control projects and dams, however, changed the Willamette River significantly and prevented the formation of chub habitat and the natural dispersal of the species. Other factors responsible for the decline of the chub include habitat alteration; the proliferation of nonnative fishes; desiccation of habitats; sedimentation resulting from timber harvesting in the watershed; and possibly the demographic risks that result from a fragmented distribution of small, isolated populations.

Elevated levels of nutrients and pesticides have been found in some Oregon chub habitats (Materna and Buck 2007, p. 67). The source of the contamination is likely agricultural runoff from adjacent farm fields (Materna and Buck 2007, p. 68). Water quality investigations at sites in the Middle Fork and mainstem Willamette subbasins have found some adverse effects to Oregon chub habitats caused by changes in nutrient levels. Elevated nutrient levels at some Oregon chub locations, particularly increased nitrogen and phosphorus, may result in anoxic (absence of oxygen) conditions unsuitable for chub, or increased plant and algal growth that severely reduce habitat availability because of succession.

Many populations of chub are currently isolated from other chub populations due to the reduced frequency and magnitude of flood events and the presence of migration barriers such as impassible culverts and permanent, high beaver dams. Managing Oregon chub in isolation may have genetic consequences (DeHaan *et al.* 2010, p. 20). Burkey (1989) concluded that when species are isolated by fragmented habitats, low rates of population growth are typical in local populations and their probability of extinction is directly related to the degree of isolation and fragmentation. Without sufficient immigration, growth for local populations may be low and probability of extinction high (Burkey 1989, 1995). A genetic analysis completed in 2010 shows that while gene flow is limited among Oregon chub populations, most of the populations in isolated ponds are currently genetically viable and have remained so over several years (1997 to 2005)(DeHaan *et al*. 2010). However, the data were collected over only a 3 to 4-generation time period and it may be too soon to see evidence of negative genetic effects. Additionally, genetic data from historic populations (pre-Willamette project) is not available to compare with these results.

Climate change presents substantial uncertainty regarding the future environmental conditions in the Willamette Basin and is expected to place an added stress on the species and its habitats. The Intergovernmental Panel on Climate Change (IPCC) has concluded that recent warming is already strongly affecting aquatic biological systems; this is evident in increased runoff and earlier spring peak discharge in many glacier- and snow-fed rivers (IPCC 2007, p. 8). Projections for climate change in North America include decreased snowpack, more winter flooding, and reduced summer flows (IPCC 2007, p. 14). Projections for climate change in the Willamette Valley in the next century include higher air temperatures that will lead to lower soil moisture and increased evaporation from streams and lakes (Climate Leadership Initiative (CLI) and the National Center for Conservation Science and Policy 2009, p. 9). While there is high uncertainty in the total precipitation projections for the region, effective precipitation (precipitation that contributes to runoff) may be reduced significantly even if there is no decline in total precipitation (CLI and the National Center for Conservation Science and Policy 2009, p. 9).

Although climate change is almost certain to affect aquatic habitats in the Willamette Basin (CLI 2009, p. 1), there is great uncertainty about the specific effects of climate change on the Oregon chub. The Service has developed a strategic plan to address the threat of climate change to vulnerable species and ecosystems; goals of this plan include maintaining ecosystem integrity by protecting and restoring key ecological processes such as nutrient cycling, natural disturbance cycles, and predator-prey relationships (USFWS 2010d; p. 23). The Oregon chub recovery program will strive to achieve these goals by working to establish conditions that allow populations of Oregon chub to be resilient to changing environmental conditions and to persist as viable populations into the future. Our recovery program for the species focuses on maintaining large populations distributed across the species' entire historical range in a variety of ecological settings (e.g., across a range of elevations). This approach is consistent with the general principles of conservation biology. In their review of minimum population viability literature, Traill et al. (2009, p. 3) found that maintenance of large populations across a range of ecological settings increases the likelihood of species persistence under the pressures of environmental variation and facilitates the retention of important adaptive traits through the maintenance of genetic diversity. Maintaining multiple populations across a range of ecological settings, as described in the recovery plan, will also increase the likelihood that at least some of these populations persist under the stresses of a changing climate.

4.2.5 Conservation

Needs

In the past, the recovery strategy focused on improving Oregon chub habitats in isolation due to the loss and fragmentation of suitable habitats and the threats posed by non-native fishes.

Increasing the abundance and distribution of Oregon chub in isolation has proven to be effective at halting the decline of Oregon chub populations and in meeting the recovery criteria for downlisting. However, managing Oregon chub in isolation does not allow genetic transfer between populations and may have future genetic consequences. Floodplain connectivity at many sites near mainstem rivers is not well understood. Recent hydrological data were collected by ODFW at sites that are influenced by the operation of dams in the Willamette Basin to determine the point of connectivity at each site and the duration of floodplain connection. They found that several sites connect to the river more frequently or for longer periods than previously known. Additionally, in 2012, ODFW detected upstream movement of two marked Oregon chub between habitats in the Middle Fork Willamette River. This is the first documentation of upstream movement of Oregon chub. Although, it is not known how frequently Oregon chub are moving between habitats, the connectivity study shows that the mechanism for dispersal does exist. Future studies will include monitoring for movement of Oregon chub between connected populations in other subbasins. Genetic studies are also needed to determine whether the populations in these periodically connected sites are operating as a metapopulation.

Additionally, some populations are persisting even in the presence of nonnatives, although many of these populations are less abundant than populations without nonnatives present. Understanding what habitat characteristics allow Oregon chub to coexist with nonnatives in these connected habitats will be useful in determining whether chub can be reintroduced in connected habitats.

Current Actions

The Oregon Chub Working Group was formed in 1991 and has been proactive in conserving and restoring habitat for the Oregon chub and raising public awareness of the species since before the Federal listing in 1993 (USFWS 2008a, p. 11).

In 1992, an interagency Conservation Agreement for the Oregon Chub in the Willamette Valley, Oregon was completed and signed by the Service, the U.S. Forest Service, the Bureau of Land Management, the ODFW, and Oregon Parks and Recreation Department (USFWS 1998). The purpose of the coordinated plan was to facilitate Oregon chub protection and recovery and to serve as a guide for all agencies to follow as they conduct their missions.

In February 1997, a Memorandum of Understanding was signed by the Service and the City of Salem to protect and enhance the population of Oregon chub located in the drinking water treatment facility at Geren Island in the North Santiam River.

In 1996, a no-spray agreement with the Oregon Department of Transportation was formalized to protect Oregon chub sites located in the Middle Fork Willamette River drainage adjacent to Highway 58 in Lane County. The agreement prohibits spraying of herbicides in the vicinity of Oregon chub sites and limits vegetation control to mechanical methods if necessary.

The Service has completed three individual safe harbor agreements (SHA) for Oregon chub. To streamline the process for landowners to enter into a SHA in the future, a programmatic SHA was prepared by the Service and ODFW in 2009 (USFWS 2009). Under a SHA, property owners who undertake management activities that attract listed species onto their property or that increase the numbers or distribution of listed species already present on their property will not incur future property-use restrictions. SHAs provide assurances to the property owner that allow alterations or modifications to enrolled property, even if such action results in the incidental take of the covered listed species or, in the future, returns the species back to an originally agreed-upon baseline condition.

In 2008, the Service signed a biological opinion on the continued operation and maintenance of the Willamette River Basin Project and effects to Oregon chub, bull trout, and bull trout critical habitat (Service 2008b). To address specific terms and conditions outlined in the opinion, ODFW initiated a study in 2009 to determine the current status of chub populations, fish assemblages, and habitat conditions in habitats potentially affected by the operation of Willamette River Basin Project dams. They are assessing relationships between pond bathymetry, pond elevations, pond temperatures, river flow levels, site connectivity, and fish assemblages. Data from this study will be used to provide the USACE with flow management recommendations that will contribute to Oregon chub recovery and minimize incidental take of chub.

The improvement in status of Oregon chub is due largely to the implementation of actions identified in the Oregon chub recovery plan. This includes habitat restoration, the discovery of many new populations as a result of ODFW’s surveys of the basin, and the establishment of additional populations via successful reintroductions within the species’ historical range. Introduced populations have been established in suitable habitats with low connectivity to other aquatic habitats to reduce the risk of invasion by nonnative fishes.

Figure 2. Locations of Oregon Chub Critical Habitat

4.3 Marbled Murrelet

The murrelet is a small diving seabird that nests mainly in coniferous forests and forages in near-shore marine habitats. Males and females have sooty-brown upperparts with dark bars. Underparts are light, mottled brown. Winter adults have brownish-gray upperparts and white scapulars. The plumage of fledged young is similar to that of adults in winter. Chicks are downy and tan colored with dark speckling.

4.3.1 Legal Status

The murrelet was listed as a threatened species on September 28, 1992, in Washington, Oregon, and northern California (57 FR 45328 [October 1, 1992]). Since the species' listing, the FWS has completed two 5-yr status reviews of the species: September 1, 2004 (USFWS 2004e) and June 12, 2009 (USFWS 2009d). The 2004 5-year review determined that the California, Oregon, and Washington distinct population segment of the murrelet did not meet the criteria outlined in the FWS 1996 Distinct Population Segment (DPS) policy (USFWS and USDC NMFS 1996, USFWS 2004e). However, the 2009 5-year review concluded the 2004 analysis of the DPS question was based on a flawed assumption regarding discreteness at the international border with Canada (USFWS 2009d, pages 3-12). The legal status of the murrelet remains unchanged from the original designation.

4.3.2 Life history

i. Reproduction

Murrelets produce one egg per nest and usually only nest once a year, however re-nesting has been documented. Nests are not built, but rather the egg is placed in a small depression or cup made in moss or other debris on the limb. Incubation lasts about 30 days, and chicks fledge after about 28 days after hatching. Both sexes incubate the egg in alternating 24-hour shifts. The chick is fed up to eight times daily, and is usually fed only one fish at a time. The young are semiprecocial, capable of walking but not leaving the nest. Fledglings fly directly from the nest to the ocean. If a fledgling is grounded before reaching the ocean, they usually die from predation or dehydration, as murrelets need to take off from an elevated site to obtain flight.

Generally, estimates of murrelet fecundity are directed at measures of breeding success, either from direct assessments of nest success in the terrestrial environment, marine counts of hatch-year birds, or computer models. Telemetry estimates are typically preferred over marine counts for estimating breeding success due to fewer biases (McShane et al. 2004, p. 3-2). However, because of the challenges of conducting telemetry studies, estimating murrelet reproductive rates with an index of reproduction, referred to as the juvenile ratio (Ŕ),[26] continues to be important, despite the debate over use of this index (see discussion in Beissinger and Peery 2007, p. 296).

Although difficult to obtain, nest success rates[27] are available from telemetry studies conducted in California (Hebert and Golightly 2006; Peery et al. 2004) and Washington (Bloxton and Raphael 2006). In northwestern Washington, Bloxton and Raphael (2005, p. 5) documented a nest success rate of 0.20 (2 chicks fledging from 10 nest starts). In central California, murrelet nest success is 0.16 (Peery et al. 2004, p. 1098) and in northern California it is 0.31 to 0.56 (Hebert and Golightly 2006, p. 95). No studies or published reports from Oregon are available.

Unadjusted and adjusted values for annual estimates of murrelet juvenile ratios at sea suggest extremely low breeding success in Conservation Zone 4 (mean ratio for 2000-2011 of 0.046, range 0.01 to 0.1, CCR 2012, p. 11), northern California (0.003 to 0.029 - Long et al. 2008, pp. 18-19; CCR 2012, p. 11), central California (0.035 and 0.032 - Beissinger and Peery 2007, pp. 299, 302), and in Oregon (0.0254 - 0.0598 - CCR 2008, p. 13). Estimates for Ŕ (adjusted) in the San Juan Islands in Washington have been below 0.15 every year since surveys began in 1995, with three of those years below 0.05 (Raphael et al. 2007a, p. 16).

These current estimates of Ŕ are assumed to be below the level necessary to maintain or increase the murrelet population. Demographic modeling suggests murrelet population stability requires a minimum reproductive rate of 0.18 to 0.28 (95 % CI) chicks per pair per year (Beissinger and Peery 2007, p. 302; USFWS 1997). The estimates for Ŕ discussed above from individual studies, as well as estimates for the listed range (0.02 to 0.13) are all below the lowest estimated value (0.18) identified as required for population stability (USFWS 1997, Beissinger and Peery 2007, p. 302).

The current estimates for Ŕ also appear to be well below what may have occurred prior to the murrelet population decline. Beissinger and Peery (2007, p. 298) performed a comparative analysis using historic data from 29 bird species to predict the historic Ŕ for murrelets in central California, resulting in an estimate of 0.27 (95% CI: 0.15 - 0.65). Therefore, the best available scientific information of current murrelet fecundity from model predictions, and from juvenile ratios and trend

---

[26] The juvenile ratio (Ŕ) for murrelets is derived from the relative abundance of hatch-year (HY; 0-1 yr-old) to after-hatch-year (AHY; 1+ yr-old) birds (Beissinger and Peery 2007, p. 297) and is calculated from marine survey data.

[27] Nest success here is defined by the annual number of known hatchlings departing from the nest (fledging) divided by the number of nest starts.

analyses based on population survey data appear to align well; both indicate that the murrelet reproductive rate is generally insufficient to maintain stable population numbers throughout all or portions of the species' listed range.

ii. *Population structure*

Murrelets are long-lived seabirds that spend most of their life in the marine environment, with breeding adult birds annually nesting in the forest canopy of mature and old-growth forests from about March 24 through September 15. Murrelets have a naturally low reproductive rate. Murrelets lay just one egg and are thought to usually first breed at age 3.

iii. *Recovery Zones*

The Recovery Plan identified six Conservation Zones (Figure 4) throughout the listed range of the species: Puget Sound (Conservation Zone 1), Western Washington Coast Range (Conservation Zone 2), Oregon Coast Range (Conservation Zone 3), Siskiyou Coast Range (Conservation Zone 4), Mendocino (Conservation Zone 5), and Santa Cruz Mountains (Conservation Zone 6). Recovery zones are the functional equivalent of recovery units as defined by FWS policy (USFWS 1997, p. 115).

iv. *Recovery Zones in Oregon*

1. *Conservation Zone 3 (Oregon Coast Range Zone)*: This zone extends from the Columbia River, south to North Bend, Coos County, Oregon. Conservation zone 3 includes waters within 2 km (1.2 miles) of the Pacific Ocean shoreline and extends inland a distance of up to 56 km (35 miles) from the Pacific Ocean shoreline and coincides with the zone 1 boundary line. This zone contains the majority of murrelet sites in Oregon. Murrelet sites along the western portion of the Tillamook State Forest are especially important to maintaining well-distributed murrelet populations. Maintaining suitable and occupied murrelet habitat on the Elliot State Forest, Tillamook State Forest, Siuslaw NF, and BLM-administered forests is an essential component for the stabilization and recovery of murrelets (USFWS 1997). Beissinger and Peery (2003, page 22) estimated a 2.8 to 13.4 percent annual population decline for this zone. Miller et al. (2012, page 775) estimated a 1.5 percent population decline for this zone, with a 95 percent confidence limit of 5.4 percent decline to 2.6 percent increase in the population.

2. *Conservation Zone 4 (Siskiyou Coast Range Zone):* The Siskiyou Coast Range zone extends from North Bend, Coos County, Oregon south to the southern end of Humboldt County, California. It includes waters within 1.2 miles of the Pacific Ocean shoreline (including Humboldt and Arcata bays) and, generally extends inland a distance of 56 km (35 miles) from the Pacific shoreline. This zone contains populations in Redwood National Park and several state parks. It contains nesting habitat on private lands in southern Humboldt County and at

lower elevations in the western portions of Smith River National Recreation Area (USFWS 1997). Beissinger and Peery (2003, page 22) estimated a 2.5 to 13.2 percent annual population decline for this zone. Miller et al. (2012, page 775) estimated a 0.9 percent population decline for this zone, with a 95 percent confidence limit of 3.8 percent decline to 2.0 percent increase in the population.

3. *Ecology / Habitat Characteristics:* Murrelets are long-lived seabirds that spend most of their life in the marine environment, but use old-growth forests for nesting. Courtship, foraging, loafing, molting, and preening occur in near-shore marine waters. Throughout their range, murrelets are opportunistic feeders and utilize prey of diverse sizes and species. They feed primarily on fish and invertebrates in near-shore marine waters although they have also been detected on rivers and inland lakes.

   Murrelets spend most of their lives in the marine environment where they forage in near-shore areas and consume a diversity of prey species, including small fish and invertebrates. In their terrestrial environment, the presence of platforms (large branches or deformities) used for nesting is the most important characteristic of their nesting habitat. Murrelet habitat use during the breeding season is positively associated with the presence and abundance of mature and old-growth forests, large core areas of old-growth, low amounts of edge habitat, reduced habitat fragmentation, proximity to the marine environment, and forests that are increasing in stand age and height. Additional information on murrelet taxonomy, biology, and ecology can be found in Ralph et al. (1995), McShane et al. (2004), and Piatt et al. (2007).

4. *Aquatic Habitat Use*
   Murrelets are usually found within 5 miles (8 km) from shore, and in water less than 60 meters deep (Ainley et al. 1995; Burger 1995; Strachan et al. 1995; Nelson 1997; Day and Nigro 2000; Raphael et al. 2007b). In general, birds occur closer to shore in exposed coastal areas and farther offshore in protected coastal areas (Nelson 1997). Courtship, foraging, loafing, molting, and preening occur in marine waters.

   Murrelets are wing-propelled pursuit divers that forage both during the day and at night (Carter and Sealy 1986; Henkel et al. 2003; Kuletz 2005). Murrelets can make substantial changes in foraging sites within the breeding season, but many birds routinely forage in the same general areas and at productive foraging sites, as evidenced by repeated use over a period of time throughout the breeding season (Carter and Sealy 1990, Whitworth et al. 2000; Becker 2001; Hull et al. 2001; Mason et al. 2002; Piatt et al. 2007). Murrelets are also known to forage in freshwater lakes (Nelson 1997). Activity patterns and foraging locations are influenced by biological and physical processes that concentrate prey, such as weather, climate, time of day, season, light intensity, up-wellings, tidal rips, narrow passages between island, shallow banks, and kelp (*Nereocystis* spp.) beds (Ainley et al. 1995; Burger 1995; Strong et al. 1995; Speckman 1996; Nelson 1997).

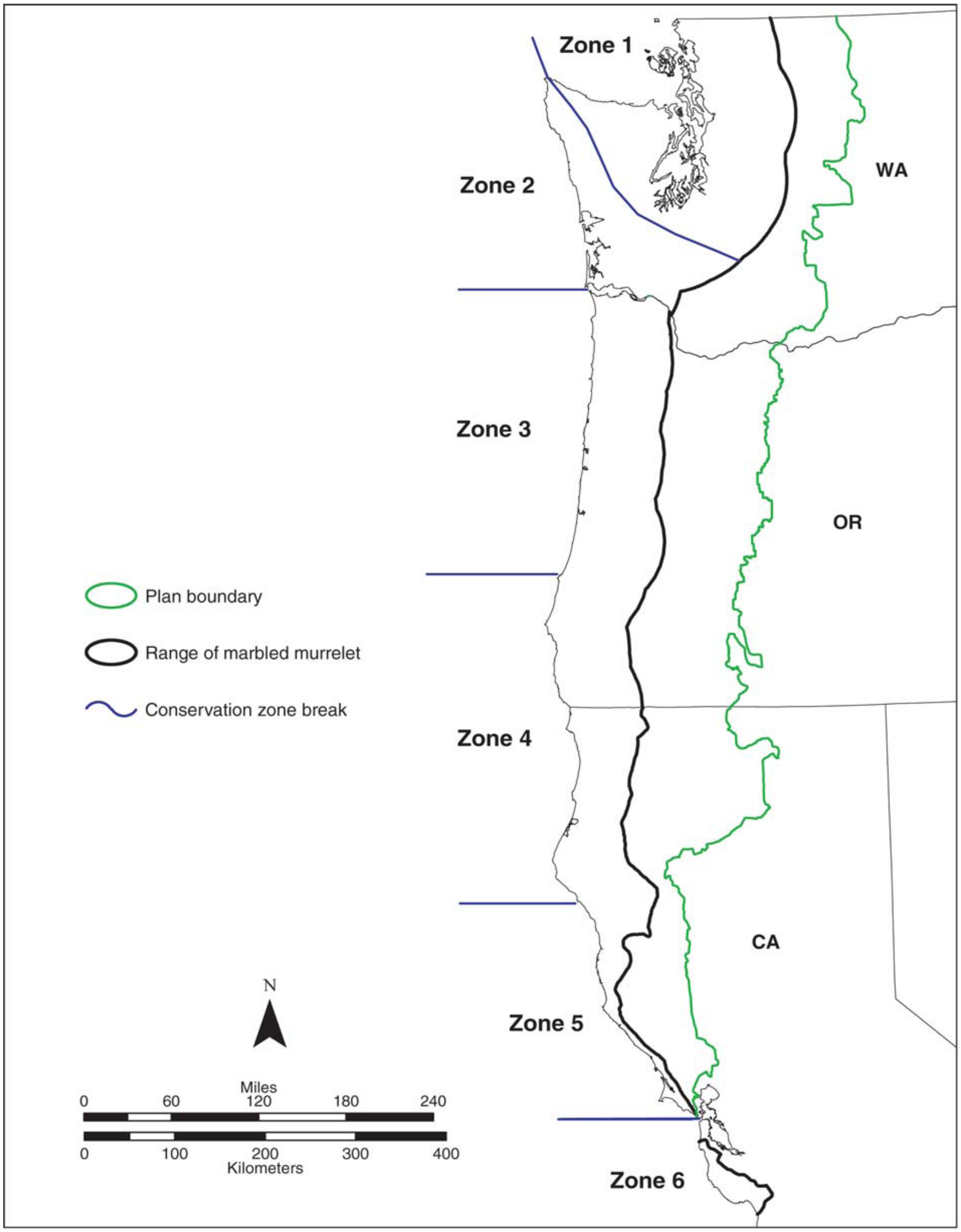

Figure 3. The six geographical areas identified as Conservation Zones in the recovery plan for the murrelet (USFWS 1997). Note: "Plan Boundary" refers to the Northwest Forest Plan. Figure adapted from Huff et al. (2006, p. 6).

Within the area of use, murrelets usually concentrate feedings in shallow, near-shore water less than 98 feet (30 m) deep (Huff et al. 2006), but are thought to be able to dive up to depths of 157 feet (47 m) (Mathews and Burger 1998). During the non-breeding season, murrelets disperse and can be found farther from shore (Strachan et al. 1995). Although little information is available outside of the nesting season, limited information on winter distribution also suggests they do move farther offshore (Craig Strong, Biologist, Crescent Coast Research, Crescent City, California, pers. comm., 2007). In areas with protective waters, there may be a general opportunistic shift from exposed outer coasts into more protected waters during the winter (Nelson 1997); for example many murrelets breeding on the exposed outer coast of Vancouver Island appear to congregate in the more sheltered waters within the Puget Sound and the Strait of Georgia in fall and winter (Burger 1995). In many areas, murrelets also undertake occasional trips to inland nesting habitat during the winter months (Carter and Erickson 1992). Throughout the listed range, murrelets do not appear to disperse long distances, indicating they are year-round residents (McShane et al. 2004).

Throughout their range, murrelets are opportunistic feeders and utilize prey of diverse sizes and species. They feed primarily on fish and invertebrates in marine waters although they have also been detected on rivers and inland lakes (Carter and Sealy 1986; 57 FR 45328). In general, small schooling fish and large pelagic crustaceans are the main prey items. Pacific sand lance (*Ammodytes hexapterus*), northern anchovy (*Engraulis mordax*), immature Pacific herring (*Clupea harengus*), capelin (*Mallotus villosus*), Pacific sardine (*Sardinops sagax*), juvenile rockfishes (*Sebastas* spp.), and surf smelt (Osmeridae) are the most common fish species taken. Squid (*Loligo* spp.), euphausiids, mysid shrimp, and large pelagic amphipods are the main invertebrate prey. Murrelets are able to shift their diet throughout the year and over years in response to prey availability (Becker et al. 2007). However, long-term adjustment to less energetically-rich prey resources (such as invertebrates) appears to be partly responsible for poor murrelet reproduction in California (Becker and Beissinger 2006).

Breeding adults exercise more specific foraging strategies when feeding chicks, usually carrying a single, relatively large (relative to body size) energy-rich fish to their chicks (Burkett 1995; Nelson 1997), primarily around dawn and dusk (Nelson 1997, Kuletz 2005). Freshwater prey appears to be important to some individuals during several weeks in summer and may facilitate more frequent chick feedings, especially for those that nest far inland (Hobson 1990). Becker et al. (2007) found murrelet reproductive success in California was strongly correlated with the abundance of mid-trophic level prey (e.g., sand lance, juvenile rockfish) during the breeding and postbreeding seasons. Prey types are not equal in the energy they provide; for example parents delivering fish other than age-1 herring may have to increase deliveries by up to 4.2 times to deliver the same energy value (Kuletz 2005).

Therefore, nesting murrelets that are returning to their nest at least once per day must balance the energetic costs of foraging trips with the benefits for themselves and their young. This may result in murrelets preferring to forage in marine areas in close proximity to their nesting habitat. However, if adequate or appropriate foraging resources (i.e., "enough" prey, and/or prey with the optimum nutritional value for themselves or their young) are unavailable in close proximity to their nesting areas, murrelets may be forced to forage at greater distances or to abandon their nests (Huff et al. 2006). As a result, the distribution and abundance of prey suitable for feeding chicks may greatly influence the overall foraging behavior and location(s) during the nesting season, may affect reproductive success (Becker et al. 2007), and may significantly affect the energy demand on adults by influencing both the foraging time and number of trips inland required to feed nestlings (Kuletz 2005).

v. *Nesting Biology*

Incubation is shared by both sexes, and incubation shifts are generally one day, with nest exchanges occurring at dawn (Nelson 1997, Bradley 2002). Hatchlings appear to be brooded by a parent for one or two days and then left alone at the nest for the remainder of the chick period (from hatching until fledging) while both parents spend most of their time foraging at sea. Both parents feed the chick (usually a single fish carried in the bill) and the chick typically receives 1-8 meals per day (mean 3.2) (Nelson 1997). About two-thirds of feedings occur early in the morning, usually before sunrise, and about one-third occur at dusk. Feedings are sometimes scattered throughout the day (Hamer and Nelson 1995a). Chicks fledge 27-40 days after hatching, at 58-71 percent of adult mass (Nelson 1997). Fledging has seldom been documented, but it typically appears to occur at dusk (Nelson 1997).

vi. *Nest Tree Characteristics*

Lank et al. (2003) states that murrelets "occur during the breeding season in near-shore waters along the north Pacific coastline from Bristol Bay in Alaska to central California", nesting in single platform trees generally within 20 miles of the coast and older forest stands generally within 50 miles of the coast. Unlike most auks, murrelets nest solitarily on mossy platforms of large branches in old-forest trees (Lank et al. 2003). Suitable murrelet habitat may include contiguous forested areas with conditions that contain potential nesting structure. These forests are generally characterized by large trees greater than 18 inches dbh, multi-storied canopies with moderate canopy closure, sufficient limb size and substrate (moss, duff, etc.) to support nest cups, flight accessibility, and protective cover from ambient conditions and potential avian predators (Manley 1999, Burger 2002, Nelson and Wilson 2002). Over 95 percent of measured nest limbs were ≥15 cm diameter, with limb diameter ranges from 7-74 cm diameter (Burger 2002). Nelson and Wilson (2002) found that all 37 nest cups identified were in trees containing at least seven platforms. All trees in their study were climbed, however, and ground-based estimates of platforms per tree in the study were not analyzed. Lank et al. (2003) emphasizes that murrelets do not select nest sites based on tree species, but rather they select those individual trees that offer suitable nest platforms. Nest cups have been found in deciduous trees, albeit rarely and nest trees may be scattered or clumped throughout a forest stand.

vii. *Nest Stand Characteristics*

Nest stands are typically composed of low elevation conifer species. In California, nest sites have been located in stands containing old-growth redwood and Douglas-fir, while nests in Oregon and Washington have been located in stands dominated by Douglas-fir, western hemlock and Sitka spruce. Murrelets appear to select forest stands greater than 123.6 acres (50 ha) (Burger 2002), but nest in stands as small as one acre (Nelson and Wilson 2002). In surveys of mature or younger second-growth forests in California, murrelets were only found in forests where there were nearby old-growth stands or where residual older trees remained (USFWS 1992c, Singer et al. 1995).

At the stand level, vertical complexity is correlated with nest sites (Meekins and Hamer 1998, Manley 1999, Waterhouse et al. 2002, Nelson and Wilson 2002), and flight accessibility is probably a necessary component of suitable habitat (Burger 2002). Some studies have shown higher murrelet activity near stands of old-forest blocks over fragmented or unsuitable forest areas (Paton et al. 1992, Rodway et al. 1993, Burger 1995, Deschesne and Smith 1997, Rodway and Regehr 2002), but this correlation may be confounded by ocean conditions, distance inland, elevation, survey bias and disproportionately available habitat. Nelson and Wilson (2002) found that potential nest platforms per acre were a strong correlate for nest stand selection by murrelets in Oregon.

Adjacent forests can contribute to the conservation of the murrelet by reducing the potential for windthrow during storms by providing area buffers and creating a landscape with a higher probability of occupancy by murrelets (USFWS 1996, Burger 2001, Meyer et al. 2002, and Raphael et al. 2002). Trees surrounding and within the vicinity of a potential nest tree(s) may provide protection to the nest platform and potentially reduce gradations in microclimate (Chen et al. 1993).

Consulted on effects from October 1, 2003 to January 31, 2013 that impact nest stands are summarized in Table 9.