Biological Assessment for

USDA Forest Service (Pacific Northwest Region),
USDI Bureau of Land Management (Oregon State Office)
and the Coquille Indian Tribe

Fish Habitat Restoration Activities
Affecting ESA and MSA-listed Animal and Plant Species
found in Oregon and Washington

Prepared by

USDA Forest Service (Pacific Northwest Region),
Bureau of Land Management (Oregon State Office)
and the Coquille Indian Tribe

In Partnership with

US Fish and Wildlife Service
and
NOAA Fisheries

Submitted to

US Fish and Wildlife Service
and
NOAA Fisheries

December 12, 2006

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I. Introduction

This Aquatic Restoration Biological Assessment (ARBA) includes a number of individual actions which, when grouped together, represent programs that may occur at many individual sites across U.S. Forest Service (FS), Bureau of Land Management (BLM), Coquille Indian Tribe, and adjacent lands in Washington and Oregon. These actions can occur on a routine basis or sporadically and over the period FY 2007 to FY 2012 (6 years). The Coquille Indian Tribe is included in this ARBA as they are the only Tribe signatory to the Northwest Forest Plan. This programmatic approach provides each FS, BLM and Coquille administrative unit with a consistent methodology to design, implement, monitor, and document aquatic restoration activities. In addition, the ARBA facilitates Endangered Species Act (ESA) Section 7 and Magnuson/Stevens Act (MSA) consultation with the NOAA Fisheries and Endangered Species Act (ESA) Section 7 consultation with the U.S. Fish and Wildlife Service (FWS). The ARBA also provides information in sufficient detail and quality to support an appropriate NOAA Fisheries and FWS analysis.

All proposed activity categories comply with the Record of Decision and Standards and Guidelines of the Northwest Forest Plan (USDA and USDI 1994), INFISH (USDA and USDI 1995a), PACFISH (USDA and USDI 1995b), and respective National Forest Land and Resource Management Plans and BLM Resource Management Plans.

This ARBA is intended to include those aquatic restoration activities that are commonly implemented on FS, BLM, and Coquille Indian Tribal lands. The activities are predictable as to their effects to ESA and MSA listed species and consistent with broad scale aquatic conservation strategies and the best available science. This programmatic consultation does not include those actions that have limited application and which are only applicable to a limited number of administrative units. This consultation also is not intended to cover aquatic restoration actions that are overly complex or result in high risk to listed species during and/or after project implementation. Projects not fitting the appropriate categories will require separate consultation.

For the purpose of this analysis, all activities listed in Table 4 are considered to Likely Adversely Affect (LAA) ESA listed fish species and designated Critical Habitat and May Adversely Affect (MAA) MSA Essential Fish Habitat. The FS, BLM, and Coquille Indian Tribe request that this ARBA serve as a consultation document for effects to Essential Fish Habitat for the entire ARBA geographic area, including areas currently without ESA-listed fish, where Chinook, coho, and pink salmon are present. In addition, this analysis includes the Puget Sound Steelhead, which is proposed for listing under ESA.

Administrative units that already have a biological opinion or concurrence letter covering aquatic restoration activities should continue to use those documents until their coverage expires and then begin using this programmatic consultation. Aquatic restoration actions not covered in this ARBA can be covered in new local or provincial Biological Assessments (BA). However, future (until 2012) local or provincial BAs cannot include actions covered in the ARBA. Further, invasive plant treatments included in this ARBA are to serve FS, BLM, and Coquille Indian Tribe administrative units until such units complete a local or provincial consultation for this activity type.

A. Background

To better protect fish habitat and address dwindling salmon, trout, and other native fish stocks in Washington, Oregon, California, and Idaho, the FS amended National Forest Land and Resource Management Plans and the BLM amended Land Management Plans with one or more the of the following conservation strategies: Northwest Forest Plan (NWFP) (USDA and USDI 1994), INFISH (USDA and USDI 1995a), and PACFISH (USDA and USDI 1995b). A common element in these plans is an aquatic conservation strategy (ACS), providing a framework for the protection and restoration of fish stocks and water quality. The FS, BLM, and Coquille Indian Tribe believes that the ACS has and will continue to serve as a major cornerstone of Pacific Northwest (PNW) fish recovery efforts into the foreseeable future. The ACS is comprised of four basic elements, those being riparian reserves, key watersheds, watershed analysis, and watershed restoration:

- *Riparian Reserves* (NWFP) or Riparian Habitat Conservation Areas (INFISH and PACFISH) are those portions of National Forest system lands where riparian dependent resources receive primary emphasis. Riparian Reserves include those places in the watershed directly coupled to streams and rivers, the areas required for maintaining hydrologic, geomorphic, and ecological processes that directly affect standing and flowing water bodies such as lakes, ponds, wetlands, streams, stream processes and fish habitats (USDA and USDI 1994). These riparian habitats help maintain the integrity of the aquatic ecosystems by (1) influencing the delivery of coarse sediment, organic matter, and woody debris to streams (2) providing root strength for channel stability (3) shading the stream, and (4) protecting water quality (USDA and USDI 1995a). To maintain the integrity of Riparian Reserves, which vary from 50 to 400 feet on either side of a water body, all management activities in these areas are guided by standards and guides, which prohibit or regulate activities that retard or prevent the attainment of riparian functions. Many of these Riparian Reserves gain added significance with inclusion in Key Watersheds.

- *Key or Priority Watersheds* are a network of watersheds that serve as refuges for salmon and other fish species, many of which are listed under the Endangered Species Act (ESA). Watersheds in good condition serve as anchors for the potential recovery of depressed fish stocks, while watersheds characterized by having low quality habitat and high potential for restoration can serve as future refuge areas (USDA and USDI 1994). Under INFISH, priority watersheds were designated, in part, to protect watersheds with excellent habitat, especially for bull trout and metapopulation objectives (USDA and USDI 1995a).

- *Watershed Analysis* is a means to diagnose the health of a watershed, especially key watersheds, and documents the root causes of habitat degradation and those ecosystem processes that create quality habitat through time. Since 1994, approximately 300 watershed analyses have been completed by Oregon and Washington National Forests, all of which identify factors limiting fish production and associated restoration actions.

- *Watershed Restoration* is a program, based on watershed analysis, that helps restore a watershed's hydrological and ecological processes that are necessary to ensuring the long-term recovery of fish populations and water quality. The FS, BLM and Coquille Indian Tribe watershed restoration programs emphasize key watersheds and are holistic in approach, whereby projects cover uplands (i.e. conifer thinning, controlled burning, and road treatments), riparian areas (i.e. conifer or hardwood thinning and road treatments), and in-

channel projects (i.e. large wood, boulders, channel reconstruction, and fish passage restoration at road crossings).

Since implementation of the NWFP, PACFISH, and INFISH, the way in which the FS, BLM, and Coquille Indian Tribe conduct aquatic restoration has evolved from an opportunistic, single project approach to a more strategic focus on entire watersheds. In this case, restoration is defined as restoring (within existing biological and social constraints) the natural habitat forming processes within a watershed under which native fish evolved (Reeves *et. al.* 1995; Roni *et. al.* 2002). In doing so, the action agencies conduct watershed assessments, identify limiting factors that alter habitat forming processes and develop action plans to identify high priority projects through passive and active restoration. Even more, a growing number of restoration efforts concentrate funds in priority areas in a manner that results in whole-watershed restoration, whereby high priority projects are completed within a short time period (2-4 years).

Since 1998 the FS and BLM have tracked restoration activities on federal lands through the Interagency Restoration Database (IRDA), which reflects the whole watershed focus as projects are documented in uplands, riparian areas, and stream channels. The IRDA data fields include:

- *Instream Structure:* Includes actions designed to change or modify stream complexity and structure, including but not limited to: placement of large woody debris, construction of weirs/deflectors, creation of pools, placement of boulders, gravel placement, development or improvement of side channels, alcoves, or other actions designed to improve stream structure. These restoration actions are reported in terms of stream miles.

- *Instream Passage:* Includes actions designed to protect and improve fish passage for juvenile or adult fish including but not limited to: culvert removal, culvert upgrade, fish ladder improvement or installation, and improvement of irrigation diversions and fish screens. These restoration actions are reported in terms of number of miles reopened to fish passage.

- *Riparian Treatments:* Includes actions designed to improve, restore, or maintain quality and/or conditions of riparian zone vegetation, including but not limited to planting, fencing, off channel watering, beaver management, invasive plant control, livestock rotation or other management, stand conversion. These restoration actions are reported in terms of acres treated.

- *Upland Projects:* Roads and Vegetation Treatments.

Table 1 displays FS and BLM aquatic restoration projects from 1999 through 2004 (IRDA 2003). Most of the treatment types fall within the activity categories described in Table 4.

Table 1. Typical activity amounts per 5th Field Watershed on FS, BLM in Oregon and Washington from IRDA 2004.*

Year	1998	1999	2000	2001	2002	2003	2004
# of 5th Field Watersheds treated	**262**	**177**	**126**	**120**	**166**	**197**	**116**
Average stream miles treated	0.6	0.7	1.0	0.5	2.2	1.6	2.1
Total stream miles treated	168	116	131	60	152	132	74
Maximum stream miles treated in a watershed	13.6	13.6	24	6	35	16	13.73
Average acres of riparian treatments	5	3	155	17	30	43	50
Maximum acres of riparian treatments	685	54	9330**	400	557	712	332
Upland Projects	Road information was not included.						

* There are eight-hundred and twelve 5th field watersheds on FS and BLM lands in Oregon and Washington. The average size of a typical 5th field watershed is approximately 122,000 acres and can contain between 100-250 miles of fish bearing stream (IRDA 2003, 1:24,000 hydrography, <12% gradient).
**Watersheds in the Oregon Coast Range often show large amounts of riparian treatments due to the density of streams and hence overlapping delineated riparian areas where vegetation treatments occur.

B. Programmatic Objective

In 2004, the Regional Interagency Executives Committee (FS, BLM, FWS, and NOAA) identified a significant shortage of programmatic consultations for aquatic restoration in the Pacific Northwest. For instance, just 14 out of 24 of the FS and BLM administrative units with ESA-listed salmon or steelhead species currently have NOAA programmatic biological opinions for aquatic restoration. The Coquille Indian Tribe shares a NOAA biological opinion with FS and BLM administrative units in southwest Oregon. Approximately 33% of the FS and BLM administrative units with ESA-listed resident fish species currently have FWS programmatic biological opinions for aquatic restoration. Even more, the majority of these programmatic consultations are due to expire in 2007. Refer to Table 2, FS, BLM and Coquille administrative units with Programmatic Biological Opinions for Aquatic Restoration**.**

In response to this shortage of programmatic consultations, the Regional Interagency Executives Committee issued a December 10, 2004 memorandum (Appendix A) that recommended the development of new program-level fish habitat restoration consultations to aid in the recovery of fish stocks on federal lands. The executives also directed that the new consultation draw from recently completed programmatic consultations issued to the FS and/or BLM to expedite the process—culvert BOs (FWS 1-3-03-I-1482, 1-7-03-I-0395 [OR], 1-3-03-PF-1243 [WA] and NOAA 2003/00676) and Willamette and Deschutes Province BOs (FWS 1-7-03-F-20 and NOAA 2002/01254). Consequently, this biological assessment is intended to address this recommendation by filling a consultation void for all FS, BLM and Coquille Indian Tribe administrative units in Oregon and Washington.

Table 2. FS, BLM and Coquille Administrative Units with Programmatic Biological Opinions for Aquatic Restoration

FS and BLM Administrative Units and Coquille Tribe	NOAA Programmatic Biological Opinions for Aquatic Restoration			FWS Programmatic Biological Opinions for Aquatic Restoration		
	Yes, No, or NA*	Tracking Number	Expiration Date	Yes, No, or NA*	Log Number	Expiration Date
Oregon National Forest Units						
Deschutes	No	-	-	No	-	-
Fremont/Winema	NA	-	-	No	-	-
Malheur	No	-	-	No	-	-
Mt. Hood	Yes	2002/01254	9/30/07	Yes	1-7-03-F-20	9/30/07
Ochoco	No	-	-	No	-	-
Rogue River/Siskiyou**	Yes	2002/00879	10/18/07	NA	-	-
Siuslaw	Yes	2002/01254	9/30/07	NA	-	-
	Yes	2002/00879	10/18/07		-	-
Umpqua	Yes	2002/00879	10/18/07	NA	-	-
Wallowa/Whitman	No	-	-	No	-	-
Willamette	Yes	2002/01254	9/30/07	Yes	1-7-03-F-20	9/30/07
Washington National Forests						
Colville	NA	-	-	No	-	-
Gifford Pinchot	Yes	2003/01309	1/1/09	Yes	1-3-04-PF-0943/ 1-3-04-C-0944	1/1/09
Mt. Baker/Snoqualmie	Yes	2002/01961	12/15/08	Yes	1-3-04-PI-0606	6/16/09
Okanogon/Wenatchee	No	-	-	No	-	-
Olympic	No	-	-	Yes	-1-3-03-F-0833	12/31/2008
Oregon/Washington Scenic Area and National Forest						
Columbia River Gorge Scenic Area	Yes (OR)	2002/01254	9/30/07	Yes	1-7-03-F-20	9/30/07
	Yes (WA)	2003/01309	1/1/09	No	-	-
Umatilla	No	-	-	No	-	-
Oregon BLM Districts						
Burns	No	-	-	No	-	-
Coos Bay	Yes	2002/00879	10/18/07	NA	-	-
Eugene	Yes	2002/01880	9/30/07	Yes	1-7-03-F-20	9/30/07
		2002/00879	10/18/07		-	-
Lakeview	NA	-	-	No	-	-
Medford	Yes	2002/00879	10/18/07	No	-	-
Prineville	No	-	-	No	-	-
Roseburg	Yes	2002/00879	10/18/07	No	-	-
Salem	Yes	2002/01880	9/30/07	NA	-	-
Vale	No	-	-	No	-	-
Washington BLM Districts						
Spokane	No	-	-	No	-	-
Total with BO's 27 units	**14 of 24**			**7 of 22**		

*NA – Applies to those areas where NOAA or FWS ESA-listed fish species do not occur.

C. ARBA Activity Categories

Restoration activities will maintain, enhance and/or restore watershed functions that affect aquatic species. This ARBA is intended to include those aquatic restoration activities that are commonly implemented on FS, BLM and Coquille lands that are predictable as to their effects to ESA and MSA listed species and are consistent with broad scale aquatic conservation strategies and the best available science. It is not intended to include those actions that have limited application and which are only implemented at a local scale. For the purpose of this analysis, the 19 activities listed below are considered to Likely Adversely Affect (LAA) ESA-listed fish species and designated Critical Habitat and May Adversely Affect (MAA) MSA listed species. This ARBA addresses the following 19 aquatic restoration program activity types:

1. Large Wood, Boulder, and Gravel Placement (Includes tree removal for large wood projects)
2. Reconnection of Existing Side Channels and Alcoves
3. Head-cut Stabilization and Associated Fish Passage
4. Bank Restoration
5. Fish Passage Culvert and Bridge Projects
6. Irrigation Screen Installation and Replacement and Weir Removal
7. In-channel Nutrient Enhancement
8. Floodplain Overburden Removal
9. Reduction of Recreation Impacts
10. Estuary Restoration
11. Riparian Vegetation Treatment (non-commercial)
12. Riparian and Upland Juniper Treatment (non-commercial)
13. Riparian Vegetation Treatment (controlled burning)
14. Riparian Area Invasive Plant Treatment
15. Riparian Exclusion Fencing (with water gaps and stream crossings)
16. Riparian Vegetation Planting
17. Road Treatments
18. Removal of Legacy Structures
19. Fisheries, Hydrology, Geomorphology Wildlife, Botany, and Cultural Surveys in Support of Aquatic Restoration

D. ARBA Geographic Scope

This ARBA covers those portions of Oregon and Washington wherever FS, BLM and Coquille Indian Tribe administrative units are found. It also covers portions of administrative units that are primarily located in Oregon and Washington but overlap into California (Rogue/Siskiyou NF), Nevada (Lakeview and Vale BLM District) and Idaho (Wallow Whitman NF). This ARBA covers the above projects that occur within the range of listed species under the ESA of 1973 as amended and current critical habitat. Further, this ARBA covers issues related to the Magnuson-Stevens Fishery Conservation and Management Act (MSA) as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267) establishing essential fish habitat across Oregon and Washington. It also covers those projects where aquatic restoration is conducted to enhance habitat for non ESA-listed fish (such as redband trout) but might have

associated terrestrial species effects that need ESA coverage. This ARBA covers aquatic restoration projects that may incidentally affect ESA-listed terrestrial wildlife, insect, mollusk and plant species, proposed species and critical habitat. Figure 1 displays the geographic scope of the BA.

E. ARBA Projects on Non-Federal Lands

Projects that occur on non-federal lands are included under this consultation when a project directly assists the FS, BLM, or Coquille Indian Tribe in achieving their aquatic restoration goals. The FS and BLM are permitted to fund such projects under Wyden Amendment authority (16 U.S.C. 1011(a), as amended by Section 136 of PL 105-277). To be included, non-federal land projects must follow all elements of the proposed action outlined in Chapter II. The FS, BLM, or Coquille Indian Tribe will ensure that projects covered under this programmatic on non-federal land undergo the same process and compliance as projects occurring on FS, BLM and Coquille Tribal land. The FS, BLM, or Coquille Indian Tribe shall retain discretion over the non-federal land action in order to ameliorate unexpected adverse effects during and after project implementation.

F. ARBA Projects funded with Timber Sale and Stewardship Contracting Receipts as well as funds from the Emergency Relief for Federally Owned Roads (ERFO) program.

First, this ARBA covers those aquatic restoration projects funded through the Knutson-Vandenberg Act (KV). The KV projects must be non-essential or those that are not required to implement a timber sale. In doing so, a timber sale and associated aquatic restoration actions can be included in the same NEPA document but covered under different consultations, the timber sale by one and the aquatic restoration actions by this ARBA. Second, the ARBA includes projects funded through Stewardship Contracts. A joint notice detailing Stewardship actions was previously published by the FS and the BLM on June 27, 2003 (68 FR 38285) to give notice and provide an opportunity for public comment on the interim guidelines for stewardship contracting developed jointly by the FS and BLM. Fianlly, ERFO funds can be used to support ARBA projects as long as such projects (as with all projects implemented under this ARBA) have a direct link to aquatic restoration and are in accordance with activity categories, conservation measures, and design criteria listed in Table 4.

Figure 1 - Geographic Scope of Aquatic Restoration BA

G. Species That May Be Affected by Programmatic Actions

1. Fish Species

a. This assessment evaluates and describes potential effects on the following ESA-listed fish species and their respective critical habitat as regulated by NOAA Fisheries:

Lower Columbia River Chinook,
Upper Columbia River Spring-Run Chinook Salmon,
Puget Sound Chinook Salmon,
Snake River Fall-Run Chinook Salmon,
Snake River Spring/Summer-Run Chinook Salmon,
Upper Willamette River Chinook Salmon,
Lower Columbia River Chum Salmon,
Hood Canal Summer-Run Chum Salmon,
Oregon Coast Coho Salmon (in anticipation of a re-listing under ESA)
Southern Oregon/Northern California Coho Salmon,
Lower Columbia Coho Salmon,
Ozette Lake Sockeye Salmon,
Snake River Sockeye Salmon,
Lower Columbia River Steelhead,
Middle Columbia Steelhead,
Upper Columbia River Basin Steelhead,
Snake River Basin Steelhead,
Upper Willamette River Steelhead,
Puget Sound Steelhead – Proposed Threatened,
EFH Chinook, coho, and pink salmon that are not listed under the ESA

b. Further, this assessment evaluates and describes potential effects on the following ESA-listed fish species and their respective critical habitat as regulated by the FWS:

Bull Trout,
Lahontan Cutthroat Trout,
Lost River Sucker,
Shortnose Sucker,
Warner Sucker,
Borax Chub,
Oregon Chub
Foskett Speckled Dace

2. Wildlife Species

Wildlife Species – Next, this assessment evaluates and describes potential effects fromaquatic restoration activities on the following ESA-listed bird and mamammal species and their respective critical habitat as regulated by the FWS:

Northern Bald Eagle,
Marbled Murrelet,
Northern Spotted Owl,
Canada Lynx
Gray Wolf,
Grizzly Bear,
Woodland Caribou,

3. **Plant Species –** This assessment evaluates and describes potential effects on the following ESA-listed plant species and their respective critical habitat as regulated by the FWS:

   Howells's Spectacular Thelypody,
   Marsh Sandwort
   Spalding's Catchfly,
   Water Howellia,
   Rough Popcornflower,
   Gentner's Fritillary,
   Western Lily,
   Bradshaw's Lomatium,
   Large-flowered Woolly Meadowfoam,
   Malheur Wire-Lettuce,
   Kincaids Lupine
   MacFarlane's Four-O'clock,
   Showy Stickweed,
   Ute Ladies'-Tresses (WA only),
   Wenatchee Mountains Checker-Mallow,
   Macdonald's Rockcress,
   Nelson's Checker-Mallow,
   Willamette Valley Daisy,
   Cook's Lomatium,
   Applegate's Milk-vetch,
   Golden Paintbrush,

4. **Mollusks and invertebrates –** This assessment evaluates and describes potential effects on the following ESA-listed invertebrate species and their respective critical habitat as regulated by the FWS:

   Vernal Pool Fairy Shrimp

Table 3 displays each FS, BLM and Coquille Indian Tribe administrative unit where proposed activities may occur and the associated ESA-listed fish, wildlife, and plant species that may be affected, as well as associated critical habitat. These species may occur on adjacent, non-Federal lands, where Wyden Amendment projects are likely to take place.

Table 3. Affected ESA-Listed Species and their Critical Habitat on each FS, BLM and Coquille lands.

Forest Service Units	State(s)	Affected Species
Colville NF	WA	**Fish** - Bull Trout (Columbia River) **Wildlife** – Northern Bald Eagle, Canada Lynx, Gray Wolf, Grizzly Bear, woodland caribou **Plants** – None
Columbia River Gorge National Scenic Area	OR/WA	**Fish** – Bull Trout (Columbia River), Lower Columbia River Chinook Salmon, Snake River Spring/Summer and Fall Chinook, Lower Columbia River Chum Salmon, Lower Columbia River Steelhead, Middle Columbia River Steelhead, Snake River Basin Steelhead **Wildlife** – Northern Bald Eagle, Northern Spotted Owl **Plants -** Water Howellia
Crooked River National Grasslands	OR	**Fish-**Bull Trout, Middle Columbia River Steelhead, Middle Columbia River Spring Chinook **Wildlife-**none **Plants-**none
Deschutes	OR	**Fish** – Bull Trout (Columbia River) **Wildlife** – Northern Bald Eagle, Northern Spotted Owl, Canada Lynx **Plants -** None
Fremont/Winema	OR	**Fish** – Bull Trout (Klamath), Lost River Sucker, Shortnose Sucker, Warner Sucker **Wildlife** – Northern Bald Eagle, Northern Spotted **Plants** – None
Gifford Pinchot	WA	**Fish** – Bull Trout (Coastal/Puget Sound, Columbia River), Lower Columbia River Chinook Salmon, Lower Columbia River Steelhead, Middle Columbia River Steelhead **Wildlife** – Northern Bald Eagle, Marbled Murrelet, Northern Spotted Owl, Gray Wolf **Plants** – Water Howellia
Malheur	OR	**Fish** – Bull Trout (Columbia River), Middle Columbia River Steelhead **Wildlife** –Northern Bald Eagle, Canada Lynx, Gray Wolf **Plants** – None
Mt. Baker-Snoqualmie	WA	**Fish** – Bull Trout (Coastal/Puget Sound), Puget Sound Chinook Salmon, Puget Sound Steelhead **Wildlife** – Northern Bald Eagle, Marbled Murrelet, Northern Spotted Owl Gray Wolf, Grizzly Bear **Plants** – None
Mt. Hood	OR	**Fish** – Bull Trout (Columbia River), Upper Willamette Chinook, Lower Columbia River Chinook, Lower Columbia River Steelhead, Middle Columbia River Steelhead **Wildlife** – Northern Spotted Owl, Northern Bald Eagle **Plants** – Water Howellia
Ochoco	OR	**Fish -** Bull Trout (Columbia River), Middle Columbia River Steelhead **Wildlife** – Northern Bald Eagle **Plants** – None
Okanogan/Wenatchee	WA	**Fish** – Bull Trout (Columbia River), Upper Columbia River Spring-Run Chinook Salmon, Middle Columbia River Steelhead, Upper Columbia River Steelhead **Wildlife** –Northern Bald Eagle, Northern Spotted Owl, Marbled Murrelet, Canada Lynx, Gray Wolf, Grizzly Bear **Plants** – Showy Stickseed, Ute Ladies'-tresses, Water Howellia, Wenatchee Mountains Checker-Mallow

Table 3 (continued). Affected ESA-Listed Species and their Critical Habitat on each FS, BLM and Coquille lands.

Olympic	WA	**Fish -** Bull Trout (Coastal/Puget Sound), Puget Sound Chinook Salmon, Hood River Canal Summer-Run Chum Salmon, Ozette Lake Sockeye Salmon, Puget Sound Steelhead **Wildlife –** Northern Bald Eagle, Marbled Murrelet, Northern Spotted Owl **Plants –** Marsh Sandwort
Rogue River/Siskiyou	OR	**Fish –** Southern Oregon/Northern California Coho Salmon **Wildlife –** Northern Bald Eagle, Northern Spotted Owl, Marbled Murrelet **Plants –** MacDonald's Rockcress, Gentner's Fritillary, Cook's Lomatium
Siuslaw	OR	**Fish –** OC coho salmon MSA/EFH **Wildlife –** Oregon Silverspot butterfly**,** Northern Spotted Owl, Northern Bald Eagle, Marbled Murrelet, Western Snowy Plover **Plants –** Western Lilly, Nelson's Checkermallow
Umatilla	OR/WA	**Fish –** Bull Trout (Columbia River), Snake River Spring/Summer and Fall-Run Chinook Salmon, Middle Columbia River Steelhead, Snake River Basin Steelhead **Wildlife –** Northern Bald Eagle, Canada Lynx, Gray Wolf **Plants –** Spalding's Catchfly
Umpqua	OR	**Fish –** OC coho salmon MSA/EFH only **Wildlife –** Northern Spotted Owl, Northern Bald Eagle **Plants** – Kincaid's Lupine, Rough Popcorn Flower
Wallowa-Whitman	OR	**Fish –** Bull Trout (Columbia River), Snake River Spring/Summer and Fall Chinook, Middle Columbia Steelhead, Snake River Steelhead, Snake River Sockeye **Wildlife –** Northern Bald Eagle, Gray Wolf, Canada Lynx **Plants -** Howell's Spectacular Thelypody, MacFarlane's Four-O'clock, Spalding's Catchfly, Ute Ladies'-Tresses, and Water Howellia
Willamette	OR	**Fish –** Bull Trout (Columbia River), Oregon chub, Upper Willamette River Spring Chinook, Upper Willamette River Steelhead **Wildlife –**Northern Bald Eagle, Northern Spotted Owl. **Plants –**None
Bureau of Land Management	**State(s)**	
Burns	OR	**Fish –** Bull Trout (Columbia River), Lahontan Cutthroat Trout**,** Borax Lake Chub **Wildlife** – Northern Bald Eagle, Canada Lynx, Sage Grouse **Plants –** Malheur Wire Lettuce
Coos Bay	OR	**Fish –** Southern Oregon/Northern California Coho Salmon OC coho salmon MSA/EFH **Wildlife –** Northern Bald Eagle, Marbled Murrelet, Northern Spotted Owl**,** Western Snowy Plover, California Brown Pelican, Northern Sea Lion**,** Streaked Horned Lark **Plants –** Western Lily
Eugene	OR	**Fish** – Bull Trout, Upper Willamette Spring-Run Chinook, OC coho salmon MSA/EFH, Upper Willamette Basin Steelhead, Oregon Chub **Wildlife** – Northern Bald Eagle, Northern Spotted Owl, Marbled Murrelet, Streaked Horned Lark, California Brown Pelican, Fenders Blue Butterfly **Plants** – Kincaid's Lupine, Willamette Daisy, Bradshaw's Lomatium, Golden Paintbrush, Water Howellia
Lakeview	OR	**Fish** – Warner Sucker, Foskett Speckled Dace, Lost River Sucker, Short-nosed Sucker **Wildlife** – Northern Bald Eagle, Northern Spotted Owl **Plants** – Applegate's Milk-Vetch, Gentner's Fritillary

Table 3 (continued). Affected ESA-Listed Species and their Critical Habitat on each FS, BLM and Coquille lands.

Medford	OR	**Fish** –Southern Oregon/Northern California Coastal Coho, Oregon Coast Coho (EFH only), Umpqua Chub **Wildlife** – Northern Bald Eagle, Marbled Murrelet, Northern Spotted Owl **Invertebrates** - Vernal Pool Fairy Shrimp **Plants** – Gentner's Fritillary, Cook's Lomatium
Prineville	OR	**Fish** – Bull Trout, Middle Columbia Steelhead **Wildlife** – Northern Bald Eagle, Canada Lynx, Sage Grouse **Plants** – None
Roseburg	OR	**Fish** –OC Coho salmon MSA/EFH, **Wildlife** – Northern Bald Eagle, Northern Spotted Owl, Marbled Murrelet **Plants** – Rough Popcorn flower, Kincaid's Lupine
Salem	OR	**Fish** – Oregon Chub, Upper Willamette River Spring-Run Chinook, Lower Columbia Spring and Fall-Run Chinook, Columbia River Chum Salmon, Lower Columbia Coho Salmon, OC Coho Salmon MSA/EFH, Lower Columbia Winter-Run Steelhead, Upper Willamette River Steelhead. **Wildlife** – Northern Bald Eagle, Marbled Murrelet, Northern Spotted Owl, Fender's Blue Butterfly. **Plants** – Nelson's Checkermallow, Kincaid's Lupine, Willamette Valley Daisy, Water Howellia, Bradshaw's Lomatium, Golden Paintbrush
Spokane	WA	**Fish** – Bull Trout (Columbia River), Upper Columbia Spring-Run Chinook Salmon, Upper Columbia Steelhead, Lower Columbia Winter-Run Steelhead, Middle Columbia Steelhead **Wildlife** – Northern Bald Eagle, Gray Wolf, Woodland Caribou, Washington Ground Squirrel, Canada Lynx, Grizzly Bear, Greater Sage Grouse, Marbled Murrelet **Plants** – Showy Stickseed, Marsh Sandwort, Golden Paintbrush, Umtanum Desert Buckwheat, Whitebluff's Bladderpod, Kincaid's Lupine, Wenatchee Mountain Checkermallow, Nelson's Checkermallow, Spalding's Catchfly, Ute's Ladies-Tresses, Water Howellia
Vale	OR	**Fish** – Bull Trout (Columbia River), Snake River Fall, Spring and Summer-Run Chinook, Snake River Basin Steelhead, Snake River Sockeye, Middle Columbia Steelhead, Lahontan Cutthroat Trout **Wildlife** – Northern Bald Eagle, Canada Lynx, Gray Wolf, Sage Grouse. **Plants** – Howell's Spectacular Thelypody, MacFarlane's Four O'Clock, Spalding's Catchfly
Coquille Indian Tribe	State	
	OR	**Fish** – OC Coho salmon MSA/EFH **Wildlife** – Northern Bald Eagle, Northern Spotted Owl, Marbled Murrelet **Plants** – none

II. Description of the Programmatic Aquatic Restoration Activity Categories

The FS, BLM and Coquille Indian Tribe propose to implement 19 aquatic restoration activities listed in Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities. Table 4 provides general project descriptions and design criteria, as well as the philosophical underpinnings of why and how aquatic restoration projects in this ARBA will be conducted. Next, general conservation measures that are to be applied to all 19 activity categories are listed in the table. These standard measures were developed to minimize adverse effects to the aquatic environment and ESA-listed fish species and their designated Critical Habitat as well as MSA habitats. Following the general project descriptions and conservation measures, each of the 19 activity categories are fully described, complete with design criteria, and any conservation measures that are specific to that particular activity. Excluded activities are those actions that have affects which are not predictable on the scale of this ARBA. The FS, BLM and Coquille Indian Tribe are not discouraged from doing these excluded activities but such activities must undergo separate ESA/MSA consultation.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
1. Large Wood, Boulder, and Gravel Placement (includes tree removal for large wood projects) 2. Reconnection of Existing Side Channels and Alcoves 3. Head-cut Stabilization and Associated Fish Passage 4. Bank Restoration 5. Fish Passage Culvert and Bridge Projects 6. Irrigation Screen Installation and Replacement (includes weir removal) 7. In-channel Nutrient Enhancement 8. Floodplain Overburden Removal 9. Reduction of Recreation Impacts 10. Estuary Restoration 11. Riparian Vegetation Treatment (non-commercial) 12. Riparian and Upland Juniper Treatment (non-commercial) 13. Riparian Vegetation Treatment (controlled burning) 14 – 19 continued on next page.	**a) General Project Descriptions:** Aquatic habitat projects are designed and implemented to restore or enhance stream and riparian area function and fish habitat. These projects will improve channel dimensions and stability, sediment transport and deposition, and riparian, wetland, floodplain and, hydrologic functions, 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. Aquatic habitat restoration and enhancement projects are conducted within stream channels, adjacent riparian/floodplain areas, wetlands, and uplands. Work may be accomplished using manual labor, hand tools (chainsaws, tree planting tools, augers, shovels, and more), all-terrain vehicles, flat-bed trucks, heavy equipment (backhoes, excavators, bulldozers, front-end loaders, dump trucks, winch machinery, etc). Helicopters will be used for many large wood projects and salmon carcass placement projects **b) General Project Design Criteria (PDC):** All projects will be guided by design criteria that help restore or enhance stream channel, riparian, wetland, and/or upland functions that would occur under natural disturbance regimes. **c) General Conservation Measures (CM):** Conservation measures are intended to minimize effects to the aquatic environment, and the following apply, when relevant, to all 19 activity types listed in this table: i. **Technical Skill and Planning Requirements** a. Ensure that an experienced professional fisheries biologist, hydrologist or technician is involved in the design of all projects covered by this BA. The experience should be commensurate with technical requirements of a project. If ESA-listed wildlife/plant species occur in the planning area, as determined by a unit wildlife biologist or botanist, the appropriate specialist will assist with project design. b. Planning and design includes field evaluations and site-specific surveys, which may include reference reach evaluations that describe the appropriate geomorphic context in which to implement the project. Planning and design involves appropriate expertise from professional staff or experienced technicians (e.g. engineer, silviculturist, fire/fuels specialists.) c. The project biologist should insure that PDCs and CMs are incorporated into any implementation contract agreements. If a biologist is not the Contracting Officers Representative (COR), then the biologist must regularly coordinate with the project COR to insure the PDCs and CMs are being followed. ii. **State and Federal Requirements** a. Follow the appropriate state (ODFW or WDFW) guidelines for timing of in-water work. Exceptions to ODFW and WDFW in-water work windows must be requested and granted from the appropriate state agency. Exceptions can be approved through documented phone conversations or email messages with the state agency(s). Such guidelines are intended to prevent project implementation in fish spawning habitat when spawning is taking place or while eggs and alevins fish are in gravel. b. Project actions will follow all provisions and requirements (including permits) of the Clean Water Act for maintenance of water quality standards as described by Oregon Department of Environmental Quality (Oregon FS and BLM), Washington Department of Ecology (Washington FS and BLM) and the MOU between WDFW and the USFS regarding Hydraulic Projects Conducted by USDA Forest Service, Pacific Northwest Region, January 2005. c. All regulatory permits and official project authorizations will be secured prior to project implementation.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
14. Riparian Area Invasive Plant Treatment 15. Riparian Exclusion Fencing (includes water gaps and stream crossings) 16. Riparian Vegetation Planting 17. Road Treatments 18. Removal of Legacy Structures 19. Survey and Monitoring (includes fisheries, hydrology, geomorphology wildlife, botany, and cultural surveys in support of ARBA activities)	iii. **Pollution and Erosion Control Plans (PECP)** – Develop and implement a PECP for each authorized project, one that includes methods and measures to minimize erosion and sedimentation associated with the project. The following measures will assist in the creation of a PECP. a. Spill Prevention Control and Containment Plan (SPCCP) – The contractor will be required to have a written SPCCP, which describes measures to prevent or reduce impacts from potential spills (fuel, hydraulic fluid, etc). The SPCCP shall contain a description of the hazardous materials that will be used, including inventory, storage, handling procedures; a description of quick response containment supplies that will be available on the site (*e.g.*, a silt fence, straw bales, and an oil-absorbing, floating boom whenever surface water is present.) b. The PECP should be included in construction contracts or force account work plans. c. The PECP must be commensurate with the scale of the project and include the pertinent elements of iv., v., vi., vii. listed below. iv. **Minimize Site Preparation Impacts** a. Establish staging areas (used for construction equipment storage, vehicle storage, fueling, servicing, hazardous material storage, etc) beyond the 100-year floodplain in a location and manner that will preclude erosion into or contamination of the stream or floodplain. b. Minimize clearing and grubbing activities when preparing staging, project, and or stockpile areas. Stockpile large wood, trees, vegetation, sand, topsoil and other excavated material, that is removed when establishing area(s) for site restoration c. Materials used for implementation of aquatic restoration categories (e.g. large wood, boulders, fencing material etc.) can be staged within the 100-year floodplain. d. Prior to construction, flag critical riparian vegetation areas, wetlands, and other sensitive sites to prevent ground disturbance in these areas. e. Place sediment barriers prior to construction around sites where significant levels of erosion may enter the stream directly or through road ditches. Maintain barriers throughout construction. f. Where appropriate, include hazard tree removal (amount and type) in project design. Fell hazard trees within in riparian areas when they pose a safety risk. If possible, fell trees towards the stream. Keep felled trees on-site when needed to meet coarse woody debris objectives. g. Wildlife biologist should determine if a hazard tree is a potential ESA listed bird nest tree. Nesting trees that are hazardous to restoration activities may only be removed outside of active nesting season. v. **Minimize Heavy Equipment Impacts** a. Consider contracting with operators who use non-petroleum lubricants and fluids in their machinery. b. The size and capability of heavy equipment will be commensurate with the project. c. All equipment used for instream work shall be cleaned and leaks repaired prior to entering the project area. Remove external oil and grease, along with dirt and mud prior to construction. Thereafter, inspect equipment daily for leaks or accumulations of grease, and fix any identified problems before entering streams or areas that drain directly to streams or wetlands d. All equipment shall be cleaned of all dirt and weeds before entering the project area to prevent the spread of noxious weeds.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
	Minimize Heavy Equipment Impacts (continued) e. Equipment used for instream or riparian work shall be fueled and serviced in an established staging area outside of riparian zone. When not in use, vehicles shall be stored in the staging area. f. Minimize the number and length of stream crossings and access routes through riparian areas. Crossings and access routes should be at right angles. Stream crossings shall not increase risks of channel re-routing at low and high water conditions and shall avoid potential listed fish spawning areas when possible. g. Existing roadways or travel paths will be used whenever reasonable. Minimize the number of new access paths to minimize impacts to riparian vegetation and functions. h. Project operations must cease under high flow conditions that inundate the project area, except for efforts to avoid or minimize resource damage. i. Minimize time in which heavy equipment is in stream channels, riparian areas, and wetlands. When operating heavy equipment in stream channels it is because project specialists reasoned that such actions are the only reasonable alternative for implementation and/or would result in less sediment in the stream channel or damage (short- or long-term) to the overall aquatic/riparian ecosystem relative to other alternatives. vi. **Site Restoration** a. Upon project completion, remove project related waste. b. Initiate rehabilitation of all disturbed areas in a manner that results in similar or better than pre-work conditions through spreading of stockpiled materials (from C, iv. b. above), seeding, and/or planting with locally native seed mixes or plants. Planting shall be completed no later than spring planting season of the year following construction. c. 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. Short-term stabilization measures will be maintained until permanent erosion control measures are effective. Stabilization measures will be instigated within three days of construction completion. d. All riparian plantings shall follow FS direction described in the Regional letter to Units, Use of Native and Nonnative Plants on National Forests and Grasslands May 2006 (Final Draft), and or BLM Instruction Memorandum No. OR-2001-014, Policy on the Use of Native Species Plant Materials (Appendix B). e. When necessary, loosen compacted areas, such as access roads, stream crossings, staging, and stockpile areas. vii. **Wildlife General Conservation Measures** – For wildlife conservation measures common to all activities, see Chapter II, Section C, and Chapter V, Section E.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
1. Large Wood, Boulder, and Gravel Placement (Includes tree removal for large wood projects)	**a) Description** – Place large wood (LW) and/or boulders in stream channels and adjacent floodplains to increase channel stability, rearing habitat, pool formation, spawning gravel deposition, channel complexity, hiding cover, low velocity areas, 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. Full channel-spanning porous boulder weirs (boulder weirs) can only be installed in streams with a legacy of splash damming, stream cleaning, or other activities that have resulted in highly uniform, incised, bedrock-dominated channels with few boulders or woody debris. Live and or dead trees may be removed to provide LW for restoration projects, under special conditions described herein. Large wood, boulder, boulder weirs and gravel projects would include the use of log trucks and dump trucks for transport and excavator-type machinery, spyders, cable yarders, draft horses, or helicopters for placement **b) Design Criteria** i. **LW , Boulder, and Gravel Placement** a. Place LW and boulders only in those areas where they would naturally occur and in a manner that closely mimic natural accumulations for that particular stream type. b. LW includes whole conifer and hardwood trees, logs, and root wads. LW size (diameter and length) should account for bankfull width and stream discharge rates. When available, trees with rootwads should be a minimum of 1.5x bankfull channel width, while logs without rootwads should be a minimum of 2.0 x bankfull width. Structures may partially or completely span stream channels or be positioned along stream banks. c. No conifers should be felled in the riparian area for in-channel large wood placement unless conifers are fully stocked and are consistent with project design criteria in vegetation treatment categories. Felled hazard trees can be used for in-channel wood placement. d. Key boulders (footings) or LW can be buried into the stream bank or channel but shall not constitute the dominant placement method of boulders and LW. e. Anchoring Large Wood– Anchoring large wood with cable should be used sparingly, primarily for the protection of infrastructure and in consideration of downstream landowner concerns. Before using cable, attempt to use, when feasible, the following anchoring alternatives in preferential order: (1) use of adequate sized wood sufficient for stability (2) oriented and place wood in such a way that movement is (3) ballasting (gravel and/or rock) is used to increase the mass of the structure to resist movement (4) use large boulders as anchor points for the large wood, and (5) wood is pinned with rebar to large rock to increase its weight f. Gravel augmentation should only occur in areas where the natural supply has been eliminated or significantly reduced through anthropogenic means. Gravel to be placed in streams shall be a properly sized gradation for that stream, clean, and non-angular. When possible use gravel of the same lithology as found in the watershed. After gravel placement, allow the stream to naturally sort and distribute the material. g. If other aquatic restoration activities included in this ARBA are used as complementary actions, follow the associated design criteria and conservation measures.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
Large Wood, Boulder, and Gravel Placement (includes tree removal for large wood projects) **Continued**	ii. **Boulder Weirs** a. Full channel spanning boulder weirs are to be installed only in highly uniform, incised, bedrock-dominated channels to enhance or provide fish habitat in stream reaches where log placements are not practicable due to channel conditions (not feasible to place logs of sufficient length, bedrock dominated channels, deeply incised channels, artificially constrained reaches, etc.), where damage to infrastructure on public or private lands is of concern, or where private landowners will not allow log placements due to concerns about damage to their streambanks or property. b. 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). If larger boulders are needed to withstand bankfull flows, boulder size should be determined through site specific analysis—such as shear stress analysis—and should not promote bank scouring and channel routing around the structure. c. 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. 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. d. The use of gabions, cable or other means to prevent the movement of individual boulders in a boulder weir is not allowed. e. 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 f. The project designer or an inspector experienced in these structures should be present during installation. g. Full spanning boulder weir placement should be coupled with measures to improve habitat complexity and protection of riparian areas to provide long-term inputs of LWD. h. If other aquatic restoration activities included in this ARBA are used as complementary actions, follow the associated design criteria and conservation measures. iii. **Tree Removal for LW Projects** a. Tree felling in suitable nesting or dispersal habitat for Northern Spotted Owl (NSO), Marbled Murrelet (MM) and or bald eagles must occur after the disturbance dates listed in Tables 7a-7d. b. A wildlife biologist must be fully involved in all "Individual 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. c. Trees may be removed by cable, ground-based equipment, horses or helicopters, and or felled directly into the stream. Felled trees may be stock piled for later use for instream restoration projects. d. No suitable nesting trees greater the 36" dbh are to be removed. Trees greater than 36" may be felled if a wildlife biologist determines those trees do not provide suitable nesting habitat e. Individual trees or small groups of trees (<5) 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). f. When acquiring trees from an area burned by wildfire, consult with a wildlife biologist for assistance in determining the location and number of trees that can be acquired.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
Large Wood, Boulder, and Gravel Placement (Includes tree removal for large wood projects) **Continued**	**Tree Removal for LW Projects (Continued)** g. Single tree removal may only be removed from the first two lines of trees from iv., e, above. h. Trees selected for LW restoration projects must be spaced at least one site potential tree height apart and at least one crown width from any trees with potential nesting structure for ESA listed bird species. i. No conifers should be felled in the riparian area for in-channel large wood placement unless conifers are fully stocked and are consistent with project design criteria in vegetation treatment categories. Felled hazard trees can be used for in-channel wood placement j. When removing LW from an area burned by a wildfire, consult a wildlife biologist to determine the latitude in which trees can be removed. **c) Conservation Measures –** No additional conservation measures are required **d) Excluded Activities–** The following activities are not included in this ARBA: In non-bedrock dominated systems, boulder weirs greater than ½ the channel width; an individual structure, such as a log jam, longer than 7 bankfull channel widths. Full spanning boulder weir structures installed perpendicular to the streamflow in bed-rock dominated streams are not covered in this consultation. Full spanning, downstream pointed U or V style weirs are not covered in this consultation.
2. Reconnection of Existing Side Channels and Alcoves	**a) Description** – Reconnect and/or restore existing side channels and alcoves to increase rearing habitat for juvenile fish and high flow refuge areas for all life stages of fish. Functioning side channels have inlet and outlet connections to the main channel and often contain flow only during flood events—bankfull or greater. Functioning alcoves are back-water channels that typically contain water during both low and high flows. This action includes the removal of plugs which block water movement through side channels and alcoves. Further, side channel and alcove improvements include fill removal within channels and alcoves, large wood (LW) and/or boulder placement, riparian planting etc. Boulder placement may be used in the main river to stabilize the channel and bring the entrance of the side channel into alignment (vertically and horizontally). Construction would involve use of heavy equipment, such as excavators, spyders, backhoes, and dump trucks. **b) Design Criteria** i. Excavated material removed from side-channels or alcoves shall be hauled to an upland site or spread across the adjacent floodplain in a manner that does not restrict floodplain capacity. ii. Design and construct side-channels in such a manner as to prevent the capture and relocation of the main channel. iii. Design project to naturally maintain inlet and outlet connections with the main stream channel (i.e. placement of LW to increase local scour). iv. Should fish rescue occur, use fish handling criteria listed under activity #5. v. If other aquatic restoration activities included in this ARBA are used as complementary actions, follow the associated design criteria and conservation measures. **c) Conservation Measures –** No additional conservation measures are required. **d) Excluded Activities –** Creation of new side channels and excavation of severely aggraded (completely filled in) side channels and alcoves.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
3. Head-cut Stabilization and Associated Fish Passage	**a) Description –** Stabilize active or potentially active head-cuts to prevent further channel degradation (upstream migration of head-cut) and to promote downstream channel aggradation. In streams currently or historically occupied by fish, provide fish passage over the stabilized headcut. Construction would involve use of heavy equipment, such as excavators, spyders, backhoes, dump trucks. **b) Design Criteria –** The choice of treatment should be based on site characteristics and limitations (i.e. channel slope, bed material type), but may also be based on material availability, economics, land use, design competence or familiarity, and/or regulatory restrictions (i.e. jump heights for fish). i. **Rock and Organic Material Placement** – This method is often used on severe headcuts in meadow areas east of the Cascade Mountains to stop further channel incision. Stream types are typically Rosgen "C" and "E" channel types. 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. In streams with current or historic fish presence, provide fish passage over stabilized head-cut through a series of log or rock weir structures as described in part ii below. e. Short-term headcut stabilization (including emergency stabilization projects) may occur without associated fish passage measures. However, fish passage must be incorporated into the final head cut stabilization action and be completed during the first subsequent in-water work period. f. In streams without current or historic fish presence, it is recommended to construct a series of downstream log or rock weirs as described in part ii below to expedite channel aggradation. ii. **Rock and Log Weirs** – Rock and log weirs are very low channel spanning structures that are often used to stabilize streambeds and halt channel incision in low gradient streams (generally less than 2%). a. Construct weirs in a 'V' shape, oriented with the apex upstream, and lower in the center to direct flows to the middle of channel. b. 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. c. If several structures will be used in series, space the weirs at the appropriate distances to promote fish passage of all life stages of native fish. Incorporate state fish passage criteria (jump height, pool depth, etc.) in the design of weir structures. Recommended weir spacing should be no closer than the net drop divided by the channel slope (for example, a one-foot high weir in a stream with a two-percent gradient will have a minimum spacing of 50-feet (1/0.02)). d. 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.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
Head-cut Stabilization and Associated Fish Passage **Continued**	iii. **Large Roughness Elements (Wood and Boulder Placements) –** This treatment type is preferred for those areas where large wood and boulder provide natural grade control. This technique is applicable to a wide range of stream types, from low gradient meandering streams (less than 1%) to high gradient cascade channels (greater than 8%). The goal of using large roughness elements is not to completely halt the incision process, but rather to slow it down and spread the elevation change over a greater length of channel. Because log jams are porous structures, not all of the sediment will be held in place; sediment inputs, however, will be spread out over time and space. a. Rock and wood structures should mimic natural colluvial features, such as debris flow or landslide deposits, to provide channel stabilization. b. Rock and wood should be sized so that it is not mobile during the design flood. An engineering technical note regarding buoyancy is available through NRCS (http://www.or.nrcs.usda.gov/technical/engineering/eng-notes.html). c. To promote or maintain fish passage, ensure that structures contain enough spaces to allow for up and downstream movement of fish. iv. If other aquatic restoration activities included in this BA are used as complementary actions, follow the associated design criteria and conservation measures. **c) Conservation Measures –** No additional conservation measures are required. **d) Excluded Activities –** Any structures that include the use of gabion baskets, sheet pile, concrete, articulated concrete block, and/or cable anchors are excluded. Straight weirs, which disperse flows and can cause channel widening and thus structure "flanking" (erosion around the ends of the structure), are not allowed.
4. Bank Restoration	**a) Description –** Restore eroding stream banks to reduce chronic bank erosion, improve water quality, restore natural channel cross-sections, expand floodplain area, promote growth of riparian vegetation and create undercut banks for adult and juvenile fish hiding cover. Projects will not significantly restrict the channel migration zone and ability of the channel to form and maintain habitat. Construction would involve use of heavy equipment, such as excavators, spyders, backhoes, and dump trucks. **b) Design Criteria** i. Work will focus on eroding stream banks, primarily the outside edge of meander bends. ii. Limit bank restoration projects to those sites where existing channel conditions are at or near reference channel conditions—radius of curvature, etc. To the extent possible, use bank stabilizing materials that would naturally occur at that site (such as LW, woody and herbaceous plantings, native sedge/rush mats, and native rock). iii. Banks may be reshaped and sloped where the objective is to reduce blank slope angle to provide more favorable planting surfaces. Such work should not change the location of the bank toe. iv. Jute matting or other biodegradable material can be used with plantings to help prevent erosion of affected banks. v. If other aquatic restoration activities included in this BA are used as complementary actions, follow the associated design criteria and conservation measures. **c) Conservation Measures –** No additional conservation measures are required. **d) Excluded Activities –** Use of dikes, groins, buried groins, drop structures, porous weirs, weirs, riprap, rock toes, and similar structures to stabilize streambanks are not covered by this BA.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
5. Fish Passage Culvert and Bridge Projects	**a) Description –** Remove or replace existing road-stream crossing structures—culverts and bridges—that restrict fish passage with stream simulation structures to restore up- and downstream passage for all life stages of native fish. Replacements of existing road-stream crossing structures that do not restrict fish passage are permissible. Construction would involve use of heavy equipment, such as excavators, cranes, backhoes, front-end loaders, dump trucks, bull dozers, and on occasion pile-drivers and helicopters. **b) Design Criteria** i. Fish passage projects should be designed by an experienced engineer with design input from an experienced fisheries biologist and hydrologist. Such personnel shall oversee or review the project during construction to ensure that project designs and conservation measures are being properly implemented. ii. Forest Service Design Assistance Teams or the BLM and Coquille Indian Tribe equivalent will provide design review for projects that exceed $100,000 in cost or will result in structures that are greater than 20' in width. iii. Assess sites for a potential to headcut below the natural stream gradient. Along with field surveys, refer to the following document as a guide to assess headcut potential: Castro, J. 2003. *Geomorphologic Impacts of Culvert Replacement and Removal: Avoiding Channel Incision.* FWS, Portland, OR and/or the Dichotomous Key to Evaluate the Potential for Stream Incision at Sites Being Considered for Culvert Replacement or Removal Projects, FWS, Lacey, WA (Appendix C) Projects that lead to headcutting below the natural stream gradient are excluded from this consultation. iv. Design Standards a. Structure Type – Structure types include closed-bottomed culverts, open-bottomed arch culverts, and bridges. Structure material must be concrete or metal. b. Structure Width – The structure width shall never be less than the bankfull channel width. (The stream width inside the culvert or between bridge footings shall be equal to or greater than the bankfull width.) The minimum structure width and height for a closed bottom culvert shall be 6 feet to allow manual placement of stream simulation material. Structures must accommodate a 100-year flood flow while maintaining sediment continuity (similar particle size distribution) within the culvert as compared to the upstream and downstream reaches. To meet this requirement, unconfined channel types (Rosgen C, E, and B channel types, Rosgen 1996) may require structures wider than bankfull and/or the addition of flood relief culverts or other comparable flood relief methods. c. When possible, flood relief culverts will be designed to restore and maintain access to off-channel holding areas for juvenile and adult fish. Therefore, existing floodplain channels should be the first priority for location of flood relief culverts and installed in a manner that match floodplain gradient and does not lead to scour at the outlet. d. Channel Slope – The structure slope shall approximate the average channel gradient of the natural stream up and downstream of the structure. The maximum slope for closed-bottomed culverts shall not exceed 6% because of difficulties in retaining substrate in the culvert at higher gradients. Open-bottom arches can be placed in channel gradients that exceed 6%.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
Fish Passage Culvert and Bridge Projects **Continued**	**Design Criteria (continued)** e. Embedment – If a closed culvert is used, the bottom of the culvert shall be buried into the streambed not less than 20% and not more than 50% of the culvert height. For open-bottomed arches and bridges, the footings or foundation shall be designed to be stable at the largest anticipated scour depth. Substrate and habitat patterns within the culvert should mimic stream patterns that naturally occur above and below the culvert. Coarser material may be incorporated to create velocity breaks during high flows, thereby improving fish passage, and to provide substrate stability. f. Rip Rap – The use of riprap is permissible above bankfull height to protect the inlet or outlet of new culverts or open-bottomed arches. If the use of riprap is required for culvert stability, then an additional analysis may be required to ensure that the structure is not undersized. Rip rap may only be placed below bankfull height when necessary for protection of abutments and pilings for bridges. However, the amount and placement of rip rap around the abutments and/or pilings should not constrict the bankfull flow. g. Grade Control Structures – Grade control structures are permitted to prevent headcutting above or below the culvert or bridge. Grade control typically consists of boulder structures that are keyed into the banks, span the channel, and buried in the substrate. h. Road Dips – Where applicable, incorporate road dips into crossing design, to ensure catastrophic flood events will transport overflow back into the stream channel instead of onto the road bed. v. Structures containing concrete must be sufficiently cured or dried before they come into contact with stream flow. vi. In cases of structure removal or when removing an existing structure and replacing it with a bridge, restore the stream channel and reconnect the floodplain at the site using applicable restoration categories. vii. When removing woody debris from the road-crossing inlet, place the debris downstream of the road crossing. viii. Monitor structures after high flow events, which occur during the first fall/winter/spring after project completion. Assess the following parameters: headcutting below natural stream gradient, substrate embeddedness in the culvert, scour at the culvert outlet, and erosion from sites associated with project construction. If necessary, apply remedial actions (using project design criteria and conservation measures) if projects do not meet the intended goals. ix. If other aquatic restoration activities included in this ARBA are used as complementary actions, follow the associated design criteria and conservation measures. **c) Conservation Measures –** Along with the General Conservation Measures, the following conservation measures will be used to minimize sediment and turbidity and effects of fish handling/transport. i. **Isolate Construction Area and Remove Fish from Project Area** a. All fish capture, removal, and handling activities shall be conducted by an experienced fisheries biologist or technician. b. Isolate Capture Area – Install block nets at up and downstream locations and leave in a secured position to exclude fish from entering the project area. Leave nets secured to the stream channel bed and banks until fish capture and transport activities are complete. If block nets or traps remain in place more than one day, monitor the nets and or traps at least on a daily basis to ensure they are secured to the banks and free of organic accumulation and to minimize fish predation in the trap.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
Fish Passage Culvert and Bridge Projects **Continued**	**Isolate Construction Area and Remove Fish from Project Area (continued)** c. Fish Capture Alternatives 1. Collect fish by hand or dip nets, as the area is slowly dewatered. 2. Seining – Use seine with mesh of such a size to ensure entrapment of the residing ESA-listed fish. 3. Minnow traps – Traps will be left in place overnight and in conjunction with seining. 4. Electrofishing – Prior to dewatering, use electrofishing only where other means of fish capture may not be feasible or effective. The protocol for electrofishing includes the following: 5. If fish are observed spawning during the in-water work period, electrofishing shall not be conducted in the vicinity of spawning adult fish or active redds. 6. Only Direct Current (DC) or Pulsed Direct Current (PDC) shall be used. 7. Conductivity <100 use voltage ranges from 900 to 1100. Conductivity from 100 to 300 then use voltage ranges from 500 to 800. Conductivity greater than 300 then use voltage to 400. 8. Begin electrofishing with minimum pulse width and recommended voltage and then gradually increase to the point where fish are immobilized and captured. Turn off current once fish are immobilized. 9. Do not allow fish to come into contact with anode. Do not electrofish an area for an extended period of time. Remove fish immediately from water and handle as described below. Dark bands on the fish indicate injury, suggesting a reduction in voltage and pulse width and longer recovery time. ii. **Handling and Release** –Fish must be handled with extreme care and kept in water the maximum extent possible during transfer procedures. A healthy environment for the stressed fish shall be provided—large buckets (five-gallon minimum to prevent overcrowding) and minimal handling of fish. Place large fish in buckets separate from smaller prey-sized fish. Monitor water temperature in buckets and well-being of captured fish. As rapidly as possible (especially for temperature-sensitive bull trout), but after fish have recovered, release fish upstream of the isolated reach in a pool or area that provides cover and flow refuge. Document all fish injuries or mortalities and include in annual report. iii. **Dewater Construction Site** –Upstream of the isolated construction area, divert flow around the construction site with a coffer dam (built with non-erosive materials) and an associated pump or a by-pass culvert. Diversions constructed with material mined from the streambed or floodplain is not permitted. Small amounts of instream material can be moved to help seal and secure diversion structures. Pumps must have fish screens and be operated in accordance with NMFS fish screen criteria (NMFS 1995). Dissipate flow energy at the bypass outflow to prevent damage to riparian vegetation or stream channel. If diversion allows for downstream fish passage (i.e. is not screened), place diversion outlet in a location to promote safe reentry of fish into the stream channel, preferably into pool habitat with cover. When necessary, pump seepage water from the de-watered work area to a temporary storage and treatment site or into upland areas and allow water to filter through vegetation prior to reentering the stream channel. iv. **Stream Re-watering** – Upon project completion, slowly re-water the construction site to prevent loss of surface water downstream as the construction site streambed absorbs water and to prevent a sudden increase in stream turbidity. Monitor downstream during re-watering to prevent stranding of aquatic organisms below the construction site. **d. Excluded Activities –** No use of treated wood for replacement bridges. Bridge piers and abutments will not occur in the bankfull width. The hydraulic method will not be used (e.g. culverts with baffles or weirs)

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
6. Irrigation Screen Installation and Replacement (includes weir removal)	**a) Description –** This action if for existing diversions only and is focused on installing, replacing, or upgrading off-channel screens to improve fish passage or prevent fish entrapment in irrigation canals. This action also includes the removal of non-needed existing diversions that are less than six feet high or impound less than 15 acre feet of water. Construction would involve use of heavy equipment, such as excavators, backhoes, front-end loaders, dump trucks, and bull dozers. **b) Design Criteria** i. All fish screens must be sized to match the landowner's documented or estimated historic water use and legal water right(s) which ever is less. ii. Irrigation diversion intake and return points must be designed (to the greatest degree possible) to prevent all native fish life stages from swimming or being entrained into the irrigation system. iii. Screens, including screens installed in temporary and permanent pump intakes, must meet NMFS fish screen criteria. NMFS fish screen criteria applies to federally listed salmonid species under their jurisdiction as well as bull trout, Oregon chub, shortnose sucker, Lahontan cutthroat trout, Lost River sucker, and Warner sucker under FWS jurisdiction. iv. Size of bypass structure should be big enough to pass kelt steelhead and migratory bull trout back into the stream. v. Abandoned ditches and other similar structures will be plugged or backfilled, as appropriate, to prevent fish from swimming or being entrained into them. vi. When making improvements to pressurized irrigation systems, install a totalizing flow meter capable of measuring rate and duty of water use. For non-pressurized systems, install a staff gage or other measuring device capable of measuring instantaneous rate of water flow. vii. For diversion removal projects, use conservation measures under Activity #5 – Fish Passage Culvert and Bridge Projects. viii. If other aquatic restoration activities included in this ARBA are used as complementary actions, follow the associated design criteria and conservation measures. **c) Conservation Measures –** For diversion removal, follow the appropriate conservation measures described in Activity #5 – Fish Passage Culvert and Bridge Projects. **d) Excluded Activities –** Large diversions/structures which have substantial accumulations of sediment that may be released and adversely affect downstream fish, critical and or essential fish habitat. Consolation, improvement, modification of diversions are not covered.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
7. In-channel Nutrient Supplementation	**Description –** This activity includes the placement of salmon carcasses, carcass analogs (processed fish cakes), or inorganic fertilizers in stream channels to help return stream nutrient levels back to historic levels. Large trucks may be used to transport nutrients. Application and distribution of nutrients throughout a stream corridor can occur manually from bridges or stream banks, by boat, or by helicopter. **b) Design Criteria** i. In Oregon, projects are permitted through ODEQ. Use carcasses from the treated watershed or those that are certified disease free by an ODFW pathologist. ii. In Washington, follow WDFW's *Protocols and Guidelines for Distributing Salmonid Carcasses, Salmon Carcass Analogs, and Delayed Release Fertilizers to Enhance Stream Productivity in Washington State, 2004*. iii. Ensure that the relevant streams have the capacity to capture and store placed carcasses. iv. Carcasses should be of species native to the watershed and placed during the normal migration and spawning times, as would naturally occur in the watershed. v. Do not supplement nutrients in eutrophic or naturally oligotrophic systems. vi. If other aquatic restoration activities included in this ARBA are used as complementary actions, follow the associated design criteria and conservation measures. **c) Conservation Measures –** No additional conservation measures are required. **d) Excluded Activities –** None

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
8. Floodplain Overburden Removal	**a) Description –** Remove anthropogenic overburden and fill—such as dredged mine tailings, railroad beds, dikes, berms, levees, and other fill types—from floodplains to restore natural floodplain functions. Such functions include overland flow during high-water events, dissipation of flood energy, increased water storage to augment low flows, sediment and debris deposition, growth of riparian vegetation, nutrient cycling, and development of side channels and alcoves. Construction would involve use of heavy equipment, such as excavators, earthmovers, scrapers, backhoes, front-end loaders, dump trucks, and bull dozers. **b) Design Criteria** i. Create floodplain characteristics—elevation, width, gradient, length, and roughness—that mimic, to the greatest degree possible, those that would naturally occur at that stream and valley type. ii. Overburden or fill comprised of native materials, which originated from the project area, can be used to reshape the floodplain, placed in small mounds on the floodplain, used to fill anthropogenic holes, buried on site, and/or disposed into upland areas. iii. To the greatest degree possible, non-native fill material, originating from outside the project area shall be removed from the floodplain to an upland site. iv. Where it is not possible to remove all portions of dikes and berms, create openings with culverts and/or breaches. Place culverts through or remove portions of such structures to pass high flows—bankfull or greater— into floodplain areas. The width of a culvert or breach should be equal to or greater than the bankfull width of the stream. Culverts and breaches should be located at a depositional area of the channel. Design for proper number and location of culvert and breach sites as to help prevent fish stranding as high flows recede. v. Conduct a contaminant survey for mine tailing removal projects prior to project implantation. If contaminants are found above levels set by the Environmental Protection Agency a separate consultation is required. vi. Consider decompaction of soils once overburden material is removed. vii. If other aquatic restoration activities included in this ARBA are used as complementary actions, follow the associated design criteria and conservation measures. **c) Conservation Measures –** No additional conservation measures are required. **d) Excluded Activities –** None

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
9. Reduction of Recreation Impacts	**a) Description –** Close or better control recreation use along streams and within riparian areas. This includes removal of designated campgrounds, dispersed camp sites, and foot trails as well as treatments of off-road vehicle (ORV) roads/trails in riparian areas. Actions that reduce aquatic disturbances within recreation sites to be left open are included. Dispersed and developed campground restoration usually include some or all of the following: removal of campground fill material and/or structures, such as berms, toilets, fences, picnic tables; ripping or sub-soiling sites to remove compaction; stream bank restoration; placement of rock or other barriers such as fences to block vehicle access; gravel surfacing of existing sites to designate access routes and parking; planting shrubs and trees to restore streamside, floodplain, and meadow vegetation; reducing or clearing noxious weeds. Construction would involve use of heavy equipment, such as excavators, earthmovers, scrapers, backhoes, front-end loaders, dump trucks, and bull dozers. **b) Design Criteria** i. Design remedial actions to restore floodplain characteristics—elevation, width, gradient, length, and roughness—in a manner that closely mimics, to the greatest degree possible, those that would naturally occur at that stream and valley type. ii. Overburden or fill comprised native materials, which originated from the project area, can be used to reshape the floodplain, placed in small mounds on the floodplain, used to fill anthropogenic holes, buried on site, and/or disposed into upland areas. iii. To the greatest degree possible, non-native fill material, originating from outside the project area shall be removed from the floodplain to an upland site. iv. Consider de-compaction of soils once overburden material is removed. v. Place barriers—boulders, fences, gates, etc—outside of the bankfull width and across traffic routes to prevent ORV access into and across streams. vi. If other aquatic restoration activities included in this ARBA are used as complementary actions, follow the associated design criteria and conservation measures. **c) Conservation Measures –** No additional conservation measures are required. **d) Excluded Activities –** None

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
10. Estuary Restoration	**a) Description –** Restore estuary functions through removal of tide gates, dikes, berms, levees, culverts and tiles, drainage systems, or portions thereof, which block tidal waters from flooding historic estuaries. Such functions include overland flow during high-tide and flood events, dissipation of flood energy, sediment and debris deposition, growth of riparian vegetation, nutrient cycling, and development of side channels, alcoves and rearing habitat for juvenile salmonids. Construction would involve use of heavy equipment, such as excavators, backhoes, front-end loaders, dump trucks, and bull dozers. **b) Design Criteria** i. Project implementation shall be conducted in a sequence that will not preclude repairing or restoring estuary functions once dikes/levies are breached and the project area is flooded. ii. For tide gate removal projects, use conservation measures under Activity #5 – Fish Passage Culvert and Bridge Projects, when appropriate. iii. Roads within the project area should be removed or breached to allow free flow of water. Material either will be placed in a stable area above the ordinary high water line or highest measured tide or be used to restore topographic variation in estuary wetlands. iv. Where appropriate, remove drain tiles. Fill generated by drain tile removal will be compacted back into the ditch created by removal of the drain tile. v. Side channel construction may be implemented to recreate channel morphology based on aerial photograph interpretation, literature, topographic surveys, and nearby undisturbed channels. Channel dimensions (width and depth) are based on measurements of similar types of channels and the drainage area. vi. Where appropriate, fill ditches that were constructed and maintained to drain wetlands. Portions of a ditch may be over filled, while other points may be left as low spots to enhance topography and encourage sinuosity of developing channels. vii. If other aquatic restoration activities included in this ARBA are used as complementary actions, follow the associated design criteria and conservation measures. **c. Conservation Measures –** For tide gate removal projects, use conservation measures under Activity #5 – Fish Passage Culvert and Bridge Projects, when appropriate. **c) Excluded Activities –** Replacement of tidegates is not included in this ARBA.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
11. Riparian Vegetation Treatment (non-commercial)	**a) Description –** Conduct non-commercial treatments of vegetation in the riparian area (as defined by NWFP, PACFISH, and INFISH) as a means to help restore plant species composition and structure that would occur under natural disturbance regimes. The resulting benefits to the aquatic system can include desired levels of stream shade, bank stability, stream nutrients, large wood inputs, increased grasses, forbs, and shrubs, and reduced soil erosion. An additional benefit includes fuels reduction, which decreases the probability of a catastrophic fire in a watershed containing isolated populations of ESA-listed fish. Treatments may include, but are not limited to, the following: thin conifers in even-age stands (typically plantations) to expedite late-seral conditions; thin conifer under-story to maintain viability of later-seral trees; create stand structure that would be expected under natural disturbance regimes; alder treatments; disease pocket treatments; create planting gaps to promote growth of conifers, deciduous trees, shrubs, and grass. Further, brush (felled trees) removal, planting of tree seedlings (conifer and deciduous) and shrubs, and animal damage control (no pesticides) are included. Equipment may include chainsaws, pruning shears, winch machinery, and slash-busters. **b) Design Criteria** i. An experienced silviculturist, botanist, ecologist, or associated technician, and wildlife biologist shall be involved in designing vegetation treatments. ii. No roads or landings will be constructed. iii. Thin conifers to accelerate attainment of late-seral conditions. A project example is thinning riparian areas in the ecosystem initiation or competitive exclusion developmental stages (Cary and Cuertis 1996) within plantations (i.e. where even-aged stands are growing because of previous silvicultural prescriptions, wildfire, or disease.) iv. Thin dense understories to maintain survival of late-seral trees. A project example is thinning dense understory stands of early- to mid-seral ponderosa pine which have become established as a result of fire exclusion. v. Restore meadow sites along stream corridors or adjacent uplands through removal of conifers which have become established as a result of fire exclusion or other anthropogenic causes. vi. To increase species diversity of riparian vegetation, fell conifer and/or hardwood trees (if above natural stocking levels) to create planting gaps. vii. Trees felled within riparian area will be used to restore aquatic and terrestrial habitat by returning large and coarse woody debris levels to within the range of natural variability (RNV). Felled trees in excess of the RNV can be removed or piled and burned. If controlled burns are used, refer to design criteria in activity 13 in this table. viii. If other aquatic restoration activities included in this ARBA are used as complementary actions, follow the associated design criteria and conservation measures. **c) Conservation Measures –** No additional conservation measures are required. **d) Excluded Activities** – The use of feller-buncher machinery.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
12. Riparian Juniper Treatment (non-commercial)	**a) Description –** Fell juniper trees occurring in riparian and associated uplands to help restore natural plant species composition and structure that would occur under natural fire regimes. The associated benefits to aquatic and riparian environments include the following: reduction of soil erosion into stream channels; increased frequencies and diversity of herbaceous, shrub, and tree species; increased bank stability and stream nutrients. Associated uplands include those areas where juniper stands are or will create conditions that result in lost ground cover and increased sedimentation into stream channels; upland treatments would only be covered if those treatments directly benefit the aquatic environment. Treatments will emphasize the removal of junipers above natural stocking levels. Equipment may include the use of feller-buncher type equipment, slash-buster, chainsaws, winch machinery, and/or prescribed fire. **b) Design Criteria** i. Do not cut old-growth juniper, which typically has several of the following features: sparse limbs, dead limbed or spiked-tops, deeply furrowed and fibrous bark, branches covered with bright-green arboreal lichens, noticeable decay of cambium layer at base of tree, and limited terminal leader growth in upper branches (Miller *et al*. 2005). ii. On steep and/or south-facing slopes, where ground vegetation is sparse, leave felled juniper in sufficient quantities to promote reestablishment of vegetation and prevent erosion. iii. If seeding is a part of the action, consider whether seeding would be most appropriate before or after juniper treatment. iv. Where appropriate, move cut juniper stems into the stream channel and floodplain to provide aquatic benefits. Juniper can be felled or placed into the stream to promote channel aggradation as long as such actions do not obstruct fish movement, cover spawning gravels of ESA/MSA-listed fish or increase width to depth ratios. v. When using feller-buncher and slash-buster equipment, operate equipment in a manner that minimizes soil compaction and disturbance to soils and desired native vegetation to the greatest degree possible. Equipment exclusion areas (buffer area along stream channels) should be as wide as the feller-buncher or slash-buster arm. vi. If other aquatic restoration activities included in this ARBA are used as complementary actions, follow the associated design criteria and conservation measures. **c) Conservation Measures –** No additional conservation measures are required. **d) Excluded Activities –** Exclude placement of juniper in streams where the action will preclude the stream from attaining its natural sinuosity.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.	
Activity Category	**Project Description, Design Criteria, Conservation Measures, and Excluded Activities**
13. Riparian Vegetation Treatment (controlled burning)	**a) Description –** Implement controlled burning to help restore plant species composition and structure that would occur under natural fire disturbance regimes. Controlled burning of piled, pre-commercially thinned trees associated with other vegetation treatments under this ARBA is permissible. Resulting benefits include restoration of desired levels of stream shade, bank stability, soil erosion and stream turbidity, stream nutrients, and/or large wood inputs. Additional benefits include maintenance of late-seral (old-growth) trees which serve as sources of large wood to streams and a reduced potential of catastrophic fire within watersheds occupied by isolated populations of ESA-listed fish. This treatment should maintain the function of the riparian area as it affects the aquatic environment (e.g. temperature regime). Equipment would include drip torches and chainsaws, along with fire suppression vehicles and equipment. **b) Design Criteria** i. An experienced fuels technician, silviculturist, and fisheries biologist shall be involved in designing prescribed burn treatments. ii. Prescriptions/burn plans should be written to help restore plant species composition and structure that would occur under natural fire regimes. iii. Low severity burns shall constitute the dominant type of controlled burn, resulting in a mosaic pattern of burned and unburned landscape. Low severity burns, as defined in the National Fire Plan (2002), are characterized by the following: low soil heating, or light ground char, occurs where litter is scorched, charred, or consumed, but the duff is left largely intact, although it can be charred on the surface. Woody debris accumulation is partially consumed or charred. Mineral soil is not changed. Fire severity in forest ecosystems is low if the litter and duff layers are scorched but not altered over the entire depth. iv. Moderate-severity burns are permitted in no more than 20% of the riparian area to invigorate decadent aspen stands, willows, and other relevant deciduous species. Such burns shall be contained within the observable historic boundaries of the aspen stand or willow site. Moderate-fire severity, as defined in the National Fire Plan (2002), is characterized by the following: moderate soil heating, or moderate ground char, occurs where the litter on forest sites is consumed and the duff is deeply charred or consumed, but the underlying mineral soil surface is not visibly altered. Light colored ash is present. Woody debris is mostly consumed, except for logs, which are deeply charred. v. Non-commercial tree thinning and slash removal maybe required to reduce fuel loads required to implement a low to moderate severity burn. vi. Tree thinning may be required prior to project implementation to create fuel loads necessary to carry a controlled fire. vii. To the greatest degree possible, avoid creating hydrophobic soils when burning slash piles within the riparian areas adjacent to the stream. Slash piles should be far enough away from the stream channel so as any sediment resulting from this action will be less likely to reach the stream. viii. Ignition can occur anywhere within the riparian area as long as project design criteria are met. ix. If other aquatic restoration activities included in this ARBA are used as complementary actions, follow the associated design criteria and conservation measures. **c) Conservation Measures –** No additional conservation measures are required **d) Excluded Activities –** No mechanical piles in riparian area. Fire line construction. Chemical fire retardants.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
14. Riparian Area Invasive Plant Treatment	**a) Description** – Invasive plant treatment in riparian areas is intended to improve the function of riparian areas by restoring native ecosystem components. In general, improved riparian function due to invasive plant treatment will benefit listed fish by restoring inputs of native detritus to stream systems and reducing erosion. Treatment of an invasive plant sites may include one or more of the following treatment methods listed below. A combination of treatments may be necessary to achieve effective control or eradication of an invasive plant species at many sites. All herbicide applications will comply with label instructions and may be further restricted as stated below. Treatment methods were selected due to their low potential for adversely affecting aquatic species, while facilitating riparian restoration through invasive plant control. Herbicides were selected due to their low toxicity to aquatic species and application methods were selected for their low potential for contaminating soils, thereby minimizing the risk of herbicides leaching to streams. Methods, tools, and project design criteria are summarized in Table 4(a), and subsequently discussed in more detail. Riparian Area Invasive Plant Treatment projects that may adversely affect listed plants are not covered by this programmatic consultation.

Table 4a. Summary of methods, tools, and project design criteria for invasive plant treatment

Methods	Tools	Project Design Criteria
Manual & Mechanical Treatment		- Minimize work from channel - Minimize ground disturbance - All methods allowed to bankfull of perennial streams, and in intermittent/ephemeral - Hand pulling allowed to emergent plants
Hand pulling	Non-motorized tools (weed wrenches, etc)	
Seed clipping	String trimmer or hand-held blade	- Transport only daily fuel supply for chainsaws and string trimmers to project site - Do not fuel chainsaws and string trimmers within 100 feet of water
Stabbing	Shovel, hoe, or similar hand tool	
Girdling	Chainsaw, axe, or similar hand-held tool.	
Cutting	String trimmer or hand-held blade	
Solarization	Plastic, geotextile, cardboard, or similar ground cover material	
Herbicide Treatment	Selective application techniques for chlorsulfuron, clopyralid, aquatic labeled glyphosate, imazapyr (aquatic and non-aquatic labeled), metsulfuron methyl, sethoxydim, sulfometuron methyl. Due to fish/aquatic toxicity issues, covering picloram and triclopyr under the restoration programmatic would have been problematic, and would have required design criteria that would have sharply limited their use. Programmatic or project specific coverage for these herbicides can be requested at the Forest (or multi-Forest) level. Imazapic was not included in the restoration programmatic at the request of the FS & BLM because of concerns over non-target plant exposure via root-to-root contact.	- Only daily quantities of herbicide transported to project site - Apply sethoxydim (Poast) when air temperature > 60º F - Do not apply herbicides if rain likely within 24 hours - Emergent treatment restricted to knotweed with aquatic labeled glyphosate - No treatment of submerged aquatic plants - Spill prevention, cleaning, and storage requirements - Use only LI 700, Agri-Dex, or an equivalent when adding surfactants to formulations .

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities

Table 4a (continued). Summary of methods, tools, and project design criteria for invasive plant treatment

Methods	Tools	Project Design Criteria
Stem injection	Appropriate syringes/injectors	- Knotweed applicators will be familiar with appropriate methods - Knotweed injection will use only aquatic labeled glyphosate (up to 100% concentration) - Emergent knotweed stems > 0.75 inches will be injected
Cut-stump and Hack & squirt	Backpack or hand-held sprayers, squirt bottles, and wiping applicators (brush, etc); Axe, hatchet, machete, drill, chainsaw, or other hand-held tool; Squirt bottles, backpack sprayer, or other hand-held spray bottle; Also tree injector and pellet gun.	- Herbicides to be used are imazapyr, metsulfuron methyl, and glyphosate - Application with aquatic glyphosate and aquatic imazapyr allowed to waters edge, and bankfull level for metsulfuron methyl non-aquatic imazapyr
Wicking, wiping	Sponge, wick, or similar absorbent material	- Herbicides to be used are chlorsulfuron, clopyralid, aquatic labeled glyphosate, imazapyr, metsulfuron methyl, sethoxydim, and sulfometuron methyl - Application with aquatic glyphosate and aquatic imazapyr allowed to waters edge, and to bankfull level for clopyralid, sethoxydim, and sulfometuron - Aquatic glyphosate application to emergent knotweed plants < 0.75 inch diameter allowed
Spot spray	Backpack, hand-pumped, or hand-held spray bottles	- Herbicides to be used are chlorsulfuron, clopyralid, aquatic labeled glyphosate, imazapyr, sethoxydim, metsulfuron methyl, and sulfometuron methyl - Backpack spray of aquatic glyphosate, metsulfuron, and sulfometuron allowed to bankfull level - Hand-held spray application (no backpack spray) of aquatic glyphosate and aquatic imazapyr to waters' edge in perennial channels - Hand-held spray of emergent knotweed < 0.75 inch diameter with aquatic glyphosate allowed within perennial channels - Hand-held spray application (no backpack spray) of aquatic glyphosate, imazapyr metsulfuron, and sulfometuron allowed within intermittent or ephemeral channels - No spray of sethoxydim or clopyralid within 15 feet of perennial stream bankfull level - No spray of chlorsulfuron within 50 feet of perennial stream bankfull level - No spray of sethoxydim, clopyralid, chlorsulfuron in intermittent/ephemeral streams - Drift minimized by 200-800 µm droplet size, and wind speeds and wind speeds consistent with label or local agency requirements, whichever is less
Biological Control	Insects, parasites, or pathogens	- State and U.S. Animal & Plant Health Inspections Service approved - Agents with direct adverse effects to non-target organisms no used
Site preparation	Rakes, shovels, hoes, and similar non-motorized hand tools.	- Minimize disturbance by clearing only area necessary for effective planting
Planting & seeding	Rakes, shovels, hoes, and similar non-motorized hand tools.	

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
Riparian Area Invasive Plant Treatment **Continued**	i. **Manual and Mechanical** a. Hand pulling – Uprooting is performed either by hand or using hand (non-motorized) tools. Generally appropriate for non-rhizome forming, tap-rooted species and/or species which produce only from seed. Treatment occurs when plant growth stage and soil conditions allow, and prior to seed-set for annual species. Hand pulling of emergent invasive plants is included. b. Seed clipping – Seed heads are cut, bagged, and removed from the area. The remainder of plant is left intact but is likely to be treated with another method. c. Stabbing – Some invasive plants can be severely weakened or killed by severing or injuring the carbohydrate storage structure at the base of the plant. Depending on species, this structure may be a root corm, storage rhizome, or taproot. Can be accomplished with shovel, hoe, or similar hand tool. d. Girdling – A strip of bark is removed around the base of susceptible woody species. The vascular cambium, or inner bark, which translocates carbohydrates between roots and leaves, is removed e. Cutting – Removal of the above-ground portion of an invasive plant by cutting with chainsaw, handsaw, pruning shears, or similar hand held device. Also includes mowing/cutting with a string-trimmer type machine, which does not have wheels or contact the ground. f. Solarization (ground cover) – Invasive plant infestations may be covered with plastic, geotextile, cardboard, or other ground cover material to kill the plant and roots or reduce plant vigor prior to treatment with another method. ii. **Herbicide Treatments** a. Stem-injection – Stems of actively growing species are injected with herbicide, usually near the base of the plant. b. Cut-stump –Herbicide is applied by spray, squirt, or wicking/wiping to the stump of a plant (usually a shrub or tree) shortly after the shoot or trunk is cut down. c. Wicking, & wiping – Use a sponge or wick to wipe herbicide onto foliage, stems, or trunk. Use of wicking/wiping method reduces the possibility affecting non-target plants. d. Spot application – Herbicide is directly sprayed onto target plants only, and spraying of desirable, non-target vegetation is avoided. Includes backpack and hand-pumped spray or squirt bottles, which can target very small plants or parts of plants (foliage, stems, or trunk). e. Hack & squirt – Woody species are cut using a saw or axe or drilled; herbicide is then immediately applied to the cut with a backpack sprayer, squirt bottle, syringe, or similar equipment. iii. **Biological Controls** a. Biological control is the inoculation of an infestation site with insects, parasites, or pathogens that specifically target the invasive plant species of concern. Treatment of invasive plant infestations with biological controls is a gradual process requiring several years to reach full effectiveness. Subsequent treatment with other methods may also occur. b. Site Preparation and Competitive Planting and Seeding c. Invasive plant infestation sites treated using one or more of the above stated methods may be revegetated by planting cuttings, seedlings, or seeding. d. Site preparation can involve removal of litter/duff layer suitable to allow proper soil to seed/root contact. This will be accomplished by scuffing/scalping micro-sites (generally less than 1 square meter) with hand tools within the larger planting/seeding site.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
Riparian Area Invasive Plant Treatment **Continued**	**b) Design Criteria** i. Design invasive plant treatments to reduce or eliminate adverse effects to species and critical habitats proposed and/or listed under the Endangered Species Act. This may involve surveying for listed or proposed plants prior to implementing actions within un-surveyed habitat if the action has a reasonable potential to adversely affect the plant species. Use site-specific project design (e.g. application rate and method, timing, wind speed and direction, nozzle type and size, buffers, etc.) to mitigate the potential for adverse disturbance and/or contaminant exposure. a. **Manual and Mechanical**. 1. Minimize treating invasive plants on banks from the stream when listed aquatic species are present. 2. Use the least ground disturbing method that results in effective invasive plant treatment. b. **Fuel handling** 1. Transport no more than a one day supply of fuel for chainsaws and string-trimmers into riparian areas. 2. Fueling of chainsaws and string-trimmers would not occur within 100 feet of surface waters. c. **Herbicides General Criteria** 1. Only daily use quantities of herbicides will be transported to the project site. 2. Use only LI 700, Agri-Dex, or an equivalent when adding surfactants to formulations. 3. In order to allow efficient volatilization of naptha solvent, application of sethoxydim will only occur during warm (above 60ºF), dry weather. 4. Do not apply herbicides if precipitation is likely within 24 hours. 5. Only herbicide application methods for plants emergent from water are stem injection, wicking/wiping, and hand-held spray bottle application of glyphosate to knotweed. No application to submerged aquatic vegetation with any herbicide is included. 6. Areas used for mixing herbicides will be placed where an accidental spill will not run into surface waters or result in groundwater contamination. Impervious material will be placed beneath mixing areas in such a manner as to contain any spills associated with mixing/refilling. 7. Equipment cleaning and storage and disposal of rinsates and containers will follow all applicable state and Federal laws. d. **Knotweed stem-injection** 1. Individuals will be familiar with proper glyphosate stem-injection methodology prior to treatment. 2. Only aquatic glyphosate formulations will be used. The formulation can be used at up to 100% concentration for the stem injection method. The formulation will be diluted to 50% or less active ingredient when applied directly to fresh stem cuts using wicking/wiping and up to the percentage allowed by label instructions when applied to foliage using low pressure hand-held spot spray applicators. 3. Larger emergent knotweed can be treated with glyphosate by stem injection, and smaller emergent knotweed by wicking/wiping and spot spray with hand-held sprayers. Wicking/wiping and hand-held spray bottle application of glyphosate allowed to emergent knotweed plants less than 4 to 5 feet tall, and usually smaller. 4. Emergent plants with stems over 0.75 inch in diameter will be treated by stem injection.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
Riparian Area Invasive Plant Treatment **Continued**	**Knotweed stem-injection (continued)** 5. Most knotweed patches are expected to have overland access. However, some sites may only be reached by water travel, either by wading or inflatable raft (or kayak). The following measures will be used to reduce spills during water transport: a) No more than 2.5 gallons of glyphosate will be transported per person or raft; 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. e. **Cut-stump and hack & squirt** 1. Herbicides to be used are imazapyr, metsulfuron methyl, and aquatic labeled glyphosate. 2. Application with aquatic labeled glyphosate and aquatic labeled imazapyr allowed to waters edge and to bankfull level for metsulfuron methyl and imazapyr not labeled for aquatic use. f. **Wicking and wiping** 1. Herbicides to be used are chlorsulfuron, clopyralid, aquatic labeled glyphosate, imazapyr, metsulfuron methyl, sethoxydim, and sulfometuron methyl. 2. For perennial streams, wicking and wiping application with aquatic labeled glyphosate and aquatic labeled imazapyr is allowed to waters edge and to bankfull level for chlorsulfuron, clopyralid, imazapyr (not aquatic labeled), metsulfuron methyl, sethoxydim, and sulfometuron methyl. 3. For perennial streams, emergent knotweed—stems < 0.75 inches in diameter—can be treated with wicking and wiping of aquatic labeled glyphosate. 4. For intermittent and ephemeral channels, chlorsulfuron, clopyralid, aquatic labeled glyphosate, imazapyr, metsulfuron methyl, sethoxydim, and sulfometuron methyl can be applied to all dry portions of the channel. g. **Spot application** 1. Herbicides to be used are chlorsulfuron, clopyralid, aquatic glyphosate, imazapyr, sethoxydim, metsulfuron methyl, and sulfometuron methyl. 2. Do not spot spray sethoxydim or clopyralid within 15 feet, and chlorsulfuron within 50 feet, of perennial stream bankfull. 3. Do not spot spray sethoxydim, clopyralid, or chlorsulfuron within intermittent or ephemeral channels. 4. Spot spray using aquatic labeled glyphosate and aquatic labeled imazapyr allowed to edge of water with hand-held, hand-pump spray or squirt bottles (no backpack sprayers). 5. Hand-held spot spray of aquatic glyphosate to emergent knotweed (< 0.75 inches stem diameter) is allowed. 6. Spot spray using metsulfuron methyl and sulfometuron methyl allowed to bankfull level of perennial streams with backpack sprayers, hand-pump sprayers, and squirt bottles. 7. Spot spray of aquatic labeled glyphosate, imazapyr, metsulfuron methyl, and sulfometuron methyl within dry intermittent and ephemeral channels allowed only with hand-held, hand-pumped sprayers and squirt bottles (no backpack sprayers). Excluding backpack spot spray is a conservation measure intended to minimize overspray within channels, and subsequent "first flush" exposures to aquatic resources, while still allowing full efficacy of the treatment 8. For foliar backpack spray applications, use only low pressure sprayers producing droplet sizes between 200 and 800 microns to minimize drift. 9. Backpack spray activities will only occur during conditions with low drift potential, defined as wind velocities greater than two and less than 10 mph, or as stated on the herbicide label.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
Riparian Area Invasive Plant Treatment **Continued**	ii. **Biological Controls** a. All biological controls used will be U.S. Animal and Plant Health Inspection Service (APHIS) and state approved. b. Agents demonstrated to have direct negative effects on non-target organisms will not be released. iii. **Site Preparation and Competitive Planting and Seeding** a. Minimize ground disturbance by clearing only the area necessary for effective planting. iv. **Extent of Treatment** a. Within each sixth field HUC containing listed aquatic species, no more than 10% of the total riparian area, measured as adjacent stream length, will be treated within any one year period. This includes 10% of flowing streams, and 10% of intermittent streams, measured separately. [This was put in as a place holder until the larger issue of the allowable scope of restoration activities overall can be addressed, as per the discussion during the 3/24 conference call. **c) Conservation Measures** i. These items are consistent with conservation measures and terms and conditions from previous ESA consultations. They are designed to provide guidance in selecting appropriate conservation measures and practices in future ESA consultations on actions implementing the proposed direction. ii. When consistent with label instructions, use water when diluting herbicides prior to application. iii. A spill cleanup kit will be available whenever herbicides are used, transported, or stored. iv. A certified/licensed pesticide applicator will oversee all herbicide application projects. v. Use only surfactants or adjuvants in riparian areas that do not contain any ingredients on EPA's List 1 or 2, where listing indicates a chemical is of toxicological concern, or is potentially toxic with a high priority for testing. **d) Excluded Activities –** None

Table 4b. Summary of design criteria to minimize effects to water quality

Herbicide	Perennial/flowing channels		Dry intermittent and ephemeral channels, and ditches	
	Spot spray	**Hand/select**	**Spot spray**	**Hand/select**
Chlorsulfuron	50 feet from bankfull	to bankfull edge	to bankfull edge	allowed through channel/ditch
Clopyralid	15 feet from bankfull	to bankfull edge	to bankfull edge	allowed through channel/ditch
Glyphosate (aquatic)	- to edge of water - within stream channel*	- to edge of water - within stream channel*	allowed through channel/ditch	allowed through channel/ditch
Imazapyr	to bankfull edge	to bankfull edge	allowed through channel/ditch	allowed through channel/ditch
Imazapyr (aquatic)	to edge of water	to edge of water	allowed through channel/ditch	allowed through channel/ditch
Metsulfuron methyl	to bankfull edge	to bankfull edge	allowed through channel/ditch	allowed through channel/ditch
Sethoxydim	15 feet from bankfull	to bankfull edge	to bankfull edge	allowed through channel/ditch
Sulfometuron methyl	to bankfull edge	to bankfull edge	allowed through channel/ditch	allowed through channel/ditch

***Spot spray (hand-held) and hand/select applications of aquatic glyphosate to emergent knotweed are allowed, when stems < 0.75 inches in diameter.**

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.	
Activity Category	**Project Description, Design Criteria, Conservation Measures, and Excluded Activities**
15. Riparian Exclusion Fencing (includes water gaps and stream crossings)	**a) Description –** Construct and replace fences around riparian areas to restrict or eliminate human and livestock use to maintain or restore stream channels, riparian vegetation, and floodplain functions. Fence types can include the following: permanent barbed-wire, high-tension, smooth-wire, let-down, electric, buck and pole, and other similar types. Fence construction may involve use of all-terrain vehicles, flatbed trucks, and manual/power tools. Water gap and/or stream crossings construction may involve dump trucks and excavator-type equipment. **b) Design Criteria** i. Fence placement should allow for lateral movement of a stream. ii. Minimize vegetation removal, especially potential large wood recruitment sources, when constructing fence lines. iii. When constructing livestock crossings at streams and/or water gaps, use the following design criteria: a. Locate crossings and/or water gaps where stream banks are naturally low. b. When possible, crossings and gaps should not be constructed within known or suspected spawning areas (e.g. pool tailouts where spawning may occur). c. Fences at stream crossings and water gaps should not inhibit up or downstream movement of fish and or significantly impede bedload movement. Where appropriate, construct fences at water gaps as to allow passage of large wood and other debris. d. If necessary, the stream bank and approach lanes can be stabilized with native vegetation and/or angular rock to reduce chronic sedimentation. The stream crossing or water gap should be armored with up to cobble-size rock, and use angular rock if natural substrate is not of adequate size. e. Livestock crossings or water gaps must not be located in areas where compaction or other damage may occur to sensitive soils and vegetation (*e.g.* wetlands) due to congregating livestock. f. The maximum width of a water gap or stream crossing should be no less than 10 feet and no more than 20 feet wide in the upstream-downstream direction (NRCS, 2001). g. When using pressure treated lumber for fence posts only, complete all cutting/drilling offsite so that treated wood chips and debris does not enter water or flood prone areas. iv. If other aquatic restoration activities included in this ARBA are used as complementary actions, follow the associated design criteria and conservation measures. **c) Conservation Measures –** No additional conservation measures are required. **d) Excluded Activities –** Riparian fencing is not to be use to create livestock handling facilities or riparian pastures.

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.	
Activity Category	**Project Description, Design Criteria, Conservation Measures, and Excluded Activities**
16. Riparian Vegetation Planting	**a) Description** — Conduct riparian vegetation planting as a means to help restore plant species composition and structure that would occur under natural disturbance regimes. The resulting benefits to the aquatic system can include desired levels of stream shade, bank stability, stream nutrients, large wood inputs, increased grasses, forbs, and shrubs, and reduced soil erosion. Activities may include the following: planting conifers, deciduous tress and shrubs; placement of sedge and or rush mats; gathering and planting willow cuttings. Equipment may include excavators, backhoes, dump trucks, power augers, chainsaws, and manual tools. **b) Design Criteria** i. An experienced silviculturist, botanist, ecologist, or associated technician shall be involved in designing vegetation treatments. ii. No roads or landings will be constructed. iii. Species to be planted must be of the same species that naturally occurs in the project area. iv. 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. v. Sedge and rush mats should be sized as to prevent their movement during high flow events. vi. Concentrate plantings above the bankfull elevation. vii. If other aquatic restoration activities included in this ARBA are used as complementary actions, follow the associated design criteria and conservation measures. **c) Conservation Measures –** No additional conservation measures are required. **d) Excluded Activities –** None
17. Road Treatments	**a) Description –** This activity includes road treatments, from simple closures to more complex road obliteration and removal, with an overall goal of restoring hydrologic functions. This category also includes stormproofing roads intended to remain open, thereby hydrologically disconnecting such roads from watershed streams. Associated benefits include the following: eliminate or reduce erosion and mass-wasting hazards associated with roads; eliminate or reduce human access and associated impacts to aquatic systems; enhancing natural hydrologic processes through reduction of drainage network. Actions such as bridge and culvert removal, removal of asphalt and gravel, installing drainage culverts, constructing road dips, subsoiling or ripping of road surfaces, outsloping, waterbaring, fill removal, sidecast pullback, re-vegetating with native species and placement of large woody material and/or boulders are included. Roadway barricading to exclude vehicular traffic is covered only if the overall road remediation project substantively addresses restoration of hydrologic function. For culvert removals on closed roads, limited cutting or removal of vegetation on the closed road-bed to access the culvert site may be required. Construction would involve use of heavy equipment, such as excavators, backhoes, front-end loaders, dump trucks, and bull dozers. **b) Design Criteria** i. For road removal projects within riparian areas, recontour the affected area to mimic natural floodplain contours and gradient to the greatest degree possible. ii. When obliterating or removing segments immediately adjacent to the stream, consider using sediment control barriers between the project and the stream. iii. Drainage features used for stormproofing and treatment projects should be spaced as to hydrologically disconnect road surface

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.

Activity Category	Project Description, Design Criteria, Conservation Measures, and Excluded Activities
	runoff from stream channels. iv. Dispose of slide and waste material in stable sites out of the flood prone area. Waste material other than hardened surface material (asphalt, concrete, etc) may be used to restore natural or near-natural contours. v. Minimize disturbance of existing vegetation in ditches and at stream crossings to the greatest extent possible. vi. Conduct activities during dry-field conditions—low to moderate soil moisture levels vii. When removing a culvert from a first or second order, non-fishing bearing stream, project specialists shall determine if culvert removal should follow conservation measures under activity #5 – Fish Passage Culvert and Bridge Projects. Culvert removal on fish bearing streams shall adhere to the conservation measures under activity #5 – Fish Passage Culvert and Bridge Projects. viii. For culvert removal projects, restore natural drainage patterns and when possible promote passage of all fish species and life stages present in the area. Evaluate channel incision risk and construct in-channel grade control structures when necessary. ix. If other aquatic restoration activities included in this ARBA are used as complementary actions, follow the associated design criteria and conservation measures. **c) Conservation Measures –** No additional conservation measures are required. **d) Excluded Activities –** This activity does not include new road construction or routine maintenance.
18. Removal of Legacy Structures	**a) Description –** Remove large wood, boulders, rock gabions, and other in-channel structures that were constructed to improve fish habitat but were installed in a manner that was and continues to be inappropriate for the given stream type. Examples of such structures, which were typically installed in the 1980's and early 1990's, include boulder configurations in meadow streams, stair-step perpendicular log weirs, and rock gabions. These legacy structures typically resulted in widened stream channels, increased width/depth ratios, decreased sinuosity, and increased stream exposure to solar radiation. Removal of legacy structures would include the use of excavator-type machinery, spyders, backhoes, and dump trucks. **b) Design Criteria** i. If the structure being removed contains material (i.e. large wood, boulders, etc) not typically found within the stream or floodplain at that site, remove material from the 100-year floodplain. ii. 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 described under Large Wood, Boulder, and Gravel Placement activity category in this BA. Any such project must follow design criteria for Large Wood, Boulder, and Gravel Placement activity category within this BA. iii. If the structure being removed is keyed into the bank, fill in "key" holes with native materials as 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. iv. When removal of buried (keyed) structures may result in significant disruption to riparian vegetation and/or the floodplain, consider using a chainsaw to extract the portion of log within the channel and leaving the buried sections within the streambank. v. If the legacy structures (log, rock, or gabion weirs) were placed to provide grade control, evaluate the site for potential

Table 4. Aquatic Restoration Activity Categories—descriptions, design criteria, conservation measures and excluded activities.	
Activity Category	**Project Description, Design Criteria, Conservation Measures, and Excluded Activities**
	headcutting and incision due to structure removal. The following document can serve as guides to assessing the potential for headcuts: Castro, J. 2003. Geomorphologic Impacts of Culvert Replacement and Removal: Avoiding Channel Incision. FWS, Portland, OR, and/or the Dichotomous Key to Evaluate the Potential for Stream Incision at Sites Being Considered for Culvert Replacement or Removal Projects, FWS, Lacey, WA (Appendix C). 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 Stabilization activity category). vi. If the structure is being removed because it has caused an over-widening of the channel, consider implementing other ARBA restoration categories to decrease the width to depth ratio of the stream at that location to a level commensurate with upstream and downstream (within the same channel type). vii. If other aquatic restoration activities included in this ARBA are used as complementary actions, follow the associated design criteria and conservation measures **c) Conservation Measures –** No additional conservation measures are required. **d) Excluded Activities –** None
19. Survey and Monitoring (includes fisheries, hydrology, geomorphology wildlife, botany, and cultural surveys in support of ARBA activities)	**a) Description**. Includes assessment and monitoring projects that are specifically associated with planning, implementation, and monitoring of aquatic restoration projects covered by this ARBA. Such support projects may include surveys to document the following aquatic and riparian attributes: fish habitat, hydrology, channel geomorpholgy, water quality, fish spawning, fish presence, macro invertebrates, riparian vegetation, wildlife, and cultural resources (including excavating test pits <1 m^2 in size). This also includes presence/absence surveys for listed terrestrial wildlife, bird, and plant species in the project area. **b) Design Criteria:** i. Training personnel in survey methods that prevent or minimize disturbance of fish. Contract specifications should include these measures where appropriate. ii. Avoid impacts to fish redds. When possible, avoid sampling during spawning periods. iii. Coordinate with other local agencies to prevent redundant surveys. iv. Locate excavated material from cultural resource test pits away from stream channels. Replace all material in test pits when survey is completed and stabilize the surface. **c) Conservation Measures –** No additional conservation measures are required. **d) Excluded Activities –** Does not include surveys covered with Section 10 (a) 1a of the ESA.

A. Number of ARBA Projects that can be Implemented

The ARBA activity categories have been segregated into two groups—Group One and Group Two. Group One is comprised of those restoration categories that include the use of heavy machinery within the bankfull channel and will result in either project related sediment introduced into the stream during low flow period; short-term riparian disturbance; and/or harassment or harm of ESA-listed fish during project implementation activities. Group Two includes ARBA categories that typically occur outside of the bankfull channel and will either result in lesser amounts of sediment (and herbicides for certain invasive plant treatments) introduced into the stream during low flow period; minor, short-term disturbance of riparian areas; and/or harassment of ESA-listed fish. Refer to Tables 5 and 6 for a list of Group One and Group Two projects, respectively.

A FS or BLM administrative unit or Coquille Indian Tribe can conduct up to 10 Group One projects within a 5th field watershed each year. The Group One projects that can be conducted within a 5th field watershed can consist of the same activity type or a mixture of the 10 types included in Table 5. However, more than 10 Group One projects can be conducted as long as the effects threshold, as described in Chapter V, is not exceeded. There is no limit as to the number of Group Two projects that can be conducted in a 5th field watershed each year with the exception of Riparian Area Invasive Plant Treatments.

To permit an acceptable amount of an in-water work window to conduct Group One and Group Two aquatic restoration projects, a limited amount of incidental take (disturbance) will be exempted by the FWS for the marbled murrelet, northern spotted owl, and northern bald eagle when overlap between protective work windows occurs between terrestrial and aquatic species.

Table 5. Group One ARBA Activity Categories

Activity Type	Project Definition
Large Wood, Boulder, and/or Gravel Placement	One project is equal to: 15 stream miles of helicopter placement or 5 miles using cable yarding equipment or 1 stream mile of placement with excavator-type equipment.
Reconnection of Existing Side Channels and Alcoves	One project is equal to 1 side channel/alcove project
Head-cut Stabilization and Associated Fish Passage	One project is equal to 1 headcut project and associated fish passage structures.
Bank Restoration	One project is equal to stabilization of eroding banks along less than .5 mile of stream.
Fish Passage Culvert and Bridge Projects	One project is equal to removal or replacement of 1 road crossing structure.
Irrigation Screen Installation and Replacement (Weir Removal)	One project is equal to removal of 1 in-channel weir structure.
Estuary Restoration (Tide gate Removal)	One project is equal to removal of 1 tide gate.
Road Treatments	One project is equal to 1 mile of road treatments where the road-bed is altered with heavy equipment within the bankfull channel.
Floodplain Overburden Removal	One project is equal to overburden removal along 1 mile of stream. Includes floodplains on both sides of stream.
Removal of Legacy Structures	One project is equal to 1 stream mile of legacy structure removal.

Table 6. Group Two ARBA Activity Categories

Activity Type	Project Extent
Irrigation Screen Installation and Replacement	No limit on number of screens
In-Channel Nutrient Placement	No limit on number of miles treated
Estuary Restoration*	No limit on number of acres treated
Riparian Vegetation Treatment (non-commercial)	No limit on number of acres treated
Riparian and Upland Juniper Treatment (non-commercial)	No limit on number of acres treated
Riparian Vegetation Treatment (controlled burning)	No limit on number of acres treated
Riparian Area Invasive Plant Treatment	Within each sixth field HUC containing listed aquatic species, no more than 10% of the total riparian area will be treated within any one year period.
Riparian Exclusion Fencing	No limit on riparian acres or stream miles
Riparian Vegetation Planting	No limit on number of acres treated
Road Treatments	No limit on road miles treated for roads outside of bankfull channel.
Floodplain Overburden Removal	No limit on acres treated which occur outside of bankfull channel. (Mine-tailing removal projects are not included)
Reduction of Recreation Impacts	No limit on miles or acres treated
Survey and Monitoring	No limit on acres or miles surveyed

* Estuary projects could result in increased sediment into the water column. However, tidal waters typically carry high sediment loads, so the overall contribution of sediment to the water column from this project type is considered to be insignificant.

B. Project Design Criteria for Terrestrial Species and Habitats

This section provides Project Design Criteria (PDC) and Conservation Measures (CMs) that ensure restoration activities minimize or avoid potential adverse effects to listed terrestrial species and critical habitat. The programmatic activities are designed to Not Likely to Adversely Affect (NLAA) all terrestrial species, except as discussed below (II. C.1. Birds) for a limited number of actions that are Likely to Adversely Affect for Northern spotted owls (NSO), marbled murrelets (MAMU), and bald eagles (BE).

1. The following Conservation Measures apply to all listed terrestrial species for all programmatic activities:
   - **a.** Aquatic restoration actions will not remove or degrade suitable habitat (on either public or private land) for any listed terrestrial species.
   - **b.** Hazard tree removal will not result in NLAA or LAA for listed birds and will not adversely affect listed birds' critical habitat.
   - **c.** All restoration activities must have the unit's botanist and wildlife biologist input in/analysis of the project design and their site-specific species assessment to proceed. This includes a plant survey and nest analysis (or survey, as described in section

II.C.1.Birds) if suitable habitat is known to occur within the project prior to project implementation.

d. There will be no disturbance allowed from blasting activities as they are not part of the proposed action.

e. A unit wildlife biologist has the discretion to adjust disturbance and disruption distances, based on site-specific conditions. They may increase, but not decrease, disruption distances for spotted owls and marbled murrelets based on site-specific conditions.

f. Planning teams and contractors will observe the minimum disturbance (and disruption if applicable) distances for listed terrestrial species (see Table 7a-7d). Work activities must occur further than the species-specific disturbance distances during the time frame specified to have NLAA determinations. Alternatively, activities that occur outside these time frames are considered NLAA actions. For species with a range of disturbance/disruption distances refer to the CMs specific to that species. Also, refer to species-specific CMs to view other criteria needed to comply with NLAA determinations.

g. Marbled murrelets, spotted owls, and bald eagles not only have NLAA determinations, but also have LAA determinations for a limited number of actions that may adversely affect these three listed birds (5 marbled murrelets, 3 spotted owns, and 1 bald eagle may be adversely affected via disturbance/disruption per National Forest, BLM District, and Coquille Indian Tribe per year).

Table 7a. Disturbance Distances and Time Periods When Disturbance (and Possibly Disruption) May Occur for Terrestrial Species.*

Species	Disturbance Distance (in miles)	Time Period Applicable
Northern spotted owl (nesting)	.25	Mar 1 – July 15
Bald eagle (nesting)	.25 or .5 line-of-sight, .5 for helicopter use, or 1 mi for pile driving in WA.	Jan 1 – Aug 31
Bald eagle (wintering)	.25 or .5 line-of-sight, .5 for helicopter use, or 1 mi for pile driving in WA.	Nov 15 – Mar 15
Marbled murrelet (nesting)	.25	Apr 1 – Aug 5 Or Aug 6-Sept 15 w/ 2-hr timing
Canada lynx (denning)	.25	May 1 – Aug 31
Gray wolf (active dens/rendezvous sites)	1.5	Jan 1 – Dec 31
Grizzly bear (denning)	.25	Oct 15 – May 15
Grizzly bear (early foraging habitat)	.25	Mar 15 – July 15
Grizzly bear (late foraging habitat)	.25 (actions >1 day)	July 16 – Nov 15
Woodland caribou	Recovery Area	Early winter
All Plants	.25**	Jan 1 – Dec 31

See CMs below for additional details. **If project is within .25 mile of a listed plant, then measures must be taken to minimize threats to NE or NLAA the species to be covered by this programmatic consultation.

2. **Birds –** The proposed ARBA activities may potentially disturb Northern spotted owls, marbled murrelets, and bald eagles during their critical nesting or BE wintering periods. This ARBA attempts to minimize or avoid adverse effects to listed birds by implementing AR actions outside of critical nesting period windows and/or outside of disturbance or disruption distance from occupied habitat. However, some AR activities must occur within a listed bird critical nesting period or within a disturbance or disruption distance. A limited number of AR activities that adversely affect listed birds will therefore occur under this proposed action.

   The ARBA projects may disturb or disrupt listed birds only when the following steps have been taken to attempt to fully avoid or minimize adverse effects to listed birds from AR activities: 1) wildlife biologist has determined a listed bird species may occur in the project area; 2) a site survey by wildlife biologist indicates an active nest is within the species-specific disturbance distance of the AR project; 3) the AR action cannot be scheduled outside of the listed bird critical nesting period, or moved to a location outside of the listed bird disturbance/disruption distance. After making all attempts to avoid or minimize adverse effects by changing project timing or location, each National Forest or BLM District may only disturb or disrupt a total of one bald eagle, three spotted owl, and five marbled murrelets per year.

   a. Conditions common to all programmatic activities that shall be applied to avoid disturbance or disruption of listed bird species include:
      i. The proposed activities included in this document are consistent with the Northwest Forest Plan (USDA and USDI 1994) and the Forest Service and BLM Land and Resource Management Plans as amended by the Record of Decision for Amendments to the Survey and Manage, Protection Buffer, and Other Mitigation Measures Standards and Guidelines, USDA Forest Service and USDI Bureau of Land Management (USDA and USDI 2001).
      ii. The proposed activities do not include those that would result loss of habitat (on either public or private land) for the identified threatened species.
      iii. The proposed activities must have wildlife biologist input/analysis to proceed.
      iv. As a general rule, a disturbance site is defined as approximately 100 meters radius around the project site. However, the unit wildlife biologist has the discretion to adjust disturbance distances, based on site-specific conditions.
      v. No hovering or lifting within 500 feet of the ground within occupied spotted owl habitat or bald eagle habitat during the nesting seasons by ICS Type I or II helicopters would occur as part of any proposed action addressed by this assessment.

   b. Northern spotted owl
      i. **NSO1**: Projects will not occur between March1 – July 15 if there is an active NSO nest, known activity center, RPO (Reference Point Owl) and/or occupied habitat within the disruption/disturbance distance of the project area. Otherwise it would be LAA and either (i) delayed until July 15 (unless action involves Type I/II helicopters, which extend critical nesting window to September 30); (ii)delayed

until it is determined that young are not present, or (iii) counted toward the limited number of LAA projects covered under this programmatic.

ii. **NSO2**: The unit wildlife biologist may extend the restricted season based on site-specific information (such as a late or recycle nesting attempt).

iii. **NSO3**: No suitable, dispersal, or critical NSO habitat will be removed or degraded.

iv. **NSO4**: NSO disturbance/disruption distances applicable to the equipment types proposed in the ARBA include:

Table 7b. Northern Spotted Owl Critical Nesting Period Disruption Distances

Activity	**Critical nesting period-** Mar 1-July 15
Type I/II Helicopter	.25 mile (.25 mile July 15- September 30)
Type III/IV Helicopter	120 yards
Heavy Equipment	35 yards
Chainsaw	65 yards
Burning or Smoke	.25 mile
Tree Climbing	35 yards
Fixed wing aircraft	120 yards
Pile driving	60 yards

c. Bald eagle

i. **BE1:** Work activities will not occur within .25 mile (400 m) or .5 mile (800m) line-of-sight from nests/roost during critical nesting or wintering periods of BE use, unless surveys demonstrate that the nest or roost is not being used. Otherwise it would be LAA and either delayed until the nesting or wintering season is finished or BEs are not present or counted toward the limited number of LAA projects covered under this programmatic.

ii. **BE2:** All projects will comply with site-specific FS or BLM management plans for eagle nest or roost sites.

iii. **BE3:** No suitable or occupied habitat or potential perches will be removed or degraded.

iv. **BE4:** Table 7c shows BE disturbance distances that are applicable to the ARBA.

Table 7c. Bald Eagle Critical Nesting Period Disruption Distances

Activity	**Critical Nesting Period** Apr 1 – Aug 5	**Aug 6 –Sept 15** *w/ 2hr timing **
Chainsaws, Pile driving, Heavy Equipment, Tree Climbing and Excessive Human Presence	100 yards	0
Burning or Smoke	.25 mile	0
Type I or II	.25 mile	.25 mile
Type III or IV	120 yards	0
Fixed-wing aircraft	120 yards	0

d. **Marbled Murrelet**
   i. **MM1:** Projects will not occur within the applicable disruption and disturbance distances for MAMUs within their critical nesting period (Table 7c), unless a protocol survey determines MAMUs are not present. Otherwise the project would be LAA and either delayed until August 6 (with 2-hr timing restrictions) or until it is determined that young are not present or counted toward the limited number of LAA projects covered under this programmatic.
   ii. **MM2:** Projects implemented between August 6 and September 15 would not begin until 2 hours after sunrise and would end 2 hours before sunset.
   iii. **MM3:** No suitable, potential, or critical MAMU habitat is to be removed or downgraded.
   iv. **MM4:** Garbage containing food and food trash generated by workers in project areas is secured or removed to minimize attraction of corvids, which have been identified as predators of murrelet eggs and young.
   v. **MM5:** Table 7d shows MAMU disruption distances that are applicable to the ARBA.

Table 7d. Marbled Murrelet Critical Nesting Period Disruption Distances

Activity	**Critical Nesting Period** Apr 1 – Aug 5	**Aug 6 –Sept 15** *w/ 2hr timing*
Chainsaws, Pile driving, Heavy Equipment, Tree Climbing and Excessive Human Presence	100 yards	0
Burning or Smoke	.25 mile	0
Type I or II	.25 mile	.25 mile
Type III or IV	120 yards	0
Fixed-wing aircraft	120 yards	0

3. **Terrestrial Definitions Glossary**
   a. **Disturbance** – A *disturbance distance* is the distance within which the effects to listed species from noise (sound or concussion), human intrusion (including smoke from prescribed burning) and mechanical movement (*e.g.,* shaking of a tree by helicopter rotor wash) associated with the proposed action would be expected to affect listed species. Except as stated in Tables 1 and 2, the disturbance distance is 0.25 mile (0.5 mile line-of-sight) from bald eagles at a nest or winter roost, 0.25 mile from nesting spotted owls and occupied marbled murrelet habitat, and 0.25 miles from unsurveyed suitable spotted owl or marbled murrelet habitat or marbled murrelet potential structure. To correctly apply the standards of this assessment to individual animals or breeding pairs, the unit wildlife biologist may increase or decrease these distances according to the best available scientific information and site-specific conditions.
   b. **Disruption** – A *disruption distance* is the distance within which the negative effects to listed species from noise (sound and concussion), human intrusion or mechanical movement associated with a proposed activity would be expected to exceed the levels of "discountable" or "insignificant," or might cause the incidental taking of a listed

animal. Unit wildlife biologists may increase, but may not decrease, these distances and still comply with the standards of this assessment.

c. **Habitat Definitions**

i. **BE Suitable habitat** – Conifer-dominated habitats that generally are 80 years old or older and located within 1.0 mile of a major river or 0.5 mile of a major tributary.

ii. **BE Occupied habitat** – Suitable habitat within 0.25 mile (or 0.5 mile line-of-sight) of an active nest or roost site.

iii. **NSO Suitable habitat** – Consists of stands used by owls for nesting, roosting and foraging. Generally these stands are conifer-dominated, 80 years old or older and multi-storied in structure, and have sufficient snags and downed wood to provide opportunities for owl nesting, roosting and foraging. The canopy closure generally exceeds 60 percent.

iv. **NSO Occupied nest location** – A known currently active nest location.

v. **NSO Dispersal habitat** – Conifer and mixed mature conifer-alder habitats with a canopy cover greater than or equal to 40 percent and conifer trees greater than or equal to 11 inches average dbh. Generally, spotted owls use dispersal habitat to move between blocks of suitable habitat, roost, forage and survive until they can establish a nest territory. Juvenile owls also use dispersal habitat to move from natal areas. Dispersal habitat lacks the optimal structural characteristics needed for nesting.

vi. **MAMU Suitable habitat** – Consists of conifer-dominated stands that generally are 80 years old or older and/or have trees greater than or equal to 18 inches average dbh. Murrelet suitable habitat must include potential nesting structure as described below and in the Level 2 policy of March 26, 2004 (Appendix D).

vii. **MAMU Potential Structure** – consists of individual trees with the following characteristics: 1. It occurs within 50 miles (81 km) of the coast (USDI 1997) and below 2,925 ft. (900 m) in elevation (Burger 2002); 2. It is one of four species: Western hemlock, Douglas-fir, Sitka spruce or western red cedar (Nelson & Wilson 2002); 3. It is ≥ 19.1 in. (49 cm) (dbh) in diameter, > 107 ft. (33 m) in height, has at least one platform ≥ 5.9 in. (15 cm) in diameter, nesting substrate (e.g., moss, epiphytes, duff) on that platform, and an access route through the canopy that a murrelet could use to approach and land on the platform (Burger 2002, Nelson & Wilson 2002); 4. And it has a tree branch or foliage, either on the tree with potential structure or on a surrounding tree that provides protective cover over the platform (Nelson & Wilson 2002).

viii. **MAMU Occupied habitat** – Consists of suitable habitat or potential structure that has been found to meet the definition of occupied by interagency established survey protocol (Evans *et. al.* 2002).

ix. **MAMU 2 hour timing restrictions** – Projects implemented between August 6 and September 15 would not begin until 2 hours after sunrise and would end 2 hours before sunset to ensure disturbance of MAMU is not occurring during main feeding periods.

4. Mammals

a. Canada Lynx

i. **CL1:** No active lynx dens are located within 270 yards (based on sight distance and attenuation of sound in forested environments of a project.

ii. **CL2**: The project will meet the standards and guidelines identified in the Lynx Conservation Assessment and Strategy (LCAS) and are within the LCAS thresholds (suitable, unsuitable, and denning habitat).

iii. **CL3:** The project will not result in increased off-road vehicle access to lynx habitat during or following implementation.

b. Gray Wolf

i. **GW1**: No active den or rendezvous site or pack activity is located within 1.5-miles of the project (Chapman 1979). If an active den, rendezvous site, or pack activity if identified, the project would fall outside the scope of this ARBA, and a separate consultation would be required to address potential effects.

c. Grizzly Bear

i. **GB1**: Projects generating noise above ambient levels within ¼ mile (1 mile for blasting) of any known grizzly bear den site will not occur from October 15 through May 15.

ii. **GB2**: Projects generating noise above ambient levels and located within ¼ mile (1.0 mile for blasting) of early season grizzly bear foraging areas (e.g., low elevation grass/forb habitat, deciduous forest, riparian forest, shrub fields, montane meadows, avalanche chutes) will not occur from March 15 to July 15 if the activity will last for more than one day.

iii. **GB3**: Projects generating noise above ambient levels and located within ¼ mile (1.0 mile for blasting) of late season grizzly bear foraging areas [e.g., high elevation berry fields, shrub fields, fruit/nut sources, wet forest openings, alpine and sub alpine meadows, montane meadows (moist, cool, upland slopes dominated by coniferous trees)] will not occur from July 16 to November 15 if the activity will last for more than one day.

iv. **GB4**: Projects will not increase trail or road densities within grizzly bear core habitat. No road or trail construction or reconstruction will occur in recovery areas.

v. **GB5:** All attractants, including food and garbage, will be stored in a manner unavailable to wildlife at all times.

d. Woodland Caribou

i. **WC1**: Projects that are scheduled during early winter in the caribou recovery area (Michael Borysewicz pers. com.2003) and generate noise above ambient levels will be evaluated by the local wildlife biologist to determine if there will be disturbance effects to caribou.

ii. **WC2:** Any vegetation management will not affect more than 1.0 acre of native forest per year.

iii. **WC3:** Projects will not result in increased off-road vehicle access to caribou habitat.

5. Plants – For threatened or endangered plant species that may occur in project areas within the scope of this Biological Assessment, the following criteria will be applied:

a. All Listed Plant Species

i. **PL1**: A unit botanist will have the following input in all project designs: (a) the botanist will determine whether there are known listed plants or suitable habitat for listed plants in the project area. (b) If a known site of a listed plant is within 0.25-mile of the project action area, or that suitable or potential habitat may be affected by project activities, then a botanist will conduct a site visit/vegetation survey to determine whether listed plants are within the project area. This visit and survey will

be conducted at the appropriate time of year to identify the species and determine whether individual listed plants or potential habitat are present, and may be adversely affected by project activities (see Table 8).

ii. **PL2:** If one or more listed plants are present and likely to be adversely affected by the project, then the project is not covered by this Biological Assessment and consultation with the U.S. Fish and Wildlife Service under Section 7 of the ESA must be initiated. If project will have no effect or is NLAA listed plants it is covered under this programmatic consultation.

iii. **PL3:** Due to soil disturbance that may occur during aquatic restoration activities and use of heavy equipment that could carry seeds and plant parts into project areas, all appropriate measures will be incorporated into contract or equipment rental agreements to avoid introduction of invasive plants and noxious weeds into project areas.

Table 8. Optimal Survey Periods for Listed Flowering Periods For Listed Plants in Oregon and Washington

Species	Optimal Survey Time Period*
Applegate's Milk-Vetch	June to early August
Bradshaw's Lomatium	April to mid-May
Cook's Lomatium	Mid-March through May (varies with spring moisture)
Gentner's Fritillary	April to June
Golden Paintbrush	April to September
Howell's Spectacular Thelypody	June through July
Kincaid's Lupine	May through July
Large-flowered Wooly Meadowfoam	Mid-March to May (varies with spring moisture)
MacFarlane's four o'clock	May through June
Malheur Wire-Lettuce	July through August
Marsh Sandwort	May to August
McDonald's Rock-cress	Mid-March through June
Nelson's Checkermallow	Late May to Mid-July
Rough Popcornflower	Mid-June to early July
Showy Stickseed	May to July
Spalding's Catchfly	June to September
Ute Ladies'-Tresses	July to late August
Water Howellia	May through August
Wenatchee Mountains Checker-Mallow	June to Mid-August
Western Lily	May to July
Willamette Daisy	Mid-June to early July

*This is a guideline. The site botanist will survey when the time is appropriate.

6. **Insects and Mollusks**
   a. Vernal Pool Fairy Shrimp
   i. **VF1:** For any project site located in or adjacent to a vernal pool, activities must not disrupt the impermeable, sub-surface soil layer or cause the movement of soils that could be deposited into a vernal pool.
   ii. **VF2**: Project personnel will avoid traveling through the wetted portions of a vernal pool.

C. Implementation Process for the Aquatic Restoration Biological Assessment

1. **Integration of PDCs, Conservation Measures, and Terms and Conditions into Project Design and Contract Language** – The project lead will integrate species and activity category-appropriate PDCs (Table 4), conservation measures (Table 4), and Incidental Take Statement terms and conditions (from NMFS and FWS BOs) into the proposed restoration action. Appropriate PDCs and conservation measures listed in this ARBA and any terms and conditions included in the BOs shall be incorporated into contract language or force-account work plans.

2. **Project Notification and Reporting** – The Level 1 Team will meet on at least an annual basis to discuss implementation of the BA—project notification and completed projects. The date of the meeting will be determined by the local Level I team. This notification/reporting process may be adapted to adhere to the local Level 1 Team meeting schedule, operating protocols, and forms. Because the ARBA activities have already proceeded through formal consultation, such meetings are not required by the FS, BLM, or Coquille Indian Tribe to acquire additional approval from the NOAA or FWS Level 1 Team members. However, the action agencies do recognize the fact that NOAA and FWS Level 1 Team members can offer additional site specific information that may aid project planners.
   a. Project Notification – Level 1 teams will discuss aquatic restoration projects planned for implementation during the upcoming work season. If more than 10 Group One projects are proposed for a 5th field watershed in a given year, the FS, BLM, and/or Coquille Indian Tribe shall provide justification as to why the five-mile turbidity limit will not be exceeded. (Refer to Chapter V, section A, which provides a justification for the number of ARBA projects.) Regulatory biologists may provide additional information that will assist in project design (e.g. early spawning timing anticipated due to an ongoing drought). A Project Notification Form shall be provided to the Level 1 Team members prior to the meeting and should include the following information:
   i. Location – 6th field HUC and stream name
   ii. Timing – Project start and dates
   iii. Activity Type – All that apply from Table 4 of the ARBA
   iv. Project Description – Brief narrative of the project and objectives
   v. Extent – Number of stream miles or acres to be treated
   vi. Species Affected – Listed Fish and or Wildlife species, Critical Habitat, and or EFH affected by the project.
   b. Completed Projects – Level 1 teams will discuss aquatic restoration projects completed during the previous season. The FS, BLM, and Coquille Indian Tribe will report to the Level I team on all high impact and low impact projects implemented the previous year.

This includes Wyden projects. The reports would include the following information necessary for NMFS and FWS tracking needs:

i. Location – 6th field HUC and stream name
ii. Timing – Project start and dates
iii. Activity Type – All that apply from Table 4 of the ARBA
iv. Project Description – Brief narrative of the project and objectives
v. Extent – Number of stream miles or acres treated
vi. Species effected – Fish and or Wildlife species affected by the project, Critical Habitat and or EFH
vii. Fish Handling – If fish are handled during rescue operations the project biologist will describe removal methods, stream conditions, and the number of fish affected. This report will likely be limited to culvert replacement projects.
viii. Any Authorized Incidental Take
ix. Number of Northern Spotted Owl, Bald Eagle, or Marbled Murrelet nests disturbed during critical nesting period.
x. Agency Name – Agency and project lead name
xi. Date of submittal

3. **Monitoring Requirements –** Monitoring will be conducted during project implementation and after project completion.
   a. **Monitoring during Project Implementation and Follow-up Remedial Activities if Necessary**
      i. Monitor during project implementation to ensure effects are not greater (amount, extent) than anticipated and to contact Level 1 representatives if problems arise.
      ii. Fix any problems that arise during project implementation.
      iii. Regular biologist coordination with COR if biologist is not always on site to ensure contractor is following all stipulations.
   b. **Post Project Assessment and Follow-up Remedial Activities if Necessary** – A post-project review shall be conducted after winter high flows/rains. This can consist of a simple walk through to assess the following:
      i. Are there post-project affects that were not considered during consultation?
      ii. For fish passage culverts, assess the following parameters: headcutting below natural stream gradient, substrate embeddedness in the culvert, scour at the culvert outlet, and erosion from sites associated with project construction goals.
      iii. In cases where remedial action is required, such actions are permitted without additional consultation if they use PDCs and CMs listed in Table 4 and the effects of programmatic actions in Chapter V are not exceeded.
4. **Level 1 Team Field Review –** At its discretion, the Level 1 Team can conduct field reviews to determine a project's consistency with the BA/BO.

III. Description of the Affected Species

The following species descriptions summarize biological requirements and may include other elements, such as historical numbers and distribution, which offer insights into the life histories of affected ESA-listed fish, wildlife, and plants.

A. Fish

1. Bull Trout (*Salvelinus confluentus*)

Listing Status and Description – On November 1, 1999, the U.S. Fish and Wildlife Service (FWS) listed five distinct populations segments (DPSs) of the bull trout within the coterminous United States as threatened (USDI 1999). These five DPSs, with 187 subpopulations, include: 1) the Coastal/Puget Sound DPS, with 34 subpopulations; 2) the Columbia River DPS, with 141 subpopulations; 3) the Jarbidge River DPS, with 1 subpopulation; 4) the St. Mary-Belly River DPS, with four subpopulations; and 5) the Klamath River DPS, with seven subpopulations.

Population Trends and Distribution – Bull trout are a member of the char family and closely resemble another member of the char family, Dolly Varden (*Salvelinus malma*). Genetics indicate, however, that bull trout are more closely related to an Asian char (*Salvelinus leucomaenis*) than they are to Dolly Varden. Bull trout are sympatric with Dolly Varden over part of their range, most notably in British Columbia and the Coastal/Puget Sound region of Washington State.

Bull trout distribution has been reduced by an estimated 55 percent in the Klamath River DPS and 79 percent in the Columbia River DPS since pre-settlement times, due primarily to local extirpations, habitat degradation, and isolating factors (Quigley and Arbelride 1997). Within the Puget Sound Basin, bull trout distribution is similar to historic distributions, but population abundance has significantly decreased. Bull trout historically occurred in major river drainages in the Pacific Northwest, extending from northern California to the headwaters of the Yukon River in the Northwestern Territories of Canada (Cavender 1978; Bond 1992). In California, bull trout were historically found only in the McCloud River, which represented the southernmost extension of the species' ranges. The last confirmed report of this species in the McCloud River was in 1975, and the original population is now considered to be extirpated (Rode 1990). The remaining distribution of bull trout is highly fragmented.

Bull trout currently occur in rivers and tributaries in Montana, Idaho, Washington, Oregon (including the Klamath River basin), Nevada, two Canadian Provinces (British Columbia and Alberta), and several cross-boundary drainages in extreme southeast Alaska. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta, and the McKenzie River system in Alberta and British Columbia (Cavender 1978; McPhail and Baxter 1996; Brewin and Brewin 1997).

Bull trout have more specific habitat requirements than other salmonids (Rieman and McIntyre 1993). Growth, survival, and long-term persistence are dependent upon the following habitat characteristics: cold water, complex instream habitat, a stable substrate with a low percentage of fine sediments, high channel stability, and stream/population connectivity. Stream temperature and substrate type, in particular, are critical factors for the

sustained long-term persistence of bull trout. Spawning is often associated with the coldest, cleanest, and most complex stream reaches within basins. However, bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1995), and should not be expected to occupy all available habitats at the same time (Rieman *et al*. 1997).

Reasons for Decline – The factors that have contributed to the decline of bull trout population within each DPS include the restriction of migratory routes by dams and other unnatural barriers; forest management, grazing, and agricultural practices; road construction; mining; introduction of non-native species; and residential development resulting in adverse habitat modification, excessive timber harvest, and poaching (Bond 1992, Thomas 1992, Rieman and McIntyre 1993, Donald and Alger 1993, WDFW 1997).

Recovery Measures – No Federal lands are designated critical habitat, however, adjacent private lands may have received CH designation. The Service is currently developing the recovery plans for the Columbia River and Coastal/Puget Sound DPSs, and the bull trout recovery planning efforts are converting bull trout subpopulations into core areas. Core areas, which form the basic geographic unit upon which to gage recovery within a recovery unit, contain both core habitat (i.e., habitat that could supply all elements for the long-term security of bull trout) and a core population (i.e., bull trout inhabiting core habitat). Core areas were designated to represent the closest approximation of a healthy functioning subpopulation within each DPS.

In general, the concept of core areas were originally established with the intent to achieve optimal environmental conditions, as proposed by Rieman and McIntrye (1993) (see Lohr et al. 2001). More recently, the bull trout recovery planning team has expanded the focus of core areas to also address restoration activities and other prudent measures considered necessary for bull trout recovery. As a result of these efforts, the 141 subpopulations within the Columbia River DPS and the 34 Coastal-Puget Sound DPS subpopulations will have 88 and 14 core areas, respectively. Core areas are comprised on Local Populations. Bull trout core areas and local populations in Washington and Oregon that are at high risk of extirpation are identified in Table 9.

Table 9. Bull Trout Core Areas and Local Populations in the Programmatic BA Action Area at High Risk of Extirpation.

Washington Core Areas	Local Population/Critical Habitat
Dungeness	Dungeness River
	Gray Wolf River
Skokomish	NF Skokomish
	SF Skokomish
Stillaguamish	Upper Deer Creek
	NF Stillaguamish CH
Nooksack	SF Nooksack CH
	MF Nooksack CH
Walla Walla[1]	NF Touchet
	SF Touchet
	WF Touchet
	NF Touchet CH
	Mill Creek CH
Asotin	Charley Creek
	NF Asotin
Yakima	Ahtanum Creek
	Ahtanum Creek CH
	American River
	Box Canyon
	Bumping River
	Cle Elum River
	Crow Creek
	Gold Creek
	Kachess River
	NF Tieton
	Teanaway River
	Teanaway River CH
	Upper Yakima
	Upper Yakima CH
Wenatchee	Chiwaukum Creek
	Icicle Creek
	Little Wenatchee River
	Nason Creek
	Peshastin Creek
	White River
Entiat	Entiat River
	Mad River
Methow	Beaver Creek
	Chewuch River
	Early Winters Creek
	Goat Creek
	Gold Creek
	Lost River
	Upper Methow River
	Wolf Creek
Pend Oreille	Le Clerc Creek
	Le Clerc Creek CH
	Tacoma Creek CH
Priest Lake	Gold Creek

Table 9. Bull Trout Core Areas and Local Populations in the Programmatic BA Action Area at High Risk of Extirpation.

Washington Core Areas	Local Population/Critical Habitat
	Granite Creek
	Kalispell Creek
Grande Ronde	Upper Grande Ronde complex
	Indian Creek
	Catherine Creek
	Lookingglass Creek
Hood River	Clear Branch
	Hood River
Imnaha	Little Sheep Creek
	McCully Creek
Lower Deschutes	Shitike Creek
	Warm Springs River
Malheur River	Upper Malheur River
	North Fork Malheur River
Middle Fork John Day	Big Creek
	Granite Boulder Creek
	Clear Creek
North Fork John Day	Upper North Fork
	Upper Granite Creek
	Clear/Lightning
	Lower Clear
	Desolation Creek
	South Fork Desolation Creek
Odell Lake	Trapper Creek
Pine Creek	Upper Pine Creek
	Clear Creek
	East Pine Creek
	Elk Creek
Powder River	Upper Powder River
	North Powder River
	Big Muddy Creek
	Anthony Creek
	Wolf Creek
	Salmon Creek
	Pine Creek
	Lake Creek
Sycan Marsh/River	Long Creek
Umatilla	Upper Umatilla River Forks
	North Fork Meacham Creek
Upper John Day River	Upper John Day
	Indian Creek
Upper Klamath Lake	3-mile Creek
	Sun Creek
Upper Sprague River	Boulder-Dixon Creek
	Deming Creek
	Leonard Creek
	Brownsworth Creek
Upper Willamette	Trail Bridge Reservoir
	McKenzie River/ S.F. McKenzie River

[1]The Touchet Core Area was later incorporated into the Walla Walla Core Area

Columbia River DPS – The Service recognizes 141 sub-populations of bull trout in the Columbia River DPS within Idaho, Montana, Oregon, and Washington with additional sub-populations in British Columbia. Of these sub-populations, approximately 79 percent are unlikely to be reestablished if extirpated and 50 percent are at risk of extirpation from naturally occurring events due to their depressed status (USDI 1998a). Many of the remaining bull trout occur as isolated sub-populations in headwater tributaries, or in tributaries where the migratory corridors have been lost or restricted. Few bull trout sub-populations are considered "strong" in terms of relative abundance and sub-population stability. Those few remaining strongholds are generally associated with large areas of contiguous habitats such as portions of the Snake River Basin in Central Idaho, the Upper Flathead Rivers in Montana, and the Blue Mountains in Washington and Oregon. The listing rule characterizes the Columbia River DPS as generally occurring as isolated sub-populations, without a migratory life form to maintain the biological cohesiveness of the sub-populations, and with trends in abundance declining or of unknown status.

Extensive habitat loss and fragmentation of sub-populations have been documented for bull trout in the Columbia River basin and elsewhere within its range (Rieman and McIntyre 1993). Reductions in the amount of riparian vegetation and road construction in the Columbia River basin due to timber harvest, grazing, and agricultural practices have contributed to habitat degradation through elevated stream temperatures, increased sedimentation, and channel embeddedness. Mining activities have compromised habitat conditions by discharging waste materials into streams and diverting and altering stream channels. Residential development has threatened water quality by introducing domestic sewage and altering riparian conditions. Dams of all sizes (i.e., mainstem hydropower and tributary irrigation diversions) have severely limited migration of bull trout in the Columbia River basin. Competition from non-native trout (USDI 1998a) is also considered a threat to bull trout.

Generally, where status is known and population data exist, bull trout populations in the Columbia River DPS are declining (Thomas 1992, Pratt and Huston 1993, Schill 1992). Bull trout in the Columbia River basin occupy about 45 percent of their estimated historic range (Quigley and Arbelbide 1997). Quigley and Arbelbide (1997) considered bull trout populations strong in only 13 percent of the occupied range in the interior Columbia River basin. Rieman *et al.* (1997) estimated that populations were strong in 6 to 24 percent of the subwatersheds in the entire Columbia River basin.

Coastal/Puget Sound DPS – The Service has identified 34[1] subpopulations of native char (bull trout and/or Dolly Varden) within the Coastal/Puget Sound DPS. These subpopulations were grouped into five analysis areas based on their geographic location: Coastal, Strait of Juan de Fuca, Hood Canal, Puget Sound, and Transboundary. These groupings were made in order to identify trends that may be specific to certain geographic areas. In subpopulations where it is not known if the native char that occur there are bull trout, Dolly Varden or both, they are addressed together as “native char” in this discussion. This does not imply that both

exist within a subpopulation when the words "native char" are used, but merely that the subpopulation of char has not been positively identified as bull trout and/or Dolly Varden.

Genetic analysis has been conducted on nine of the 34 native char subpopulations. Samples from five of the nine subpopulations were determined to contain only bull trout (Green River, Queets River, Upper Elwha River, Cushman Reservoir and Lower Skagit River). Two were determined to contain only Dolly Varden (Canyon Creek and Upper Sol Duc River). The Upper Quinault River contained both bull trout and Dolly Varden. No samples had evidence of hybridization.

Within the Coastal/Puget Sound DPS, 12 of the 34 native char subpopulations are known to contain bull trout based on either genetic or morphometric measurement data. In seven of these 12 subpopulations, Dolly Varden is also believed to be present. In three out of the remaining 22 subpopulations, only Dolly Varden are currently known to be present. It should be noted that in most cases, identification was based on a limited number of samples, so it is possible that bull trout may also occur in the three subpopulations that to date, have only yielded Dolly Varden. The Service believes that the current identification trend of subpopulations within the Coastal/Puget Sound population segment indicates the high likelihood of bull trout being present in the majority of remaining subpopulations.

Within the Coastal/Puget Sound distinct population segment, 4 of the 34 delineated native char subpopulations are rated as "healthy" by WDFW, and the remaining 31 are of "unknown" status. Native char subpopulations rated as "healthy" by WDFW are: 1) Queets River; 2) Upper Dungeness River; 3) Cushman Reservoir on the Skokomish River; and, 4) the Lower Skagit River. Currently, all but the Upper Dungeness River subpopulation have been determined to consist of bull trout. The Service believes that the "healthy" status designation for the Queets River, Cushman Reservoir, and Upper Dungeness River subpopulations is not appropriate. Because of information indicating recent declines in the Cushman Reservoir subpopulation (WDFW 1998) and the lack of recent information for the Queets River subpopulation (general decline indicated by fish/day seining data between 1977 and 1991, and no trend information for 1991 to 1997) (WDFW 1998), an "unknown" rating better describes their status. The Upper Dungeness River subpopulation status is "tentatively considered healthy" by WDFW based on a single distributional and abundance survey conducted in 1996 (WDFW 1998).

2. Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*)

Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*), is an inland subspecies of cutthroat trout endemic to the physiographic Lahontan basin of northern Nevada, eastern California, and southern Oregon (USFWS 1995). It was initially listed as endangered under the Endangered Species Conservation Act of 1969 based on evidence of destruction and drastic modification of their habitat and hybridization with introduced species (35 Federal Register 13520). The species was reclassified as threatened in 1975 to facilitate management and allow regulated angling (40 Federal Register 29864). Critical habitat has not been designated for Lahontan cutthroat trout. The recovery plan for Lahontan cutthroat trout was published by the Service in January 1995. The species has been introduced into habitat outside of its native range, primarily for recreational fishing purposes.

Lahontan cutthroat trout is one of 14 recognized subspecies of cutthroat trout in the western United States. Cutthroat trout have the most extensive range of any inland trout species of western North America, and occur in anadromous, non-anadromous, fluvial, and lacustrine populations (Behnke 1979). Many of the basins in which cutthroat trout occur contain remnants of much more extensive bodies of water which were present during the wetter period of the late Pleistocene epoch (Smith 1978).

Differentiation of the species into 14 or so recognized subspecies occurred during subsequent general desiccation of the Great Basin and Inter-mountain Region since the end of the Pleistocene, and indicates presence of cutthroat trout in most of their historic range prior to the last major Pleistocene glacial advance (Behnke 1981, Loudenslager and Gall 1980). Ancestral Lahontan cutthroat trout probably invaded the pluvial Lake Lahontan system over 35,000 years ago (Gerstung 1986), although the precise events of entry and origin of original stock are unclear (Behnke 1979, Loudenslager and Gall 1980).

Lahontan cutthroat trout evolved in a range of habitat types, from cold-water, high elevation streams to warmer, more alkaline lake environments. It is likely that localized, natural events historically caused the local extirpation of small populations of Lahontan cutthroat trout. Those events included landslides and rock fall, fires, drought, and debris flows that restricted movement. Lahontan cutthroat trout population persistence is associated with the ability to maintain connectivity among populations, (i.e. networked populations). A networked system is defined as an interconnected, stream and/or stream lake system in which individuals can migrate from or disperse into areas from which fish have been extirpated (Ray *et. al.* 2000). This ability to disperse and repopulate habitats allows populations to persist (Neville-Arsenault 2003; Rieman and Dunham 1999; Ray *et. al.* 2000; Dunham *et. al.* 1997). Periodic repopulation by upstream or downstream sources enabled Lahontan cutthroat trout to survive extreme circumstances and provided for genetic exchange (Neville-Arsenault 2003).

Lahontan cutthroat trout historically occurred in most cold waters of the Lahontan Basin of Nevada and California, including the Humboldt, Truckee, Carson, Walker, and Summit Lake/Quinn River drainages. Large alkaline lakes, small mountain streams and lakes, small tributary streams, and major rivers were inhabited, resulting in the present highly variable subspecies. The fish occurred in Tahoe, Pyramid, Winnemucca, Summit, Donner, Walker, and Independence Lakes, but disappeared from the type locality, Lake Tahoe, about 1940 due primarily to blockage of spawning tributaries, and subsequently from Pyramid and Walker Lakes (Behnke 1979). The subspecies has been extirpated from most of the western portion of its range in the Truckee, Carson and Walker River Basins, and from much of its historic range in the Humboldt Basin. Only remnant populations remain in a few streams in the Truckee, Carson, and Walker Basins out of an estimated 1,020 miles of historic habitat (Gerstung 1986).

In Oregon, Lahontan cutthroat trout historically occurred in Coyote Lake subbasin including Whitehorse, Little Whitehorse, Fifteenmile, Doolittle, and Cottonwood creeks, Willow Creek and its tributary, and Antelope Creek. Fifteenmile Creek fish are restricted by a natural barrier to the first 700 meters above the mouth. Antelope Creek was stocked in 1972 with trout from Whitehorse Creek and a small population remains.

Following a genetic and taxonomic evaluation of Willow-Whitehorse cutthroat trout, these populations were determined to be Lahontan cutthroat trout (Williams 1991). Willow-Whitehorse cutthroat were afforded protection and threatened status as Lahontan cutthroat trout on November 4, 1991. Sources and mechanisms of stream colonization outside of the Lahontan Basin by Lahontan cutthroat are uncertain, but human transport is suspected. Resident stream populations have subsequently been used to stock other Willow-Whitehorse area streams during the seventies and early eighties. These transplanted populations are considered threatened until they are determined to be "experimental populations" released outside of the native range of the species for conservation purposes.

The severe decline in range and numbers of Lahontan cutthroat trout is attributed to a number of factors, including hybridization and competition with introduced trout species; loss of spawning habitat due to pollution from logging, mining, and urbanization; blockage of streams by dams; channelization; de-watering from irrigation and urban water withdrawal; and watershed degradation due to overgrazing of domestic livestock (Gerstung 1986; Wydoski 1978). Minshall *et al.* (1989) state that the major human impacts on Great Basin streams are due to irrigated farming and livestock grazing. In the Humboldt Basin in Nevada, and Behnke (1979) attribute the poor condition of most stream habitats primarily to effects of extensive long-term livestock grazing. However, in the Truckee, Carson, and Walker Basins, Gerstung (1986) does not include effects of livestock grazing as a factor in the decline of Lahontan cutthroat trout, but includes pollution, over fishing, construction of dams and diversions, and competition and hybridization with non-native trout species.

3. Borax Chub (*Gila boraxobius*)

Borax Lake is a geothermally-heated alkaline lake located in a series of more than 150 hot springs along the Alvord Basin floor. The lake comprises 10 acres of surface water fed almost entirely by geothermal groundwater inflow (35 to 40 degrees C), and is surrounded by salt crusts and perched 30 feet above the surrounding desert (Williams and Macdonald 2003).

The Borax Lake chub is endemic to Borax Lake and adjacent wetlands in Oregon's Alvord Basin. No other species of fish inhabit these waters. Borax Lake chub was formally described as a dwarf relative of the Alvord chub, which is widespread in the Alvord Basin (Williams and Bond 1980). The Borax Lake chub evolved from the Alvord chub when pluvial Lake Alvord receded, and fish were restricted to remaining springs, lakes and creeks. The fish that were restricted to Borax Lake were subject to extreme environmental conditions due to the geothermally-heated waters of Borax Lake, and thus they rapidly differentiated into the form now recognized as the Borax Lake chub.

The Borax Lake chub was listed as endangered in 1980 by emergency rule and again as endangered in 1982 by final rule pursuant to the Act. Primary threats at time of listing were potential impacts from geothermal energy development and diversion of the lake's outflows by alteration of the shoreline crust. The Borax Lake chub recovery plan was completed in 1987 (USDI 1987).

Critical habitat was designated on 640 acres of land surrounding the lake, including 320 acres of public lands and two 160-acre parcels of private lands. In 1983, the Bureau of Land Management (BLM) designated the public land around Borax Lake as an Area of Critical

Environmental Concern. The Nature Conservancy began leasing the private lands in 1983, and purchased them in 1993.

Intensive population monitoring was conducted on this species from 1986 through 1997. Additional physical and biological monitoring occurred during this period. Monitoring was terminated in 1997 when the potential geothermal energy developer decided to abandon its plans in the area.

4. **Lost River Sucker *(Deltistes luxatus)***

Listing Status and Description – The Lost River sucker was listed as endangered by the U.S. Fish and Wildlife Service in 1988 (USDI 1988). Critical habitat has not been designated. The Lost River sucker is a large sucker that may reach over 0.9 m (3 ft). It is characterized by a long, slender head with a sub terminal mouth and long, rounded snout. The coloring is dark on the back and sides, fading to white or yellow on the belly.

Population Trends and Distribution – The only species in the genus *Deltistes*, the Lost River sucker is native to Upper Klamath Lake and its tributaries. Early records from the Upper Klamath River Basin indicate that the Lost River sucker was common and abundant. This sucker also historically inhabited the Lost River watershed, Tule Lake, Lower Klamath Lake, and Sheepy Lake (Moyle 1976), but is not considered native to the Klamath River, although it is now found there, at least downstream to Copco Reservoir (Beak 1987). The majority of the population occurs in Upper Klamath Lake, with a few in J.C. Boyle Reservoir and Copco Reservoir. They are primarily deep lake and impoundment residents that spawn in associated rivers, streams, or springs, including the Williamson and Sprague Rivers. They spawn in swift stretches with rubble or compacted cobble substrate, preferentially on loose gravel when available. They also spawn in spring inflows along the shore of Upper Klamath Lake. Spawning has been observed between April and early May.

Reasons for Decline – Although a number of factors have contributed to the decline of the Lost River sucker, habitat degradation is considered the primary cause. Streams, rivers, and lakes have been modified by channelization and dams. Grazing in the riparian zone has eliminated streambank vegetation, and has added nutrients and sediment to river systems. Gilbert (1898) noted that the Lost River sucker was "the most important food-fish of the Klamath Lake region". Several commercial operations processed "enormous amounts" of suckers into oil, dried fish, canned fish, and other products (Andreasen 1975; Howe 1968). Currently, less than 75,000 acres of wetlands remain in the Basin (USDI 1992).

Recovery Measures – Conservation efforts for the Lost River sucker focus on the re-establishment of a more naturally functioning ecosystem in the Klamath Basin. Fencing portions of streams to reduce cattle-caused erosion, replanting streambanks with native vegetation, improving forestry and agricultural practices, and assuring adequate water levels in reservoirs will contribute to the recovery of this species. Through coordination of the actions of land use agencies and private landowners, further degradation of sucker habitat can be avoided and steps can be taken to improve current conditions. By minimizing the impacts of future modifications to spawning habitat and restoring waters to a more natural state, recovery of Lost River sucker populations is possible in the Klamath Basin.

5. **Shortnose Sucker *(Chasmistes brevirostris)***

Listing Status and Description – The shortnose sucker was listed as endangered by the U.S. Fish and Wildlife Service in 1988 (USDI 1988). The shortnose sucker is characterized by a terminal mouth with thin lips having weak or no papillae. The shortnose sucker is primarily a lake resident that spawns in associated rivers, streams, or springs. Individuals in spawning condition occur in swift current over gravel and rubble bottom (Lee *et al.* 1980). Spawning runs have been observed from mid-April to mid-May.

Population Trends and Distribution – It historically occurred in Upper Klamath Lake and its tributaries (Miller and Smith 1981). Its historic range likely included Lake of the Woods, Oregon, and probably the Lost River system (Scoppettone and Vinyard 1991). Early records from the Upper Klamath River Basin indicate that the shortnose suckers were common and abundant. Several commercial operations processed "enormous amounts" of suckers into oil, dried fish, canned fish, and other products (Andreasen 1975; Howe 1968). The current distribution of the shortnose sucker includes Upper Klamath Lake and its tributaries, Klamath River downstream to Iron Gate Reservoir, Clear Lake Reservoir and its tributaries, Gerber Reservoir and its tributaries, the Lost River, and Tule Lake. Gerber Reservoir represents the only habitat with a shortnose sucker population that does not also have a Lost River sucker population.

Reasons for Decline – Although a number of factors have contributed to the decline of the shortnose sucker, habitat degradation is considered its primary cause. Streams, rivers, and lakes have been modified by channelization and dams. Grazing in the riparian zone has eliminated streambank vegetation, and has added nutrients and sediment to river systems.

Recovery Measures – A recovery plan was published in 1993. Critical habitat has not been designated. Conservation efforts for the shortnose sucker focus on the re-establishment of a more naturally functioning ecosystem in the Klamath Basin. Fencing portions of streams to reduce cattle-caused erosion, replanting streambanks with native vegetation, improving forestry and agricultural practices, and assuring adequate water levels in reservoirs will contribute to the recovery of this species.

6. **Warner Sucker (*Catostomus warnerensis*)**

Listing Status and Description – The FWS listed the Warner sucker as a threatened species and designated critical habitat on September 27, 1985 (USDI 1985). The Warner sucker is a slender-bodied species that attains a maximum recorded fork length of 456 millimeters (17.9 inches). Pigmentation of sexually mature adults can be striking. The dorsal two-thirds of the head and body are blanketed with dark pigment, which borders creamy white lower sides and belly. During the spawning season, males have a brilliant red (or, rarely, bronze) lateral band along the midline of the body, female coloration is lighter.

Population Trends and Distribution – The probable historic range of the Warner sucker includes the main Warner Lakes (Pelican, Crump, and Hart), and other accessible standing or flowing water in the Warner Valley, as well as the low to moderate gradient reaches of the tributaries which drain into the Warner Valley. Warner sucker historic distribution in tributaries includes Deep Creek (up to the falls west of Adel), the Honey Creek drainage, and the Twentymile Creek drainage. In Twelvemile Creek, a tributary to Twentymile Creek, the historic range of Warner sucker extended through Nevada and back into Oregon. Stream

resident populations of Warner sucker are found in Honey Creek, Snyder Creek, Twentymile Creek and Twelvemile Creek. Intermittent streams in the drainages may support small numbers of migratory suckers in high water years. No stream resident Warner sucker have been found in Deep Creek since 1983 (Smith *et al.* 1984, Allen *et al*. 1994), although a lake resident female apparently trying to migrate to stream spawning habitat was captured and released in 1990 (White *et al*. 1990). The known upstream limit of the Warner sucker in Twelvemile Creek is through the Nevada reach and back into Oregon (Allen *et al*. 1994).

Reasons for Decline – General stream channel and watershed degradation from livestock grazing has caused hydrologic impacts to sucker habitat. In addition, numerous small, agricultural diversion dams on creeks reduce stream flows and prevent migrations of adults and young. In lake habitats, non-native brown bullhead and crappie are abundant. The crappie and brown bullhead are presumed predators on young suckers.

Recovery Measures – Completed actions include fencing of streams to restore riparian vegetation, acquisition of ephemeral lake habitat, and construction of a fishway for passage over a diversion dam on Twentymile Creek. The Bureau of Land Management and the US Forest Service have altered their grazing and forest management practices to improve habitat for Warner suckers. Additional conservation measures needed include improving stream habitat and watershed conditions throughout the Warner Basin, re-establishing migration corridors, screening irrigation diversions, controlling exotic fishes, and maintaining adequate water supplies for fish.

Warner sucker critical habitat includes the following areas: Twelvemile Creek from the confluence of Twelvemile and Twentymile Creeks upstream for about six stream kilometers (four stream miles); Twentymile Creek starting about 14 kilometers (nine miles) upstream of the junction of Twelvemile and Twentymile Creeks and extending downstream for about 14 kilometers (nine miles); Spillway Canal north of Hart Lake and continuing about three kilometers (two miles) downstream; Snyder Creek, from the confluence of Snyder and Honey Creeks upstream for about five kilometers (three miles); Honey Creek from the confluence of Hart Lake upstream for about 25 k

7. **Oregon Chub (*Oregonichthys crameri*)**

The Oregon chub is a small minnow (Family: Cyprinidae) endemic to the Willamette River drainage of western Oregon (Markle *et al.* 1991). Oregon chub evolved in a dynamic network of slack water habitats in the floodplain of the Willamette River. Major alteration of the Willamette River for flood control and navigation improvements has eliminated a large proportion of the river's historic floodplain. This alteration has also impaired or eliminated the environmental conditions in which the Oregon chub evolved. Many of the remaining suitable habitats have been invaded by non-native fish predators and competitors.

Oregon chub are found in slack water off-channel habitats such as beaver ponds, oxbows, side channels, backwater sloughs, low gradient tributaries, and flooded marshes. These habitats usually have little or no water flow, silty and organic substrate, and considerable aquatic vegetation as cover for hiding and spawning (Pearsons 1989, Markle *et al.* 1991, Scheerer and McDonald 2000). The average depth of Oregon chub habitats is typically less than two meters (six feet) and the summer temperatures typically exceed 16 degrees Celsius (61 degrees Fahrenheit). Adult Oregon 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 near shore areas in the upper layers of the water column in shallow areas (Pearsons 1989, Scheerer 1997). Juvenile Oregon chub venture farther from shore into deeper areas of the water column (Pearsons 1989). In the winter months, Oregon chub can be found buried in the detritus or concealed in aquatic vegetation (Pearsons 1989). Fish of similar size classes school and feed together. In the early spring, Oregon chub are most active in the warmer, shallow areas of the ponds.

Oregon chub spawn from April through September. Before and after spawning season, chub are social and non-aggressive. Spawning activity has only been observed at temperatures exceeding 16 degrees Celsius (61 degrees Fahrenheit). Males over 35 millimeters (1.4 inches) have been observed exhibiting spawning behavior (Pearsons 1989).

Oregon chub are obligatory sight feeders (Davis and Miller 1967). They feed throughout the day and stop feeding after dusk (Pearsons 1989). 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). The diet of juvenile chub also consists of minute organisms such as rotifers, copepods, and cladocerans (Pearsons 1989).

The action area includes all streams, rivers, ponds, reservoirs, and other bodies of water within the Willamette River Basin, which as noted above constitutes the entire historic range for the chub, since they are endemic to the Willamette River drainage. Provided below is a summary of the actions currently contributing to the environmental baseline for Oregon chub.

Oregon chub are restricted to the Willamette River drainage, including the Santiam, Coast Fork Willamette, Middle Fork Willamette, Long Tom, Mohawk, and McKenzie Rivers and their tributaries. Historically, the rivers meandered freely within the main floodplain and likely changed courses frequently as flood events occurred, especially prior to construction of numerous dams in the river systems in the 1950's and 1960's. The presence of the dams has altered the flood regime, reduced the amount of available chub habitat, and restricted chub access to existing habitat. The proliferation of introduced predators and competitors in these systems (e.g., largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*), crappie (*Pomoxus sp*.), mosquitofish (*Gambusia affinis*)) has posed an additional and significant threat to Oregon chub. Other threats include illegal water withdrawals, unauthorized fill and removal activities, timber harvest, highway and pipeline construction, roadside herbicide applications, chemical spills, and routine culvert maintenance operations (50 CFR 53800, October 18, 1993).

At present, Oregon chub occur at approximately 29 locations, including 21 naturally occurring populations and eight introduced populations (Scheerer *et al.* 2004). All populations exist within the Willamette River system and its tributaries. The naturally occurring populations are found in the North and mainstem Santiam River, Middle Fork Willamette River, McKenzie River, and the mid-Willamette drainages. Eight populations of Oregon chub have been introduced into habitats within the Willamette Basin at Wicopee Pond, Fall Creek Spillway Pond, Foster Pullout Pond, Dunn Wetland, Finley Display Pond, Cheadle Pond, Herman Pond, and Russell Pond. In addition, two introductions were

conducted during 2004 at Jampolsky Pond and Ankeny Willow Marsh. In 2004, 15 populations of Oregon chub were larger than 500 individuals. Twelve of these populations exhibited stable or increasing trends over the last five years. Oregon chub appear to have been extirpated from 14 locations at which they were detected in the 1990's (Scheerer *et al.* 2004).

Of the 29 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). Beaver (*Castor canadensis*) appear to be especially important in creating and maintaining habitats that support these diverse native species assemblages (Scheerer and Apke 1998). In contrast, sites with high abundance of exotic predaceous fish species, particularly centrarchids (bass, bluegills, crappies, and others) have few to no Oregon chub.

A variety of Federal actions have been the subject of section 7 consultation on Oregon chub. These include dam re-licensing, fish screen installation/upgrades, fish passageways, mining, road and bridge construction and maintenance, wastewater treatment plant operations, dredging, scientific studies, and habitat restoration. The majority of the effects of these actions on Oregon chub have been "no effect" or "not likely to adversely effect." A small number of consultations have resulted in "likely to adversely affect" determinations in the short term, but with anticipated long term benefits to the species (e.g., section 10(a) (1) (A) recovery permits, habitat restorations). The Service is currently consulting with the U.S. Army Corps of Engineers on the hydroelectric operations in the Willamette Valley, which has resulted in a "likely to adversely affect" determination. There have also been numerous technical assistance consultations.

8. Foskett Speckled Dace (*Rhinichthys osculus*)

The Foskett speckled dace is endemic to one spring on the western margin of Coleman Lake, Lake County, Oregon. The Foskett speckled dace was listed as threatened in 1985 (USDI 1985). Population size and age structure for this species were last assessed in 1997, by ODFW (Dambacher *et al.* 1997). The recovery plan for Foskett speckled dace was finalized in 1998 (USDI 1998). No critical habitat has been designated or proposed for the Foskett speckled dace.

Little is known about the biology or ecology of the Foskett speckled dace. Foskett Spring is a cool-water spring with temperatures recorded at a constant 18 degrees Celsius over a 2-year period. No information is available on growth rates, age of reproduction, or behavioral patterns. Monitoring has been limited since 1997 to periodic inspection of the dace habitat, along with photo point and vegetation sampling by the Lakeview District BLM.

The Foskett speckled dace is an allopatric form that is currently being described (hence, it has not yet received a subspecific name). Despite the undescribed status there is information regarding its identification. The Foskett dace can be distinguished from other speckled dace by external characteristics, such as: much reduced lateral line, about 15 scales with pores; about 65 lateral line scales; a large eye; the dorsal fin is positioned well behind the pelvic fin but before the beginning of the anal fin; barbels are present on most individuals (USDI 1998).

The timing of the isolation between the Warner Lakes Subbasin and the Coleman Subbasin is uncertain although it might be as recent as 10,000 years ago (Bills 1977). Foskett speckled dace were probably distributed throughout prehistoric (approximately 12,000 years ago) Coleman Lake during times that it held substantial amounts of water. As the lake dried, the salt content of the lake water increased. Suitable habitat would have been reduced from a large lake to any spring systems that provided enough suitable habitat for survival.

Springs that remain within the vicinity of Coleman Lake include Foskett Spring and Dace Spring. Both springs are extremely small and shallow with limited habitat for fish. Foskett Spring has the only known native population of Foskett speckled dace. The spring originates in a pool about 5 meters (16.6 feet) across, then flows toward Coleman Lake in a narrow, shallow channel (approximately 5 centimeters (2 inches) deep and 5 centimeters (2 inches) wide). The source pool has a loose sandy bottom and is choked with macrophytes. The spring brook (outflow channel) eventually turns into a marsh and dries up before reaching the bed of Coleman Lake. Bond (USDI 1985) estimated the population of Foskett speckled dace in Foskett Spring to be approximately 1,500 individuals. Dambacher (1997) estimated 204 Foskett speckled dace in the source pool, 702 in the spring brook, and 26,881 in the shallow pool/marsh. This habitat is outside the exclosure fence and dries periodically.

Dace Spring is approximately 0.8 kilometer (0.5 mile) south of Foskett Spring. This spring may have originally been occupied by Foskett speckled dace but there were none found in the 1970's. In November 1979, 50 Foskett speckled dace were transplanted into the then fishless Dace Spring from Foskett Spring (Williams *et al.* 1990). In August 1980, 50 more Foskett speckled dace were introduced into Dace Spring. Dace Spring is smaller than Foskett Spring and even more choked with macrophytes. The spring outflow terminates in a cattle watering trough where fewer than 20 Foskett speckled dace were seen in 1996 (Dambacher 1997). The watering trough is at approximately the same height/elevation as the spring head with a pipe entering into the side of the trough. This allows the fish access into the trough, but does not allow the fish to return to the spring.

Current management of the Foskett and Dace spring systems excludes livestock use. Proposals to burn dense vegetation, place flow-monitoring weirs, and develop open water pools have yet to be implemented or fully evaluated.

9. Chinook Salmon (*Oncorhynchus tshawytscha*)

Chinook salmon in streams and rivers are generally divided into two races: spring and fall run Chinook salmon. Spring Chinook enter freshwater from April though June are usually associated with larger rivers and streams that have adequate summer flows and deep resting pools for adults during the summer. Fall Chinook enter freshwater from September through December and use many of the medium-sized and larger streams with access from the ocean through low gradient stream habitat. Their annual spawning distribution in smaller streams is dependent on the amount of fall rains and resultant streamflow.

Spring Chinook spawn in the early fall, earlier than fall Chinook in most rivers. Fall Chinook spawn from early fall to mid-winter. Chinook salmon are semelparous and die after spawning. Chinook fry emerge in late winter to early spring and typically begin a downstream migration to the river estuary or the ocean. Variations from this occur in all populations with some fry remaining in freshwater for a year. Chinook salmon fry and parr

generally rear in larger streams and rivers. The typical life cycle for Chinook salmon is to spend a few months in freshwater and two to five years in saltwater and thus they are ocean rearing. Many variations occur in the freshwater rearing timing, and precocious males return from the ocean a year or two early as jacks.

a. **Lower Columbia River Chinook Salmon** – The lower Columbia River is characterized by numerous short- and medium-length rivers that drain the coast ranges and the west slope of the Cascade Mountains. The LCR Chinook salmon ESU includes all native populations from the mouth of the Columbia River to the crest of the Cascade Range, excluding populations above Willamette Falls. The former location of Celilo Falls (inundated by The Dalles reservoir in 1960) is the eastern boundary for this ESU. Stream-type, spring-run Chinook salmon found in the Klickitat River or the introduced Carson spring-run Chinook salmon strain is not included in this ESU. Spring-run Chinook salmon in the Sandy River have been influenced by spring-run Chinook salmon introduced from the Willamette River ESU. However, analyses suggest that considerable genetic resources still reside in the existing population (Myers *et al.* 1998). Recent escapements above Marmot Dam on the Sandy River average 2,800 and have been increasing (ODFW 1998). Tule fall Chinook from the LCR Chinook salmon ESU were observed spawning in the Ives Island area during October 1999. The Hardy/Hamilton Creeks/Ives Island complex is located along the Washington shoreline approximately 2 miles below Bonneville Dam.

   Historical records of Chinook salmon abundance are sparse, but cannery records suggest a peak run of 4.6 million fish in 1883. Although fall-run Chinook salmon are still present throughout much of their historical range, most of the fish spawning today are first-generation hatchery strays. Furthermore, spring-run populations have been severely depleted throughout the ESU and extirpated from several rivers.

   Most fall-run fish in the LCR Chinook salmon ESU emigrate to the marine environment as sub yearlings (Reimers and Loeffel 1967; Howell *et al.* 1985; WDF *et al.* 1993). Returning adults that emigrated as yearling smolts may have originated from the extensive hatchery programs in the ESU. It is also possible that modifications in the river environment have altered the duration of freshwater residence. Coded-wire tag (CWT) recoveries of LCR Chinook salmon ESU fish suggest a northerly migration route, but (based on CWT recoveries) the fish contribute more to fisheries off British Columbia and Washington than to the Alaskan fishery. Tule fall Chinook salmon return at adult ages 3 and 4; "bright" fall Chinook return at ages 4 and 5, with significant numbers returning at age 6. Tule and bright Chinook salmon are distinct in their spawn timing.

   As in other ESUs, Chinook salmon have been affected by the alteration of freshwater habitat (Bottom *et al.* 1984; WDF *et al.* 1993; Kostow 1995). Timber harvesting and associated road building peaked in the 1930s, but effects from the timber industry remain (Kostow 1995). Agriculture is widespread in this ESU and has affected riparian vegetation and stream hydrology. The ESU is also highly affected by urbanization, including river diking and channelization, wetland draining and filling, and pollution (Kostow 1995).

The LCR Chinook salmon ESU has been subject to intensive hatchery influence. Hatchery programs to enhance Chinook salmon fisheries in the lower Columbia River began in the 1870s, releasing billions of fish over time. That equals the total hatchery releases for all other Chinook ESUs combined (Myers *et al.* 1998). Although most of the stocks have come from inside the ESU, more than 200 million fish from outside the ESU have been released since 1930 (Myers *et al.* 1998).

For the LCR Chinook salmon ESU as a whole, NMFS estimates that the median population growth rate (lambda) over the base period ranges from 0.98 to 0.88, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure *et al.* 2000).

Critical Habitat. There are 48 watersheds within the range of this ESU. Four watersheds received a low rating, 13 received a medium rating, and 31 received a high rating of conservation value to the ESU (NMFS, 2005). The lower Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in one of the high value watersheds.

b. Upper Columbia River Spring-Run Chinook Salmon - The UCR Spring-run Chinook salmon ESU was listed as endangered on March 24, 1999 (64 FR14308). This ESU's endangered status was reaffirmed on June 28, 2005 (70 FR 37160). This ESU includes all natural-origin, stream-type Chinook salmon from river reaches above Rock Island Dam and downstream of Chief Joseph Dam, including the Wenatchee, Entiat, and Methow River basins. NMFS has identified three important spawning populations within this ESU: the Wenatchee, Entiat, and Methow populations (ICTRT 2003).

The Spring-run components of the following hatchery stocks are also listed: Chiwawa, Methow, Twisp, Chewuch, and White Rivers, and Nason Creek. Adult and juvenile UCR Spring-run Chinook salmon migrate through the action area.

The UCR Spring-run Chinook salmon exhibit classic stream-type life-history strategies: emigrating from freshwater as yearling smolts and undertaking extensive offshore ocean migrations. The majority of these fish mature at four years of age and return to the Columbia River from March through mid-May.

In July 2005, the ICTRT defined minimum abundance thresholds for Interior Columbia Basin stream-type Chinook populations. These numbers are intended to be a surrogate for the number and productivity of naturally produced spawners that may be needed for recovery, in the context of whatever take or mortality is occurring. They should not be considered in isolation, as they represent the numbers that, taken together, may be needed for the population to be self-sustaining in its natural ecosystem. For UCR Spring-run Chinook salmon, the minimum abundance thresholds are 2,000 spawners in the Wenatchee River, 500 spawners in the Entiat River, and 2,000 spawners in the Methow River.

All three of the existing UCR Spring-run Chinook salmon populations have exhibited similar trends and patterns in abundance over the past 40 years. The 1998 status review

(Myers *et al.* 1998) reported that long-term trends in abundance were generally negative. Analyses of the data series, updated to include 1996-2001 returns, indicate that those trends have continued. Based on redd count data series, spawning escapements for the Wenatchee, Entiat, and Methow rivers have declined an average of 5.6 percent, 4.8 percent, and 6.3 percent per year, respectively, since 1958. In the most recent 5-year geometric mean (1997-2001), spawning escapements were 273 for the Wenatchee population, 65 for the Entiat population, and 282 for the Methow population, only 8 percent to 15 percent of the minimum abundance thresholds, although escapement increased substantially in 2000 and 2001 in all three river systems. Based on 1980-2000 returns, the average annual growth rate for this ESU is estimated as 0.85 (a growth rate of less than 1.0 is non-viable). Assuming that population growth rates were to continue at 1980-2000 levels, UCR Spring-run Chinook salmon populations are projected to have very high probabilities of decline within 50 years (87 percent to 100 percent), and the ESU is likely to go extinct.

Critical Habitat. There are 31 watersheds within the range of this ESU. Five watersheds received a medium rating and 26 received a high rating of conservation value to the ESU (NMFS, 2005). The Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in 15 of the high value watersheds identified.

c. **Upper Willamette River Spring Chinook Salmon** - Fish in this ESU are distinct from those of adjacent ESUs in life history and marine distribution. The UWR spring Chinook life history includes traits from both ocean- and stream-type development strategies. Coded wire tag recoveries indicate that the fish travel to the marine waters off British Columbia and Alaska. More Willamette River fish are recovered in Alaskan waters than that of any populations from the Lower Columbia River ESU. UWR spring Chinook salmon mature in their fourth or fifth years. Historically, five-year-old fish dominated the spawning migration runs, but recently, most fish have matured at age four. The timing of the spawning migration is limited by Willamette Falls. High flows in the spring allow access to the Upper Willamette Basin, whereas low flows in the summer and autumn prevent later-migrating fish from ascending the falls. The low flows serve as an isolating mechanism, separating this ESU from others nearby.

UWR spring Chinook salmon migrate through and rear in the Willamette River within the action area for all populations above Willamette Falls, but not those in the Clackamas River. In the past, these populations included sizable numbers of spawning salmon in the North and South Santiam Rivers, the Middle Fork of the Willamette River, and the McKenzie River, as well as smaller numbers in the Molalla River, Calapooia River, and Albiqua Creek. Total run size, based on estimates of UWR Chinook entering the Columbia, have ranged from 30,000 to 130,000 between 1970-1990, and in the last decade estimates similarly ranged from 35,000 (1997) to 144,000 (2004). Since 1970, the percent of the run above Willamette Falls has averaged 58%, with a range from 48% to 76% (ODFW 2004c).

In 2003, approximately 12% of the estimated 126,000 returning to the mouth of the Columbia, or about 15,050 returning adults, were natural spawners in the Willamette Basin (ODFW 2004c). Marking hatchery releases with an adipose fin clip reached 100%

beginning with those released in 1998, and age 5 fish returning in 2003 set a record high for the database begun in the 1950s (ODFW 2004c).

Hatchery production in the basin began in the late nineteenth century. Eggs were transported throughout the basin, resulting in current populations that are relatively homogeneous genetically, although still distinct from those of surrounding ESUs. Hatchery production of Chinook continues in the Willamette River, with an average of 8.4 million smolts and fingerlings released each year into the main river or its tributaries between 1975 and 1994. Currently, hatcheries are responsible for up to 90% of escapement in the basin, and about 96% of the age 3-6 hatchery spring Chinook returning in 2003 had adipose fins clipped (ODFW 2004c).

Harvest on this ESU was high in the recent past, both in the ocean and in river. From 1981-1997, freshwater harvest rate averages ranged from 37% to 54% on the Clackamas, North Santiam, and McKenzie Rivers, but since 1998 rates have ranged from 6% to 16% (ODFW 2004c). Ocean harvest was estimated as between 19 and 33% since 1982. Previously, harvest management lacked coordination across jurisdictions, and pressure to increase or sustain harvests during periods of lower production resulted in high harvests and low escapements. Harvest management has undergone reforms, and now employs principles of weak stock management. These require that mixed stock fisheries are managed based on the needs of natural-origin stocks, and where possible, for total harvest mortality across all fisheries (NMFS 2005a). Before full marking of hatchery fish with an adipose fin clip, harvest occurred on both wild and hatchery fish. Beginning in 2002, only spring Chinook that were adipose fin-clipped were allowed to be retained in all freshwater fisheries, while unmarked fish were required to be released unharmed. Estimates of impacts on wild spring Chinook in 2003 were under 5% (ODFW 2004c). The 2005-2007 Interim Management Agreement set the Columbia River take maximum at 15% of total run size (NMFS 2005a).

In 2003, the BRT reviewed data of historical spring Chinook salmon populations including: Clackamas, Molalla, North Santiam, South Santiam, Calapooia, McKenzie, and Middle Fork Willamette Rivers. Populations returning to the McKenzie, the North and South Santiam, the Calapooia, and the Middle Fork Willamette Rivers will pass the proposed mining site. The only population considered potentially self-sustaining is the McKenzie, yet its abundance has been relatively low with a substantial input from hatchery populations (BRT 2003). This population will be in the action area as adults migrating upstream and as juveniles rearing and migrating.

The Technical Recovery Team (TRT) determined that of the seven historical populations of Chinook salmon in the upper Willamette River, just two populations are extant (Myers *et al.* 2003). The McKenzie River has had a recent production of 1,440 fish of natural origin, and the TRT has set the 20-year target at 7,700 fish. For the Clackamas River population, the recent abundance was 1,453 fish, and the 20-year target is 7,800 fish. The majority of fish in the other five populations are believed to be of hatchery origin. The

TRT identified the McKenzie River population as a core and legacy population,2 describing their importance to maintaining the evolutionary legacy of the ESU, and their need for prioritization in recovery efforts (WLC-TRT 2003). Other core populations are the Clackamas, the N. Santiam and the Middle Fork Willamette Rivers.

Substantial increases for the UWR Chinook were seen from 2001 to 2004, and the BRT hypothesized these resulted from increased ocean survival. Since ocean survival in the future is unknown, the long-term sustainability of this population is uncertain. For 2005, pre-season UWR Chinook estimates were not met by returns in early June. Revised model projections indicated the run will be about 60% of the preseason forecast, with only approximately 30,000 adult fish counted at Willamette Falls compared to the 2004 count of 79,000 (ODFW 2005, CRM 2005a). Forecasts have generally under-predicted when the run was increasing and over-predicted when the run was decreasing, based on trends from 1980 to 2004 (ODFW 2004c).

Although the BRT did not assess the ratio of hatchery-origin to wild-origin Chinook passing the falls, it asserted that hatchery-origin fish dominate the run. Hatchery spring-run Chinook salmon are released in the Upper Willamette River as mitigation for the loss of habitat above Federal dams. While harvest retention is only allowed for hatchery marked fish, take of natural spawners from hooking mortality and non-compliance also occurs. Overall, the hatchery production is considered a potential risk because it masks the productivity of natural population, interbreeding between hatchery and natural fish poses potential genetic risks, and incidental take from the fishery promoted by the hatchery production can increase adult mortality.

Present to historical habitat ratios3 for individual tributaries were reported to be from 46% on the Middle Fork Willamette, to 74% on the McKenzie. Hatchery fractions were reported in the range of 26% on the McKenzie, to 97% on the North Santiam (BRT 2003, Table A.2.6.1). For the UWR spring-run Chinook salmon ESU as a whole, NMFS estimated that the median population growth rate (lambda) over the base period ranges from 1.01 to 0.63, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure *et al.* 2000).

Historically, the Willamette River basin provided sufficient spawning and rearing habitat for large numbers of spring-run Chinook salmon. Mattson (1948) estimated that the spring Chinook salmon run in the 1920s may have been five times the existing run size of 55,000 fish (in 1947).

Prior to laddering of Willamette Falls, passage by returning adult salmonids was only possible during winter and spring high-flow periods. Willamette Falls may have been formed by the receding floodwaters of the Bretz Floods (12m000 – 15,000 years before

2. Populations identified by the Willamette/Lower Columbia TRT (McElhany et al., 2003) as 'core' populations were historically abundant or contained life history strategies that were specific to the ESU and may offer the most likely path to recovery.

3 The present to historical habitat ratio is the percent of the historical habitat that is currently available.

present) (Nigro2001). This isolation has provided the potential for significant local adaptation relative to other Columbia River populations.

Critical Habitat. There are 60 watersheds within the range of this ESU. Nineteen watersheds received a low rating, 18 received a medium rating, and 23 received a high rating of conservation value to the ESU (NMFS, 2005). The lower Willamette/Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in 4 of the high value watersheds identified.

d. Puget Sound Chinook Salmon – The Puget Sound chinook salmon was listed as a threatened under the Endangered Species Act (ESA) on March 24, 1999. The ESU includes all naturally spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington. Chinook salmon (and their progeny) from the following hatchery stocks are considered part of the listed ESU: Kendall Creek (spring run); North Fork Stillaguamish River (summer run); White River (spring run); Dungeness River (spring run); and Elwha River (fall run).

The Skagit River and its tributaries--the Baker, Sauk, Suiattle, and Cascade Rivers--constitute what was historically the predominant system in Puget Sound containing naturally spawning populations. Spring-run chinook salmon are present in the North and South Fork Nooksack Rivers, the Skagit River Basin, the White, and the Dungeness Rivers. Spring-run populations in the Stillaguamish, Skokomish, Dosewallips, and Elwha Rivers are thought to be extinct. Summer-run chinook salmon are present in the Upper Skagit and Lower Sauk Rivers in addition to the Stilliguamish and Snohomish Rivers. Fall-run stocks (also identified by management agencies as summer/fall runs in Puget Sound) are found throughout the region in all major river systems. Adult spring-run chinook salmon in the Puget Sound typically return to freshwater in April and May and spawn in August and September. Adults migrate to the upper portions of their respective river systems and hold in pools until they mature. In contrast, summer-run fish begin their freshwater migration in June and July and spawn in September, while summer/fall-run chinook salmon begin to return in August and spawn from late September through January.

The majority of Puget Sound fish emigrate to the ocean as subyearlings. Many of the rivers have well-developed estuaries that are important rearing areas for emigrating ocean-type smolts. In contrast, the Suiattle and South Fork Nooksack Rivers have been characterized as producing a majority of yearling smolts. The reason for this difference is unknown. Glacially influenced conditions on the Suiattle River may be responsible for limiting juvenile growth, delaying smolting, and producing a higher proportion of 4- and 5-year-olds compared to other Chinook salmon stocks in Puget Sound, which mature predominantly as 3- and 4-year-olds.

Anthropogenic activities have limited the access to historical spawning grounds and altered downstream flow and thermal conditions. Water diversion and hydroelectric dams have prevented access to portions of several rivers. Furthermore, the construction of

Cushman Dam on the North Fork Skokomish River may have resulted in a residualized population of Chinook salmon in Lake Cushman. Watershed development and activities throughout Puget Sound, Hood Canal, and Strait of Juan de Fuca regions have resulted in increased sedimentation, higher water temperatures, decreased large woody debris (LWD) recruitment, decreased gravel recruitment, a reduction in river pools and spawning areas, and a loss of estuarine rearing areas.

Overall abundance of chinook salmon in this ESU has declined substantially from historical levels, and many populations are small enough that genetic and demographic risks are likely to be relatively high. Contributing to these reduced abundances are widespread stream blockages, which reduce access to spawning habitat, especially in upper reaches. Both long- and short-term trends in abundance are predominantly downward, and several populations are exhibiting severe short-term declines. Spring-run chinook salmon populations throughout this ESU are all depressed.

Critical Habitat. There are 61 watersheds within the range of this ESU. Twelve watersheds received a low rating, 9 received a medium rating, and 40 received a high rating of conservation value to the ESU (NMFS, 2005). Nineteen near shore marine areas also received a rating of high conservation value.

e. **Snake River Fall-Run Chinook Salmon** – Snake River fall Chinook spawn above Lower Granite Dam in the mainstem Snake River and in the lower reaches of the larger tributaries. Adult fall Chinook salmon enter the Columbia River in July and August. Spawning occurs from October through November. Juveniles emerge from the gravels in March and April of the following year, moving downstream from natal spawning and early rearing areas from June through early fall.

Fall Chinook salmon returns to the Snake River generally declined through the first half of the 1900's (Irving and Bjornn 1981). In spite of the declines, the Snake River basin remained the largest single natural production area for fall Chinook salmon in the Columbia drainage into the early 1960s (Fulton 1968). Spawning and rearing habitat for Snake River fall Chinook salmon was significantly reduced by the construction of a series of Snake River mainstem dams which blocked passage to historical spawning located on the upper Snake River. Currently, natural spawning is limited to the area from the upper end of Lower Granite Reservoir to Hells Canyon dam and the lower reaches of the Imnaha, Grande Ronde, Clearwater and Tucannon Rivers.

SR fall Chinook salmon return from the ocean and between 2-5 years of age and typically enter the Columbia River in July and August and reach the mouth of the SR between late August and early October. Spawning then occurs during the latter part of October and into November.

The SR fall Chinook salmon ESU size was estimated to be approximately 72,000 spawners in the 1930's and 1940's (NOAA Fisheries 1998). This ESU suffered a severe decline in the 1970's (Meyers *et al.*1998 and Waples *et al.*1991). There were several factors for this decline including the loss of spawning and rearing habitat, the increase of hatchery production, and over-harvest. Recently the population abundance has been improving. From 1997 to 2001 the geometric mean of the natural spawning fish

returning over the Lower Granite Dam was 817. In 2001, the number of natural spawners returning over Lower Granite was 2600 which is the first time that the number of natural spawning fish has met or exceeded the interim abundance target. The long and short term trends in natural returns are positive1.013 and 1.188 respectively (BRT 2003). If hatchery spawners have been equally as effective as natural-origin spawners in contributing to brood year returns, the long-term λ estimate is 0.899 and the associated probability that λ is less than 1.0 is estimated as 98.7% (BRT). The BRT concluded that, although Snake River fall Chinook salmon numbers have been increasing in recent years, there remains a moderately high risk of extinction due to insufficient abundance (Good *et al.* 2005).

The ICTRT has identified only one extant[4] population in the Snake River fall Chinook salmon ESU, the Lower Snake River Mainstem population. This population occupies the Snake River from its confluence with the Columbia River to Hells Canyon Dam, and the lower reaches of the Clearwater, Imnaha, Grande Ronde, Salmon, and Tucannon rivers. The majority of the fish spawn in the mainstem Snake River between the head of Lower Granite Reservoir and Hells Canyon Dam, with the remaining fish distributed among lower sections of the major tributaries (Connor *et al.* 2002). Fall Chinook salmon in the mainstem Snake appear to be distributed in a series of aggregates from the mouth of Asotin Creek to River Mile (RM) 219, although smaller numbers have been reported spawning in the tailraces of the Lower Snake dams. Due to their proximity and the likelihood that individual tributaries did not support separate populations of sufficient size to be self-sustaining, the ICTRT considered these aggregates and the associated reaches in the lower major tributaries to the Snake River to be a single population (ICTRT 2003).

f. **Snake River Spring/Summer-Run Chinook Salmon** – SR spring/summer run Chinook salmon were listed as threatened, and protective regulations were issued under Section 4(d) of the ESA, on April 22, 1992 (57 FR14653). This species occupies the Snake River basin, which drains portions of southeastern Washington, northeastern Oregon, and north central Idaho. Environmental conditions are drier and warmer in these areas than in areas occupied by other Chinook species. Chinook-producing drainages occupied by this species include the Grande Ronde, Imnaha, Salmon, and Tucannon River systems.

SR spring/summer run Chinook exhibit a stream-type life history. Juvenile fish mature in fresh water for one year before they migrate to the ocean in the spring of their second year. Adults re-enter the Columbia River in late February and early March after two or three years in the ocean. In high elevation areas, mature fish hold in cool, deep pools until late summer and early fall, when they return to their native streams to begin spawning. Eggs incubate through the fall and winter and fry emerge in the late winter and early spring.

Although direct estimates of historical annual SR spring/summer run Chinook returns are not available, returns may have declined by as much as 97% between the late 1800s and

4 The ICTRT also designated two populations of Snake River fall Chinook salmon that are not extant: the Marsing Reach population and the Salmon Falls population (ICTRT May 11, 2005, memorandum regarding updated population delineation in the Interior Columbia Basin).

2000. According to Matthews and Waples (1991), total annual SR spring/summer Chinook production may have exceeded 1.5 million adult fish in the late 1800s. Total (natural + hatchery origin) returns fell to roughly 100,000 spawners by the late 1960s (Fulton 1968) and were below 10,000 by 1980 (NOAA Fisheries 2003). Between 1981 and 2000, total returns fluctuated between extremes of 1,800 and 44,000 fish. The 2001 and 2002 total returns increased to over 185,000 and 97,184 adults, respectively (Figure 1). However, over 80% of the 2001 return and over 60% of the 2002 return originated in hatcheries (NOAA Fisheries 2003).

Natural-origin SR spring/summer run Chinook returns over the Lower Granite Dam fluctuated between 1,100 and 11,500 fish from 1980 to 2000. Despite brief increases in the 1992 and 1993 returns, natural returns were consistently lowest during the1990s. Five-year averages of natural origin returns show a distinct downward trend with time between 1980 and 1999. The five-year natural origin return averages for 1980-1984, 1985-1989, 1990-1994, and 1995-1999 were 8,807, 8,595, 6,949, and 4,162 fish, respectively. Estimated natural origin returns steadily increased from 5,200 fish in 2000 to nearly 38,000 adults in 2002 (NOAA Fisheries 2003).

The natural-origin SR spring/summer run Chinook population growth rate must exceed 1.0 for production. Long-term SR spring/summer Chinook population growth rate estimates are below 1.0 and reflect the large population declines seen from the 1960s through the late 1990s. Although natural origin returns between 2000 and 2002 gave rise to positive short-term growth rates, they were still below the interim abundance target of 41,900 natural-origin spawners needed for SR spring/summer Chinook salmon population recovery (NOAA Fisheries 2002).

Thus, despite the recent increases in total spring/summer run Chinook returns to the basin, natural origin abundance and productivity are still below their targets, and the BRT determined that the SR spring/summer run Chinook salmon remains likely to become endangered (NOAA Fisheries 2003). The ICTRT has identified 32 populations in 5 major population groups (Upper Salmon River, South Fork Salmon River, Middle Fork Salmon River, Grande Ronde/Imnaha, Lower Snake Mainstem Tributaries) for this species. Historic populations above Hells Canyon Dam are considered extinct

g. Lower Columbia River Chum Salmon (*Oncorhynchus keta*) – The NMFS last provided an updated status report on CR chum in 1999 (NMFS 1999b). As documented in the 1999 report, the previous BRT was concerned about the dramatic declines in abundance and contraction in distribution from historical levels. The previous BRT was also concerned about the low productivity of the extant populations, as evidenced by flat trend lines at low population sizes. A majority of the previous BRT concluded that the CR chum salmon was likely to become endangered in the foreseeable future and a minority concluded that the species was currently in danger of extinction.

New data includes spawner abundance through 2000, with a preliminary estimate of 2002, new information on the hatchery program, and new genetic data describing the current relationship of spawning groups. New analyses include designation of relatively demographically independent populations, recalculation of previous BRT metrics with

additional years data, estimates of median annual growth rate, and estimates of current and historically available kilometers of stream.

Updated information provided in the BRT (2003), the information contained in previous LCR status reviews, and preliminary analyses by the Willamette/Lower Columbia Technical Recovery Team suggest that 14 of the 16 historical populations (88%) are extinct or nearly so. The two extant populations have been at low abundance for the last 50 years in the range where stochastic processes could lead to extinction. Encouragingly, there has been a substantial increase in the abundance of these two populations. In addition there are the new (or newly-discovered) Washougal River mainstem spawning groups. However, it is not known if the increase will continue and the abundance is still substantially below the historical levels.

Nearly all of the likelihood votes from the BRT for this species fell in the 'likely to become endangered' (63%) or 'danger of extinction' (34%) categories. The BRT had substantial concerns about every VSP element, as indicated risk estimates scores that ranged from moderately high for growth rate/productivity to high to very high for spatial structure. Most or all of the risk factors identified previously by the BRT remain important concerns. The Willamette/Lower Columbia Technical Review Team has estimated that close to 90% of the historical populations are extinct or nearly so, resulting in loss of much diversity and connectivity between populations. The populations that remain are small, and overall abundance for the species is low. This species has showed low productivity for many decades, even though the remaining populations are at low abundance and density dependent compensation might be expected. The BRT was encouraged that unofficial reports for 2002 suggest a large increase in abundance in some (perhaps many) locations. Whether this large increase is due to any recent management actions or simply reflects unusually good conditions in the marine environment is not known at this time, but the result is encouraging, particularly if it were to be sustained for a number of years.

Critical Habitat. There are 20 watersheds within the range of this ESU. Three watersheds received a medium rating and 17 received a high rating of conservation value to the ESU (NMFS, 2005). The lower Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in 1 of the high value watersheds identified.

h. Hood Canal Summer-Run Chum Salmon (*Oncorhynchus keta*) – Hood Canal chum salmon were listed as a threatened species under the Endangered Species Act (ESA) on March 25, 1999. The ESU includes all naturally spawned populations of summer-run chum salmon in Hood Canal and it tributaries as well as populations in Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington

Hood Canal summer-run chum salmon are defined as fish that spawn from mid-September to mid-October. Fall-run chum salmon are defined as fish that spawn from November through December or January. Run-timing data from as early as 1913 indicated temporal separation between summer and fall chum salmon in Hood Canal. Even though for many years there have been hatchery releases of fall chum salmon in Hood Canal and many of these fish return to hatcheries in Hood Canal and were

historically spawned before the end of October, recent spawning surveys show that temporal separation still exists between summer and fall chum salmon. Genetic data indicate strong and long-standing reproductive isolation between chum salmon in this ESU and other chum salmon populations in the United States and British Columbia. Hood Canal is also geographically separated from other areas of Puget Sound, the Strait of Georgia, and the Pacific Coast.

In general, summer-run chum salmon are most abundant in the northern part of the species' range, where they spawn in the main stems of rivers. Farther south, water temperatures are so high and stream flows are often so low during late summer and early fall that conditions become unfavorable for salmonids. River flows typically do not increase and water temperatures do not decrease until the arrival of fall rains in late October/November. Presumably for these reasons, few summer chum populations are recognized south of northern British Columbia. Ecologically, summer-run chum salmon populations from Washington must return to freshwater and spawn during peak periods of high water temperature, suggesting an adaptation to specialized environmental conditions that allow this life-history strategy to persist in an otherwise inhospitable environment.

Some chum salmon populations in the Puget Sound/Strait of Georgia ESU, which has four recognized summer-run populations and two recognized winter-run populations, also exhibit unusual run timing. However, allozyme data indicate that these populations are genetically closely linked to nearby fall-run populations. Therefore, variation in run timing has presumably evolved more than once in the southern part of the species' range. Genetic data indicate that summer-run populations from Hood Canal and the Strait of Juan de Fuca are part of a much more ancient lineage than summer-run chum salmon in southern Puget Sound.

Although summer chum salmon in this ESU have experienced a continuing decline over the past 30 years, escapement in 1995-96 increased dramatically in some streams. These increases in escapement were observed primarily in rivers on the west side of Hood Canal, with the largest increase in the Big Quilcene River where the USFWS has been conducting an enhancement program starting with the 1992 brood year. Streams on the east side of Hood Canal continued either to have no returning adults (Big Beef Creek, Anderson Creek, and the Dewatto River) or no increases in escapement.

Critical Habitat. There are 12 watersheds within the range of this ESU. Three watersheds received a medium rating and 9 received a high rating of conservation value to the ESU (NMFS, 2005). Five nearshore marine areas also received a rating of high conservation value.

i. **Southern Oregon/Northern California Coho Salmon (*Oncorhynchus* *kisutch*)** – Listed as threatened on May 6, 1997; threatened status reaffirmed on June 28, 2005. The ESU includes all naturally spawned populations of coho salmon in coastal streams between Cape Blanco, Oregon, and Punta Gorda, California, as well three artificial propagation programs: the Cole Rivers Hatchery (ODFW stock #52), Trinity River Hatchery, and Iron Gate Hatchery coho hatchery programs.

k. **Lower Columbia Coho Salmon** – Originally part of a larger Lower Columbia River/Southwest Washington ESU, Lower Columbia coho were identified as a separate ESU and listed as threatened on June 28, 2005. The ESU includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries in Washington and Oregon, from the mouth of the Columbia up to and including the Big White Salmon and Hood Rivers, and includes the Willamette River to Willamette Falls, Oregon, as well as twenty-five artificial propagation programs: the Grays River, Sea Resources Hatchery, Peterson Coho Project, Big Creek Hatchery, Astoria High School (STEP) Coho Program, Warrenton High School (STEP) Coho Program, Elochoman Type-S Coho Program, Elochoman Type-N Coho Program, Cathlamet High School FFA Type-N Coho Program, Cowlitz Type-N Coho Program in the Upper and Lower Cowlitz Rivers, Cowlitz Game and Anglers Coho Program, Friends of the Cowlitz Coho Program, North Fork Toutle River Hatchery, Kalama River Type-N Coho Program, Kalama River Type-S Coho Program, Lewis River Type-N Coho Program, Lewis River Type-S Coho Program, Fish First Wild Coho Program, Fish First Type-N Coho Program, Syverson Project Type-N Coho Program, Eagle Creek National Fish Hatchery, Sandy Hatchery, and the Bonneville/Cascade/Oxbow complex coho hatchery programs.

11. Snake River Sockeye (*Oncorhynchus nerka*)

Snake River (SR) sockeye salmon are unique. Anadromous sockeye salmon returning to Redfish Lake in Idaho's Stanley Basin travel a greater distance from the sea (approximately 900 miles) to a higher elevation (6,500 feet) than any other sockeye salmon population and are the southern-most population of sockeye salmon in the world (Bjornn *et al.* 1968; Foerster 1968). Stanley Basin sockeye salmon are separated by 700 or more river miles from two other extant upper Columbia River populations in the Wenatchee River and Okanogan River drainages. These latter populations return to lakes at substantially lower elevations (Wenatchee- 1870 feet, Okanagon- 912 feet) and occupy different ecoregions.

The SR sockeye salmon was listed as endangered in November 1991 (56 FR 58619). The only extant sockeye salmon population in the Snake River basin at the time of listing was that in Redfish Lake, in the Stanley Basin (upper Salmon River drainage) of Idaho. Other lakes in the Snake River basin historically supporting sockeye salmon populations but now considered extinct include Wallowa Lake (Grande Ronde River drainage, Oregon), Payette Lake (Payette River drainage, Idaho) and Warm Lake (South Fork Salmon River drainage, Idaho) (Waples *et al.* 1997). Although kokanee, a resident form of *Oncorhynchus nerka*, occur in numerous lakes in the Snake River basin, other lakes in the Stanley Basin and sympatrically with sockeye in Redfish Lake, resident *O.nerka* were not considered part of the species at the time of listing (1991). Subsequent to the 1991 listing a residual form of sockeye residing in Redfish Lake was identified. The residuals are non-anadromous, completing their entire life cycle in freshwater, but spawn at the same time and in the same location as anadromous sockeye salmon. In 1993, NMFS determined that residual sockeye salmon in Redfish were part of the Snake River sockeye salmon ESU. Also, artificially propagated sockeye salmon from the Redfish Lake Captive Propagation program are considered part of this ESU (70 FR 37160). NMFS has determined that this artificially propagated stock is genetically no more than moderately divergent from the natural population (NMFS 2005).

Five lakes in the Stanley Basin historically contained sockeye salmon: Alturas, Pettit, Redfish, Stanley and Yellowbelly (Bjornn *et al.* 1968). It is generally believed that adults were prevented from returning to the Sawtooth Valley from 1910 to 1934 by Sunbeam Dam. Sunbeam Dam was constructed on the Salmon River approximately 20 miles downstream of Redfish Lake. Whether or not Sunbeam Dam was a complete barrier to adult migration remains unknown. It has been hypothesized that some passage occurred while the dam was in place allowing the Stanley Basin population or populations to persist (see Bjornn *et al.* 1968, Waples *et al.* 1991). Adult returns to Redfish Lake during the period 1954 through 1966 ranged from 11 to 4,361 fish (Bjornn *et al.* 1968). Sockeye salmon in Alturas Lake were extirpated in the early 1900s as a result of irrigation diversions, although residual sockeye may still exist in the lake (Chapman and Witty 1993). From 1955-1965, the Idaho Department of Fish and Game eradicated sockeye salmon from Pettit, Stanley, and Yellowbelly lakes, and built permanent structures on each of the lake outlets that prevented re-entry of anadromous sockeye salmon (Chapman and Witty 1993). In 1985, 1986 and 1987, 11, 29, and 16 sockeye, respectively, were counted at the Redfish Lake weir (WCSBRT 2003; Good *et al.* 2005). Only 18 natural origin sockeye salmon have returned to the Stanley Basin since 1987. The first adult returns from the captive brood stock program returned to the Stanley Basin in 1999. From 1999 through 2005 a total of 345 captive brood program adults that had migrated to the ocean returned to the Stanley Basin.

Recent annual abundances of natural origin sockeye salmon to the Stanley Basin have been extremely low. No natural origin anadromous adults have returned since 1998 and the abundance of residual sockeye salmon in Redfish Lake is unknown. This species is entirely supported by adults produced through the captive propagation program at the present time. Current smolt-to-adult survival of sockeye originating from the Stanley Basin lakes is rarely greater than 0.3% (Hebdon *et al.* 2004). The current average productivity likely is substantially less than the productivity required for any population to be at Low (1-5%) extinction risk at the minimum abundance threshold. The BRT determined that the SR sockeye salmon remains in danger of extinction (Good *et al.* 2005)

12. **Ozette Lake Sockeye** (*Oncorhynchus nerka*)

The Ozette Lake sockeye ESU includes all naturally spawned populations of sockeye salmon in Ozette Lake and streams and tributaries flowing into Ozette Lake, Washington (March 25, 1999, 64 FR 14528). Two artificial propagation programs are considered to be part of this ESU: the Umbrella Creek and Big River sockeye hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (NMFS, 2005a). Siltation and alterations in the lake level regime have resulted in the loss of numerous beach spawning sites. The BRT expressed concern that the reduction in the number of spawning aggregations poses risks for ESU spatial structure and diversity. Primary sources of threats to VSP parameters include: loss of adequate quality and quantity of spawning and rearing habitat, predation and disruption of natural predator-prey relationships, introduction of nonnative fish and plant species, past overexploitation, poor ocean conditions, and interactions among those factors. There has been no directed harvest on Lake Ozette sockeye salmon since 1982, and commercial fisheries stopped in 1974 (Gustafson *et al.*, 1997, Makah Fisheries Management 2000).

The Puget Sound TRT considers the Lake Ozette sockeye salmon ESU to be composed of one historical population, with substantial sub-structuring of individuals into multiple spawning aggregations. The primary existing spawning aggregations occur in two beach locations, Allen's and Olsen's beaches, and in two tributaries, Umbrella Creek and Big River (both tributary-spawning groups were initiated through a hatchery introduction program). Recently, mature adults have been located at other beach locations within the lake (e.g., Umbrella Beach, Ericson's Bay, Baby Island, and Boot Bay), but whether spawning occurred in those locations is not known (Makah Fisheries Management 2000). Similarly, occasional spawners are found sporadically in other tributaries to the lake, but not in as high numbers or as consistently as in Umbrella Creek. The Umbrella Creek spawning aggregation was started through collections of lake-spawning adults as initial broodstock, and in recent years all broodstock has been collected from returning adults to Umbrella Creek (Makah Fisheries Management 2000). The extent to which sockeye spawned historically in tributaries to the lake is controversial (Gustafson *et al.*, 1997), but it is clear that multiple beach-spawning aggregations of sockeye occurred historically, and that genetically distinct kokanee currently spawn in large numbers in all surveyed lake tributaries (except Umbrella Creek and Big River). The two remaining beach-spawning aggregations are probably fewer than the number of aggregations that occurred historically, but there is insufficient evidence to determine how many subpopulations occurred in the ESU historically. Much of the existing spawning in recent years occurs in the spawning aggregation created via fry releases into Umbrella Creek. The status of the historically well-documented spawning aggregations at Allen's and Olsen's beaches is not well understood because of the difficulties in observing spawners and sampling carcasses in the tannin-rich lake. Although the program has a beneficial effect on ESU abundance and spatial structure, it has neutral or uncertain effects on ESU productivity and diversity (NMFS 2005a).

The 5-year average (geometric mean) estimated abundance of Ozette Lake sockeye salmon ESU for the period 1994–1998 was 580, slightly below the average of 700 (for the years 1992–1996) reported by Gustafson *et al.* (1997). This decrease is largely because the earlier average included two dominant brood-cycle years, although the recent average includes only one. The 1998 count of 984 was substantially higher than the count of 498 that was observed four years (one generation) earlier. This count may result primarily from a change in counting methods; a video camera was installed in 1998, and the operation period of the weir was expanded (7 May–14 August), resulting in a more complete count of all fish passing the weir. It is likely that counts for previous years underestimated total spawner abundance, but the magnitude of this bias is unknown. Analyses of trends using data through 1998 indicate that the short-term (10-year) trend improved from a decline of 9.9 percent per year in Gustafson *et al.* (1997) to a relatively low, 2 percent, annual increase. How much this increase was influenced by the change in counting methods in 1998 is not known. The long-term trend remained slightly downward (–2 percent).

13. Steelhead (*Oncorhynchus mykiss*)

Steelhead trout are rainbow trout that migrate to the ocean. Two races of steelhead are found: summer and winter steelhead. Summer steelhead are usually associated with larger rivers that have adequate summer flows to accommodate summer upstream migration and deep resting pools with cooler water. Summer steelhead is generally found in rivers with spring Chinook populations. Summer steelhead tends to spawn in very small; intermittent tributaries and winter steelhead tend to spawn in medium to large streams. Steelhead

exhibits a wide variety of migration and freshwater rearing strategies, and spawns from mid-winter to late spring. Summer steelhead fry tend to emerge earlier in the late winter/early spring than winter steelhead fry. Historic steelhead habitat is extremely variable as these fish are adept at migrating through steep gradient stream segments and over waterfalls of moderate height. Steelhead trout fry and parr can be found in very steep mountain stream habitat and in interior and coastal unconstrained valley streams.

Generally, steelhead remain in freshwater for one to three years and the ocean phase varies from one to three years. Steelhead trout are oviparous and can return to spawn more than once. Ocean migration is highly variable for steelhead trout, generally following the north and south migration strategies of coho salmon and Chinook salmon previously discussed. Steelhead are less gregarious than salmon in their ocean phase and individuals can range as far as offshore of the Aleutian Island area.

a. **Lower Columbia River Steelhead -** The Lower Columbia River ESU encompasses all steelhead runs in tributaries between the Cowlitz and Wind Rivers on the Washington side of the Columbia River, and the Willamette and Hood Rivers on the Oregon side. The populations of steelhead that make up the Lower Columbia River ESU are distinguished from adjacent populations by genetic and habitat characteristics. The ESU consists of summer and winter coastal steelhead runs in the tributaries of the Columbia River as it cuts through the Cascades. These populations are genetically distinct from inland populations (east of the Cascades), as well as from steelhead populations in the upper Willamette River Basin and coastal runs north and south of the Columbia River mouth. Not included in the ESU are runs in the Willamette River above Willamette Falls (Upper Willamette River ESU), runs in the Little and Big White Salmon rivers (Middle Columbia River ESU) and runs based on four imported hatchery stocks: early-spawning winter Chambers Creek/lower Columbia River mix, summer Skamania Hatchery stock, winter Eagle Creek NFH stock, and winter Clackamas River ODFW stock (63 FR 13351 and 13352). This area has at least 36 distinct runs (Busby *et al.* 1996), 20 of which were identified in the initial listing petition. In addition, numerous small tributaries have historical reports of fish, but no current abundance data. The major runs in the ESU, for which there are estimates of run size, are the Cowlitz River winter runs, Toutle River winter runs, Kalama River winter and summer runs, Lewis River winter and summer runs, Washougal River winter and summer runs, Wind River summer runs, Clackamas River winter and summer runs, Sandy River winter and summer runs, and Hood River winter and summer runs.

   For the larger runs, current counts have been in the range of one to 2,000 fish (Cowlitz, Kalama, and Sandy Rivers); historical counts, however, put these runs at more than 20,000 fish. In general, all runs in the ESU have declined over the past 20 years, with sharp declines in the last 5 years.

   Steelhead in this ESU are thought to use estuarine habitats extensively during out migration, smoltification, and spawning migrations. The lower reaches of the Columbia River are highly modified by urbanization and dredging for navigation. The upland areas covered by this ESU are extensively logged, affecting water quality in the smaller streams used primarily by summer runs. In addition, all major tributaries used by LCR steelhead have some form of hydraulic barrier that impedes fish passage. Barriers range

from impassible structures in the Sandy Basin that block access to extensive, historically occupied, steelhead habitat, to passable but disruptive projects on the Cowlitz and Lewis Rivers. The Biological Review Team (BRT 1997) viewed the overall effect of hydrosystem activities on this ESU as an important determinant of extinction risk.

Many populations of steelhead in the Lower Columbia River ESU are dominated by hatchery escapement. Roughly 500,000 hatchery-raised steelhead are released into drainages within this ESU each year. As a result, first-generation hatchery fish are thought to make up 50 percent to 80 percent of the fish counted on natural spawning grounds. The effect of hatchery fish is not uniform, however. Several runs are mostly hatchery strays (e.g., the winter run in the Cowlitz River [92 percent] and the Kalama River [77 percent] and the summer run in the North Fork Washougal River [50 percent]), whereas others are almost free of hatchery influence (the summer run in the mainstem Washougal River [0 percent] and the winter runs in the North Fork Toutle and Wind Rivers [0 percent to 1 percent]).

Escapement estimates for the steelhead fishery in the Lower Columbia River ESU are based on in river and estuary sport-fishing reports; there is a limited ocean fishery on this ESU. Harvest rates range from 20 percent to 50 percent on the total run, but for hatchery-wild differentiated stocks, harvest rates on wild fish have dropped to 0 percent to 4 percent in recent years (punch card data from WDFW through 1994).

For the LCR steelhead ESU as a whole, NMFS estimates that the median population growth rate (lambda) over the base period ranges from 0.98 to 0.78, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure *et al.* 2000).

Critical Habitat. There are 32 watersheds within the range of this ESU. Two watersheds received a low rating, 11 received a medium rating, and 29 received a high rating of conservation value to the ESU (NMFS, 2005). The lower Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in one of the high value watersheds identified.

b. Upper Willamette River steelhead – The UWR steelhead ESU occupies the Willamette River and tributaries upstream from Willamette Falls, extending to and including the Calapooia River. These major river basins containing spawning and rearing habitat comprise more than 12,000 square kilometers (km^2) in Oregon. Rivers that contain naturally-spawning, winter-run steelhead include the Tualatin, Molalla, Santiam, Calapooia, Yamhill, Rickreall, Luckiamute, and Mary's Rivers. Early migrating winter and summer steelhead have been introduced into the Upper Willamette Basin, but those components are not part of the ESU. Willamette Falls (RM 26) is a known migration barrier, and while winter steelhead and spring-run Chinook salmon historically occurred above the falls, summer-run steelhead, fall-run Chinook salmon, and coho salmon did not. Native winter steelhead within this ESU have been declining since 1971, and have exhibited large fluctuations in abundance. Habitat in this ESU has become substantially simplified since the 1800s by removal of large woody debris (LWD) to increase the river's navigability, by reduction in riparian vegetation, and by channel modifications.

In general, native steelhead of the Upper Willamette Basin are primarily late-migrating winter steelhead, entering freshwater primarily in March and April. This atypical run timing appears to be an adaptation for ascending Willamette Falls, which functions as an isolating mechanism for UWR steelhead. Reproductive isolation resulting from the falls may explain the genetic distinction between steelhead from the Upper Willamette Basin and those in the lower river. UWR late-migrating steelhead are ocean-maturing fish. Most return at age four, with a small proportion returning as five-year-olds (Busby *et al.* 1996).

Spawning takes place from April through the first of June, similar to historical conditions. Because spawning takes place primarily in May, it is separated in time from that of UWR spring-run Chinook salmon which takes place primarily in September. Some spatial separation also occurs because UWR steelhead typically spawn in smaller streams than UWR spring-run Chinook salmon.

The West Coast steelhead BRT met in January 2003, to determine if new information or data warranted any modification of the conclusions of the original BRTs. They focused primarily on information for anadromous populations in the risk assessments for steelhead ESUs, but considered the presence of relatively numerous, native resident fish as a mitigating risk factor for some ESUs. Their draft report noted that after a decade in which Willamette Falls counts were near the lowest levels on record, adult returns for 2001 and 2002 were up significantly. Yet the total abundance is small for the entire ESU, with a recent mean of less than 6,000 and with many populations at relatively low levels. Most of the populations are in decline over the period of the available time series (BRT 2003). Given that the BRT could not conclusively identify a single naturally self-sustaining population, it is uncertain whether recent increases can be sustained. The discontinuation of the releases of the 'early' winter-run hatchery population was described as positive, but continued releases of non-native summer-run steelhead are a cause for concern. Available time series are confounded by the presence of hatchery-origin spawners.

For the UWR steelhead ESU as a whole, NMFS estimated that the median population growth rate (lambda) over the base period ranges from 0.94 to 0.87, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure *et al.* 2000).

Critical Habitat. There are 38 watersheds within the range of this ESU. Seventeen watersheds received a low rating, 6 received a medium rating, and 15 received a high rating of conservation value to the ESU (NMFS, 2005a). The lower Willamette/ Columbia River rearing/migration corridor downstream of the spawning range is also considered to have a high conservation value and is the only habitat area designated in four of the high value watersheds identified above.

c. Middle Columbia River (MCR) Steelhead – The MCR steelhead confirmed as threatened under the ESA on January 5, 2006 (effective February 6, 2006) (71 FR 834). The MCR steelhead DPS includes all naturally-spawned populations of steelhead in streams within the Columbia River basin from above the Wind River in Washington, and

the Hood River in Oregon (exclusive), upstream to, and including, the Yakima River in Washington, excluding steelhead from the Snake River basin.

The major tributaries occupied by this DPS are the Deschutes, John Day, Klickitat, Umatilla, Walla Walla, and Yakima River systems. The John Day River probably represents the largest naturally spawning native stock of steelhead in the region.

The Interior Columbia Basin Technical Recovery Team (ICTRT) (2003) identified 15 populations in four major population groups (MPGs) (Cascades Eastern Slopes Tributaries, John Day River, the Walla Walla and Umatilla Rivers, and the Yakima River) and one unaffiliated independent population (Rock Creek) in this DPS. There are two extinct populations in the Cascades Eastern Slope major population group: the White Salmon River and Deschutes River above Pelton Dam. Recent negotiations during the Federal Energy Regulatory Commission relicensing of Pelton Dam led to an agreement to restore anadromous fish passage to the Upper Deschutes River.

Seven hatchery steelhead programs are considered part of the MCR steelhead DPS. These programs propagate steelhead in three of 16 populations and improve kelt survival in one population. No artificial programs produce the winter-run life history in the Klickitat River and Fifteenmile Creek populations. All of the hatchery programs are designed to produce fish for harvest, although two are also implemented to augment the naturally spawning populations in the basins where the fish are released. The NMFS' assessment of the effects of artificial propagation on extinction risk concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the DPS (NMFS 2004b). Artificial propagation increases total abundance, principally in the Umatilla and Deschutes Rivers. The kelt reconditioning efforts in the Yakima River do not augment natural abundance but do benefit the survival of the natural populations. The Touchet River Hatchery program has only recently been established, and its contribution to viability is uncertain. The hatchery programs affect a small proportion of the DPS. Collectively, artificial propagation programs provide a slight beneficial effect to abundance but have neutral or uncertain effects on productivity, spatial structure, and diversity.

The precise pre-1960 abundance of this DPS is unknown, but historic run estimates for the Yakima River imply that annual abundance may have exceeded 300,000 returning adults (Busby *et al.* 1996). MCR steelhead run estimates between 1982 and 2004 were calculated by subtracting adult counts for Lower Granite and Priest Rapids Dams from those at Bonneville Dam.

Steelhead remain well-distributed in the majority of subbasins occupied by this DPS. However, natural returns to the Yakima River, once a major historical production center for the DPS, continue to be less than 20% of the interim recovery abundance target for the subbasin (West Coast Salmon Biological Review Team (BRT) 2003). The presence of substantial numbers of out-of-basin (and largely out-of-DPS) natural spawners in the Deschutes River also raised substantial concern within the BRT regarding the genetic integrity and productivity of the native Deschutes population.

The five-year average return (geometric mean) of natural MCR steelhead for 1997-2001 was up from previous years' basin estimates (BRT 2003). However, the John Day is the only system at or above its interim abundance target, and all but two John Day steelhead populations have negative short-term growth rates. The Deschutes is close to its target, but there is significant concern about the affect on production in that drainage from fish from outside the DPS. The Touchet, Umatilla, and Yakima systems are all below their interim abundance targets.

Thus, despite recent increases in MCR steelhead returns, the BRT believes that the MCR steelhead remains at moderate risk for all four VSP parameters. Consequently the BRT has determined that the MCR steelhead remains likely to become endangered (BRT 2003).

Critical Habitat. There are 114 watersheds within the range of this ESU. Nine watersheds received a low rating, 24 received a medium rating, and 81 received a high rating of conservation value to the ESU (NMFS, 2005). The lower Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in three of the high value watersheds identified.

d. Upper Columbia River (UCR) Steelhead – The UCR steelhead was listed as endangered on August 18, 1997 (62 FR 43937). The status of this DPS was upgraded to threatened on January 5 (70 FR 834). This DPS includes all natural-origin populations of steelhead in the Columbia River basin upstream from the Yakima River in Washington to the U.S./Canada border. The Wells Hatchery stock is included among the listed populations. NMFS has identified three important spawning populations within this ESU: the Wenatchee, Entiat, and Methow populations (ICTRT 2003).

Life history characteristics for UCR steelhead are similar to those of other inland steelhead ESUs; however, smolt age is dominated by two- and three-year-olds and some of the oldest smolt ages for steelhead, up to seven years, are reported from this ESU (Peven 1990). Based on limited data, steelhead from the Wenatchee and Entiat rivers return to freshwater after one year in saltwater, whereas Methow River steelhead primarily return after two years in salt water. Similar to other inland Columbia River basin steelhead ESUs, adults typically return to the Columbia River between May and October and are considered summer-run steelhead. Adults may remain in fresh water up to a year before spawning. Unlike Chinook salmon or sockeye salmon, a fraction of steelhead adults attempt to migrate back to the ocean. These fish are known as kelts, and those that survive will migrate from the ocean to their natal stream to spawn again.

In July 2005, the ICTRT defined minimum abundance thresholds for Interior Columbia Basin steelhead populations. These numbers are intended to be a surrogate for the number and productivity of naturally produced spawners that may be needed for recovery, in the context of whatever take or mortality is occurring. They should not be considered in isolation, as they represent the numbers that, taken together, may be needed for the population to be self-sustaining in its natural ecosystem. For UCR steelhead, the minimum abundance thresholds are 1,500 spawners in the Wenatchee River, 1,500 spawners in the Methow River, 1,000 spawners in the Okanogan River, and 500 spawners

in the Entiat River. Returns of both hatchery and naturally produced steelhead to the Upper Columbia River have increased in recent years. The average 1997-2001 return counted through the Priest Rapids fish ladder was approximately 12,900 fish. The average for the previous five years (1992-1996) was 7,800 fish. Abundance estimates of returning naturally produced UCR steelhead have been based on extrapolations from mainstem dam counts and associated sampling information (*e.g.,* hatchery/wild fraction, age composition). The natural component of the annual steelhead run over Priest Rapids Dam increased from an average of 1,040 (1992-1996), representing about 10 percent of the total adult count, to 2,200 (1997-2001), representing about 17 percent of the adult count during this period of time (BRT 2003).

In terms of natural production, recent population abundances for both the Wenatchee and Entiat aggregate population and the Methow population remain well below the minimum abundance thresholds developed for these populations (ICTRT 2005). A 5-year geometric mean (1997- 2001) of approximately 900 naturally produced steelhead returned to the Wenatchee and Entiat rivers (combined) compared to a combined abundance target of 2,000 fish. Although this is well below the minimum abundance thresholds, it represents an improvement over the past (an increasing trend of 3.4 percent per year). However, the average percentage of natural fish for the recent 5-year period dropped from 35 percent to 29 percent, compared to the previous status review. For the Methow population, the 5-year geometric mean of natural returns over Wells Dam was 358. Although this is well below the minimum abundance thresholds, it is an improvement over the recent past (an increasing trend of 5.9 percent per year). In addition, the 2001 return (1,380 naturally produced spawners) was the highest single annual return in the 25-year data series. However, the average percentage of wild origin spawners dropped from 19 percent for the period prior to the 1998 status review to 9 percent for the 1997 to 2001 returns.

Critical Habitat. There are 42 watersheds within the range of this ESU. Three watersheds received a low rating, 8 received a medium rating, and 31 received a high rating of conservation value to the ESU (NMFS, 2005). The Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in 11 of the high value watersheds identified.

e. **Snake River Basin Steelhead** – The Snake River Basin (SRB) steelhead was confirmed as threatened under the ESA on January 5, 2006 (effective February 6, 2006) (71 FR 834). The SRB steelhead DPS includes all naturally spawned populations of steelhead (and their progeny) in streams in the Snake River basin of southeast Washington, northeast Oregon, and Idaho (62 FR 43937; August 18, 1997). The SRB steelhead DPS does not include resident forms of *O. mykiss* (rainbow trout) co-occurring with these steelhead.

The Interior Columbia Basin Technical Recovery Team (ICTRT) (2003) identified 23 populations in the following six major population groups (MPGs) in this DPS: Clearwater River, Grande Ronde River, Hells Canyon, Imnaha River, Lower Snake River, and Salmon River. The Biological Review Team (BRT) (2003) noted that the DPS remains spatially well distributed in each of the six major geographic areas in the

Snake River basin. Environmental conditions are generally drier and warmer in these areas than in areas occupied by other steelhead DPSs in the Pacific Northwest. SRB steelhead were blocked from portions of the upper Snake River beginning in the late 1800s and culminating with the construction of Hells Canyon Dam in the 1960s.

Sexually immature adult SRB steelhead return to the Columbia River between late June and October. They are considered a summer run and are known as a stream-maturing type. SRB steelhead returns consist of A-run fish that spend one year in the ocean, and larger B-run fish that spend two years at sea. Adults typically migrate upriver until they reach tributaries from 1,000 to 2,000 meters above sea level where, now sexually mature, they spawn between March and May of the following year. Unlike other anadromous members of the *Oncorhynchus* genus, some adult steelhead survive spawning, return to the sea, and later return to spawn a second time. After hatching, juvenile SRB steelhead typically spend 2 to 3 years in fresh water before they smolt and migrate to the ocean.

The paucity of information on adult spawning escapement for specific tributary production areas in the SRB steelhead ESU made a quantitative assessment of viability difficult. Annual return estimates are limited to counts of the aggregate return over Lower Granite Dam, and spawner estimates for the Tucannon, Grande Ronde, and Imnaha Rivers. The 2001 return over Lower Granite Dam was substantially higher relative to the low levels seen in the 1990s; the recent 5-year mean abundance (14,768 natural returns) is approximately 28% of the interim recovery target level. The abundance surveyed in sections of the Grande Ronde, Imnaha, and Tucannon Rivers was improved in 2001. However, recent 5-year abundance and productivity trends (through 2001) were mixed. Five of the nine available data series exhibit positive long- and short-term trends in abundance. The majority of long-term population growth rate estimates for the nine available series were below replacement. The majority of short-term population growth rates (through 2001) were marginally above replacement or well below replacement, depending upon the assumption made regarding the effectiveness of hatchery fish in contributing to natural production. The SRB steelhead "B run" population levels remain particularly depressed.

Cooney (2004) reported continuing high returns of natural-origin SRB steelhead (both A- and B-run fish) during 2002 and 2003 compared to those observed during much of the 1990s. In their preliminary report, Fisher and Hinrichsen (2004) estimated that the geometric mean of the natural-origin run was 37,784 during 2001-2003, a 253% increase over the 1996-2000 periods (10,694 steelhead). The slope of the population trend increased 9.3% (from 1.00 to 1.10) when the counts for 2001-2003 were added to the 1990-2000 data series. These data indicate that, at least in the short term, the natural-origin run has been increasing. Despite the recent increases in SRB steelhead returns, the BRT believes that the DPS remains at moderate risk for abundance, productivity, and diversity. Consequently, the BRT has determined that the SRB steelhead DPS remains likely to become endangered (BRT 2003).

Factors leading to the listing of SRB steelhead include adult mortality, migration delay, and juvenile mortality caused by hydropower development. SRB steelhead encounter eight Federal Columbia River Power System (FCRPS) dams along their migration to and from natal spawning areas. Water withdrawal and impoundment have led to altered

hydrographs and reduced summer streamflow throughout the range of this ESU. Habitat degradation caused by logging, road building, grazing, mining, agricultural activities, and urbanization has reduced suitable spawning and rearing habitat quality and quantity. Over-utilization through commercial, recreational and tribal harvest of this DPS is also partially responsible for the decline of this DPS.

There are six artificial propagation programs producing steelhead in the Snake River basin that are considered to be part of the DPS. Artificial propagation enhancement efforts occur in the Imnaha River (Oregon), Tucannon River (Washington), East Fork Salmon River (Idaho, in the initial stages of broodstock development), and South Fork Clearwater River (Idaho). In addition, Dworshak Hatchery acts as a gene bank to preserve the North Fork Clearwater River "B-run" steelhead population, which no longer has access to historical habitat due to construction of Dworshak Dam. During the Status Review, NMFS' assessment of the effects of artificial propagation concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the DPS in toto (NMFS 2004b). Snake River basin hatchery programs may be providing some benefit to the local target, but only the Dworshak-based programs have appreciably benefited the total number of adult spawners. The Little Sheep Hatchery program is contributing to total abundance in the Imnaha River but has not contributed to increased natural productivity. The Tucannon and East Fork Salmon river programs were only recently initiated and have yet to produce appreciable adult returns. Thus, the overall contribution of the hatchery programs in reducing risks to DPS abundance is small, and the contribution of DPS hatchery programs to the productivity of the DPS in toto is uncertain. Most returning Snake River basin hatchery steelhead are collected at hatchery weirs or have access to unproductive mainstem habitats, limiting potential contributions to the productivity of the entire DPS. The artificial propagation programs affect only a small portion of the DPS's spatial distribution and confer only slight benefits to DPS spatial structure. Large steelhead programs not considered to be part of the DPS occur in the mainstem Snake, Grande Ronde, and Salmon rivers and may adversely affect DPS diversity. These out-of-DPS programs are currently undergoing review to determine the level of isolation between the natural and hatchery stocks and to define what reforms may be needed. Collectively, artificial propagation programs in the DPS provide a slight beneficial effect to DPS abundance and spatial structure but have neutral or uncertain effects on DPS productivity and diversity.

The BRT was also concerned about the predominance of hatchery-origin fish in this DPS, the inferred displacement of naturally produced fish by hatchery-origin fish, and potential impacts on DPS diversity. High straying rates exhibited by some hatchery programs generated concern about the possible homogenization of population structure and diversity. However, recent efforts to improve the use of local broodstock and release hatchery fish away from natural production areas are encouraging. For many BRT members, the presence of relatively numerous resident fish reduces risks to DPS abundance but provides an uncertain contribution to DPS productivity, spatial structure, and diversity (NMFS 2003; 2004a). The BRT found moderate risk for the VSP categories of abundance, productivity, and diversity VSP categories and comparatively lower risk in the spatial structure category.

Critical Habitat. There are 289 watersheds within the range of this ESU. Fourteen watersheds received a low rating, 44 received a medium rating, and 231 received a high rating of conservation value to the ESU (NMFS, 2005). The lower Snake/Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in 15 of the high value watersheds identified.

f. **Puget Sound Steelhead** – This specie is included in this ARBA because of the likelihood of it being listed as Threatened in the near future. On 13 September 2004, the NMFS received a petition to list Puget Sound steelhead as endangered or threatened submitted by Sam Wright (Wright 2004). The petition describes several factors that justify a reexamination of the extinction risk for the Puget Sound steelhead ESU. These factors include: declines in steelhead abundances such that "not a single entire river basin, large or small… had a significant upward short-term trend," and that these declines have occurred under a harvest regime that prohibits the retention of wild (unmarked) adults by recreational anglers. The petition disputed the assertion by WDFW that that winter-run steelhead hatchery stocks (predominately Chambers Creek Hatchery) were substantially spatially separated from natural winter-run steelhead populations and cited studies of hatchery-wild steelhead interactions that substantiate the deleterious impact of hatchery fish on natural reproduction and sustainability. The conclusion of the petitioner was that these factors justify a determination that Puget Sound steelhead are in danger of extinction throughout all or a significant portion of its range or are likely to become so in the foreseeable future. The BRT received no new information to consider in re-evaluating the current geographic configuration of the Puget Sound steelhead ESU. A recent publication by Beacham et al. (2004) included two Puget Sound steelhead populations in a population genetic analysis of British Columbia and Washington steelhead, but the BRT concluded that these analyses provided no reason to change the ESU's current boundaries.

B. Birds

1. Northern Bald Eagle *(Haliaeetus leucocephalus)*

Listing Status and Description – The northern bald eagle was first listed as endangered in the lower 48 states in 1967, and was down-listed in 1978 to threatened status in Washington, Oregon, Minnesota, Wisconsin, and Michigan (USDI 1978). A proposal to de-list the bald eagle was published in 1999 (USDI 1999a). Recovery plan goals in the Pacific Recovery Area, which includes Oregon and Washington, have been met. There has been no further action on the proposed rule.

Population Trends and Distribution – The bald eagle is found throughout North America, and has been documented on all of the Federal and Tribal lands covered by this Biological Assessment. The largest breeding populations in the contiguous United States occur in the Pacific Northwest states, the Great Lakes states, Chesapeake Bay and Florida. Oregon and Washington are important for wintering bald eagles and support approximately 25 percent of the wintering bald eagles in the conterminous United States.

Reasons for Decline – Habitat loss (from timber harvest, recreational and urban development, and mineral exploration and extraction) is the greatest long-term threat to bald eagle populations, even though shooting is the greatest single cause of mortality.

Recovery Measures – Since listing, bald eagle populations have increased in the Pacific Northwest as a result of recovery efforts including habitat protection and the banning of DDT and other persistent organochlorines.

2. Marbled Murrelet *(Brachyramphus marmoratus)*

Listing Status and Description – The Washington, Oregon, and California marbled murrelet populations were listed as threatened by in 1992 (USDI 1992a). The marbled murrelet is a small seabird that nests along the Pacific Coast from Alaska to central California. Murrelets forage at sea, but nest on large limbs in old-growth coniferous forest.

Population Trends and Distribution – As part of the recovery planning process, a demographic model was developed to help better understand marbled murrelet population dynamics (Beissinger and Nur in Appendix B; USFWS 1997 recite this citation?). The demographic model predicted that murrelet populations are likely to be declining at an estimated rate of 4 to 7 percent per pear. Predicting or estimating population trends for marbled murrelets is difficult because their population dynamics and demography have not been well described. Ralph *et al.* (1995) summarized some of the reasons for the variability in population estimates among researchers, including differences in methodology, assumptions, spatial coverage, and survey and model errors. Nevertheless, both Ralph *et al.* (1995) and the Marbled Murrelet Recovery Team (USFWS 1997) have concluded that the listed population appears to be in a long-term downward trend.

Reasons for Decline – Old-growth coniferous forest habitat loss as well as predation by corvids. From 1974 through 1993, approximately 64% of the nests failed where nest success/failure was documented, and 57% of those that failed were due to predation (primarily by ravens, crows, and jays) (USFWS 1997).

Recovery Measures – Critical habitat was designated for the species in May 1996 (USDI 1996a). Six conservation zones for marbled murrelets were identified in the Marbled Murrelet Recovery Plan (USFWS 1997).

3. Northern Spotted Owl *(Strix occidentalis caurina)*

Listing Status and Description – The northern spotted owl was listed as a threatened species throughout its range in Washington, Oregon and northern California in 1990 (USDI 1990a).

Population Trends and Distribution – The northern spotted owl is one of three subspecies (northern, California, and Mexican) and occurs from British Columbia to northern California. The northern spotted owl is associated with late successional and old-growth forest habitats. The owl also occurs in some younger forest types where structural attributes of old-growth forests are present (Washington DNR 1997). The present range of the northern spotted owl is similar to the limits of its historic range (USDI 1992b).

Reasons for Decline – Widespread habitat loss across its entire range

Recovery Measures – Critical habitat is based on principles for owl conservation established by Thomas *et al.* (1990) and included large blocks of suitable owl habitat and/or connectivity between blocks that would support dispersal. The final rule recommended the physiographic

province as the primary basis for assessing actions under section 7 of ESA. A complete description of owl critical habitat is found in the final rule designating critical habitat (USDI 1992a).

C. Mammals

1. Canada Lynx (*Lynx canadensis*)

Listing Status and Description – The Canada lynx was listed as threatened in the contiguous United States on March 24, 2000 (USDI 2000). Canada lynx are specialized predators and their distribution coincides with the snowshoe hare. Studies in the southern portion of lynx range (Koehler 1990, Apps 2000, Squires and Laurion 2000) documented starvation as a primary cause of adult lynx mortality. The same studies reported low kitten survival. The LCAS provided guidance on maintenance of young, dense conifer vegetation to support higher densities of snowshoe hare. The LCAS also discussed the importance of mature, multiple-storied conifer vegetation that has dense horizontal cover at snow/ground level to snowshoe hare. Murray *et al.* (1994), Buskirk *et al.* (2000), Parker *et al.* (1983), and Dolbeer and Clark (1975) also described this condition. These two vegetation conditions, young, dense conifer and older, multi-storied stands, are very important to lynx because they support conditions suitable to higher densities of snowshoe hare.

Population Trends and Distribution – Historically and currently, lynx were and are present in Alaska and Canada from the Yukon and Northwest Territories east to Nova Scotia and New Brunswick and south into the continental U.S. Records document lynx occurrence in 24 states, including Washington and Oregon (McKelvey 2000). In Region 6 of the Forest Service, lynx habitat has been identified on the Okanogan/Wenatchee, Colville, Mt. Baker-Snoqualmie, Malheur, Wallowa-Whitman, Umatilla and Deschutes National Forests. Each National Forest maintains a map of lynx habitat.

Reasons for Decline – In the final listing rule, the Fish and Wildlife Service concluded that the single factor threatening the population was the inadequacy of existing regulatory mechanisms, specifically the lack of guidance for conservation of lynx in National Forest Land and Resource Management Plans and the BLM Land Use Plans.

Recovery Measures – The Canada lynx was listed as threatened in the contiguous United States on March 24, 2000 (USDI 2000). In the final rule, the Fish and Wildlife Service concluded that the single factor threatening the population was the inadequacy of existing regulatory mechanisms, specifically the lack of guidance for conservation of lynx in National Forest Land and Resource Management Plans and the BLM Land Use Plans.

2. Gray Wolf *(Canis lupus)*

Listing Status and Description – The gray wolf was listed as endangered in 1978. Wolves generally live in packs made up of 2 to 12 or more family members and individuals, lead by a dominant male and female. In other locations, denning by wolves generally occurs between April and June. Den sites often have forested cover nearby and are distant from human activity. The pups remain at the den site for the first 6 to 8 weeks, then they move to a rendezvous site until they are large enough to accompany the adults on a hunt (Peterson 1986). Once the pups are large enough to go hunting, the pack travels throughout its territory.

Population Trends and Distribution – Recent observations indicate that wolves exist in Washington, likely in small numbers, and mostly as individuals. Several family units have been documented, indicating that some level of recolonization has occurred recently (Almack and Fitkin 1998). Olterman and Verts (1972) considered wolves to have been extirpated from Oregon since the last animal was bountied in 1946. However, single animals from the experimental population in Idaho have been sighted in northeastern Oregon within the last five years (including a radio-collared animal).

Reasons for Decline – In 1930, it was believed that breeding populations of wolves in Washington were extinct because of fur trading pressure in the 1800's followed by the establishment of bounties on all predators in 1871 in the Washington Territory (Young and Goldman 1944).

Recovery Measures – A recovery plan was signed on August 3, 1987.

3. Grizzly bear *(Ursus arctos horribilis)*

Listing Status and Description – The grizzly bear was listed as a threatened species in the conterminous United States in 1975.

Population Trends and Distribution – Historically, in North America, the grizzly's range extended from the mid-plains westward to the California coast and south into Texas and Mexico (USFWS 1993). In Washington, the grizzly's range is limited to the North Cascades and the Selkirk mountains (Mt Baker-Snoqualmie, Okanogan/Wenatchee and Colville NFs). In Oregon, the grizzly bear is considered extirpated (Verts and Carraway 1998). Little is known about the grizzly bears residing in the North Cascades. It is suspected that their habits are similar to bears from other areas.

Reasons for Decline – Livestock depredation control, habitat deterioration, commercial trapping, unregulated hunting, and protection of human life were leading cause of the decline of grizzly bears (USFWS 1993). Human disturbance, usually increased with road access into grizzly habitat, is known to affect bear use of seasonal habitat components. In general, roads increase the probability of bear-human encounters and human induced mortality (USFS 1994).

Recovery Measures – Two of the six ecosystems identified in the grizzly bear recovery plan (USFWS 1993) are in Washington, the Northern Cascades Recovery Zone and the Selkirks Recovery Zone. Almack *et al.* (1993) estimated the 1991 grizzly bear population in the North Cascades recovery area at less than 50, and perhaps as low as 5 to 20.

4. Woodland Caribou *(Rangifer tarandus caribou)*

Listing Status and Description – The woodland caribou was federally listed as endangered in 1983. Woodland caribou are generally found on moderate slopes above approximately 1,200 m (4,000 feet) elevation in the Selkirk Mountains in Englemann spruce/subalpine fir and western red cedar/western hemlock forest types (USFWS 1994). Caribou use streams, bogs, basins, and other areas that are no more than 35 percent slope and are composed of mature or old-growth timber (Freddy 1974; Simpson and Woods 1987).

Population Trends and Distribution – Prior to 1900, woodland caribou were distributed throughout much of Canada and the northeastern, north-central, and northwestern coterminous United States. Since the 1960's, the woodland caribou population has restricted its range to the Selkirk Mountains of northeastern Washington, northern Idaho and southeastern British Columbia. In Washington State, caribou are found east of the Pend Oreille River in Pend Oreille County.

The recovery area for caribou in the South Selkirk Mountains is comprised of approximately 5,700 km2. About 47 percent of the area lies in British Columbia and 53 percent lies in the United States. The United States portion includes the Salmon-Priest Wilderness and other portions of the Colville and Idaho Panhandle National Forests, Idaho Department of Lands holdings, and scattered private parcels (USFWS 1994). As recently as the 1950s, the South Selkirk Mountains population consisted of an estimated 100 animals (Evans 1960). However, by the early 1980s, the population had declined to 25-30 animals whose distribution centered around Stagleap Provincial Park, British Columbia (Scott and Servheen 1985). Stagleap is a small park located a few miles north of the U.S. - Canadian border.

Reasons for Decline – Habitat fragmentation and loss, predation, poaching, and disease have all contributed to the decline of woodland caribou in North America. The small, South Selkirk Mountains population is extremely vulnerable to predation, accidental deaths and poaching (USFWS 1994). Predation from mountain lions (*Puma concolor*) may have contributed to the decline of the last population of endangered mountain caribou (*Rangifer tarandus caribou*) in the United States (Katnik 2002).

Recovery Measures – The U.S. population was augmented in 1987, 1988, and 1990 by transplanting a total of 60 animals from central British Columbia into northern Idaho. In 1996-1998, a total of 43 woodland caribou were transplanted into northeast Washington and Stagleap Provincial Park. The current population estimate for the ecosystem is 37 animals (Audet pers. com. 2002). Since the late 1980s, habitat for caribou in the ecosystem has been managed according to guidelines developed by the U.S. Forest Service, B.C. Ministry of Environment, and Idaho Department of Lands, which were developed in an attempt "to minimize the effects of logging on caribou and…to develop silvicultural standards that may enhance habitat over the long term." (USFWS 1994). The potential for habitat loss due to large wildfires or insect/disease attack is an ongoing management concern.

D. Plants

1. Howell's spectacular thelypody (*Thelypodium howellii ssp. spectabilis*)

Listing Status and Description– Howell's spectacular thelypody (thelypody) was federally listed on May 26 1999 without Critical Habitat designation. This species is also on the state of Oregon's State Endangered Plant list. A recovery plan was finalized for Howell's spectacular thelypody on June 3, 2002.

Howell's spectacular thelypody is an herbaceous biennial that reaches approximately 60 cm (24 in) tall, with branches arising from near the base of the stem. The basal leaves are approximately 5 cm (2 in) long with wavy edges and are arranged in a rosette. Stem leaves are shorter, narrow, and have smooth edges. Flowers appear in loose spikes at the ends of the stems. Flowers have four purple petals approximately 1.9 cm (0.75 in) in length, each of which is borne on a short stalk. Fruits are long, slender pods (Kagan 1986b).

The plant flowers in May, fruits in June and goes dormant in August. It is a root forming plant and is pollinated by insects. The thelypody occurs in wet alkaline meadows in valley bottoms, usually in and around woody shrubs that dominate the habitat on the knolls and along the edge of the wet meadow habitat between the knolls. Associated species include *Sarcobatus vermiculatus* (greasewood), *Distichlis stricta* (alkali saltgrass), *Elymus cinereus* (giant wild rye), *Spartina gracilis* (alkali cordgrass), and *Poa juncifolia* (alkali bluegrass) (Kagan 1986b). Soils are pluvial-deposited alkaline clays mixed with recent alluvial silts, and are moderately well-drained (Kagan 1986b). The thelypody may be dependent on periodic flooding since it appears to rapidly colonize areas adjacent to streams that have flooded (Kagan 1986b). In addition, this taxon does not compete well with encroaching weedy vegetation such as *Dipsacus fullonum* (teasel) (Davis and Youtie 1995).

Population Trends and Distribution – This taxon was thought to be extinct until rediscovered by Kagan in 1980 near North Powder (Kagan 1986b). The 11 recently discovered sites containing the thelypody are located near the communities of North Powder, Haines, and Baker. The North Powder thelypody population contains five sites; the largest is subject to a conservation easement 41.4 ac (16.8 ha). Until recently, one site near the town of North Powder, less than 2.3 ac (0.8 ha) in size, had a plant protection agreement between the landowner and The Nature Conservancy. The Haines plant population currently consists of three small sites located in or near the town of Haines. Since the publication of the proposed rule, an additional site in Haines was identified (B. Russell, consultant, in litt. 1998) and one previously known site in Haines was apparently extirpated by development (P. Brooks, Forest Service, in litt. 1998). A 1.8 ac (0.7 ha) site west of Baker is within a 20 ac (8 ha) pasture adjacent to a road. Another site north of Baker 0.08 ac (0.03 ha) exists in a small remnant of meadow habitat surrounded by farmland. One site approximately 8 km (5 mi) north of North Powder is located on private land at Clover Creek (Kagan 1986b).

Reasons for Decline – The thelypody has been extirpated from about one-third of known historic sites, including the type locality in Malheur County. Threats to the taxon include 1) habitat loss due to urban and agricultural development; 2) habitat degradation due to livestock grazing and hydrological modification; 3) consumption by livestock; 4) use of herbicides or mowing during the growing season; and 5) competition with exotic species such as teasel (*Dipsacus fullonum*), bull thistle (*Cirsium vulgare*), Canada thistle (*C. canadensis*), and yellow sweet clover (*Melilotus officinalis*).

Most of the habitat for the thelypody has been modified or lost to urban and agricultural development. Habitat degradation at all remaining sites for this species is due to a combination of livestock grazing, agricultural conversion, hydrological modifications, and competition from non-native vegetation. These activities have resulted in the extirpation of thelypody from about half its former range in Baker, Union, and Malheur counties. Plants at the type locality in Malheur County are considered to be extirpated due to past agricultural development (Kagan 1986b).

Within the City of Haines, all remaining habitat containing thelypody is being impacted by residential construction, trampling, and other activities. In 1994, a large section of habitat formerly occupied by thelypody at the Haines rodeo grounds was destroyed when a parking lot was constructed. In 1998, an estimated 5,000 to 10,000 thelypody plants were reduced to

fewer than 300 plants due to additional disturbances that occurred at the rodeo. Most of the extant plants in the population now occur outside the rodeo grounds. It is possible that the thelypody population may recover from this disturbance, but it is not likely (E. Rey-Vizgirdas, in litt. 1998).

Recovery Measures – The thelypody recovery plan calls for the protection of five self-sustaining thelypody populations throughout its extant and historic range. Each of the five populations should have management plans providing for the plant's long-term protection and have stable or increasing trends for 10 years.

Currently, four populations of thelypody receive protection from development and are managed for conservation. The BLM has managed a population for several years until recently near North Powder on private land under a conservation easement. Three populations are managed by ODOT under a SMA (N. Testa, pers. comm. 2006). Another population near North Powder was leased by TNC for 15 years, but lease negotiations were not renewed.

The Service has funded the ODA to develop cultivation and outplanting methods for several years and in the process several populations have been re-introduced.

2. MacFarlane's Four-O'clock (*Mirabilis macfarlanei*)

Listing Status and Description – MacFarlane's Four-O'clock was first listed as endangered in 1979, and was reclassified to threatened in 1996 due to improvement in the status of the species and discovery of additional populations (USDI 1996b). *Mirabilis macfarlanei* generally occurs as scattered plants on open, steep talus slopes within canyon land corridors. Because Mirabilis taxa are mainly restricted to the southwest, it is unusual for this species to exist as far north as west-central Oregon and northeastern Oregon, and it is thought that the genus expanded northward during a period of warmer climate.

Population Trends and Distribution – The species now occurs in three geographically isolated units in Oregon and Idaho. The population in the Snake River Unit occurs on Wallowa-Whitman National Forest lands, with the majority of the plants in the Hells Canyon National Recreation Area. A recovery plan was completed for the species in 1985.

Reasons for Decline – Discovery of additional localities on public lands, better grazing management, and the static condition of existing populations in both the Salmon River and the Snake River evolutionary units have reduced the degree of threat to this species. However, continued threats include lack of recruitment in some areas, insect predation, and alien plant invaders

Recovery Measures – None to date.

3. Marsh Sandwort (*Arenaria paludicola*)

Listing Status and Description – *Arenaria paludicola* was listed as endangered in 1993 (USDI 1993). *Arenaria paludicola* is an obligate wetland species that requires highly saturated soils to persist.

Population Trends and Distribution – This species was historically known from swamps and freshwater marshes in four counties in California, as well as Washington State, but the sole extant population occurs at Black Lake Canyon in San Luis Obispo County, California. The only known collection of *Arenaria paludicola* in Washington was in 1896 near Tacoma. This species has not been documented on any of the Forests included in this BA, but is suspected to occur on the Olympic NF.

Reasons for Decline – The primary threats are urban development, alteration in hydrology, competition with alien plant species, and stochastic extinction due to the small number of individuals and populations that remain.

Recovery Measures – None to date.

4. Showy Stickseed (*Hackelia venusta*)

Listing Status and Description – *Hackelia venusta* was listed as endangered in 2002 (USDI 2002a). *Hackelia venusta* is shade intolerant and grows in openings within Ponderosa pine and Douglas-fir forest types. It is found on open, steep slopes (minimum of 80% inclination) of loose, well-drained, granitic weathered and broken rock fragmented soils at an elevation of about 1,600 feet (486 meters) (USDI 2002a).

Population Trends and Distribution – This species is a narrow endemic restricted to one small population of approximately 500 plants on less than 2.5 acres (1ha) of unstable, granitic talus on the lower slopes of Tumwater Canyon, Chelan County, Washington. This site is located on the Okanogan-Wenatchee NF.

Reasons for Decline –Threats to the species include habitat modification associated with fire suppression, competition and shade from native shrubs and trees and nonnative noxious weeds, maintenance of the highway located near the known population, low reproductive capacity, and incidental loss from human trampling

Recovery Measures – None to date.

5. Spalding's Catchfly (*Silene spaldingii*)

Listing Status and Description – Spalding's Catchfly was listed as threatened in 2001 (USDI 2001b), and at the time of listing, it was known from a total of 52 populations in the United States and British Columbia, Canada. Spalding's Catchfly is primarily restricted to mesic prairie or steppe vegetation of the Palouse region, which is considered a subset of the Pacific Northwest bunchgrass habitat type.

Population Trends and Distribution – Seven of these populations occurred in Oregon (Wallowa County) and 28 in Washington (Asotin, Lincoln, Spokane, and Whitman Counties). For the area covered by this BA, it has been documented on the Umatilla and Wallow-Whitman NFs. The species is also found in canyon grassland habitat dominated by the same bunchgrass species as Palouse prairie, but the two habitat types differ in their overall plant species composition as well as topography. Canyon grasslands occur in steep, highly dissected canyon systems whereas Palouse grasslands generally occur on gently rolling plateaus.

Reasons for Decline – More than 98% of the original Palouse prairie habitat type has been lost or modified. Much of the remaining habitat occupied by *Silene spaldingii* is fragmented. Additional threats are habitat destruction and further fragmentation by agricultural and urban development, trampling by native herbivores and livestock, herbicide treatment, and competition from nonnative plants species.

Recovery Measures – None to date.

6. Ute Ladies'- Tresses (*Spiranthes diluvialis*)

Listing Status and Description – *Spiranthes diluvialis* was federally listed as threatened in 1992 (USDI 1992c) when it was only known from Colorado, Utah, and Nevada. Ute ladies'-tresses is a perennial, terrestrial orchid that is endemic to moist soils in mesic or wet meadows near springs, lakes, or perennial streams (USFWS 1995). The species is found in a variety of soil types ranging from fine silt/sand to gravels and cobbles, and has also been found in highly organic or peaty soils. The species has not been found in heavy or tight clay soils or in extremely saline or alkaline soils (pH>8.0) (USFWS 1995). It is generally intolerant of shade, preferring open grass and forb-dominated sites.

Population Trends and Distribution – Ute Ladies'-Tresses has been found in Wyoming, Montana, Nebraska, Idaho and Washington. The species is located in Okanogan and Chelan Counties in Washington State, but has not been documented on federal land, although it is suspected to occur on the Okanogan-Wenatchee NF, and also on the Wallowa-Whitman NF in Oregon.

Reasons for Decline – The main threat factors cited for listing were loss and modification of habitat and the hydrological conditions of existing and potential habitat. The orchid's pattern of distribution in small, scattered groups, restricted habitat, and low reproductive rate under natural conditions make it vulnerable to both natural and human-caused disturbances.

Recovery Measures – A draft recovery plan was issued in 1995 (USFWS 1995).

7. Water Howellia (*Howellia aquatilis*)

Listing Status and Description – *Howellia aquatilis*, a wetland plant, was listed as a threatened species in July 1994 (USDI 1994). *Howellia aquatilis* is an aquatic annual plant that is restricted to small vernal, freshwater, ephemeral wetlands which have an annual cycle of filling up with water over the fall, winter and early spring, followed by drying during the summer months. The species grows in firm consolidated clay and organic sediments that occur in wetlands associated with ephemeral glacial pothole ponds and former river oxbows. The plant's microhabitats include shallow water and the edges of deep ponds that are partially surrounded by deciduous trees.

Population Trends and Distribution – The historic range of this species included California, Idaho, Montana, Oregon and Washington, but the range has subsequently been reduced to Idaho, Montana and Washington (USDI 1994). It has been reported from Clackamas, Marion, and Multnomah Counties in Oregon, and from Mason, Thurston, Clark and Spokane Counties in Washington. It is believed to have been extirpated from California and Oregon, and from Mason and Thurston Counties in Washington. Extant populations occur in Washington in Spokane and Clark Counties. The species has not been documented

on any Forest included in this BA, but is suspected based on presence of potential habitat on the Gifford Pinchot and Okanogan-Wenatchee NFs.

Reasons for Decline – *Howellia aquatilis* has narrow ecological requirements and subtle changes in its habitat could affect a population. Threats to the populations include loss of wetland habitat and habitat changes due to timber harvest and road building, livestock grazing, residential and agricultural development, alteration of the surface or subsurface hydrology, and competition from introduced plant species such as reed canary grass (*Phalaris arundinacea*) and purple loosestrife (*Lythrum salicaria*) (USDI 1994).

Recovery Measures – None to date.

8. Wenatchee Mountains Checker-Mallow (*Sidalcea oregana var. calva*)

Listing Status and Description – The Wenatchee Mountains Checker-Mallow was federally listed as endangered in 1999 (USDI 1999b). Critical habitat was designated in 2001 (USDI 2001a). *Sidalcea oregana var. calva* is a perennial plant with a stout taproot that branches at the root crown and gives rise to several stems that are 20 to 150 centimeters in length. Pink flowers begin to appear in middle June and peaks in the middle to end of July. Fruits are ripe by August (USDI 1999b).

Population Trends and Distribution – Although the species *Sidalcea oregana* (Oregon checker-mallow) occurs throughout the western United States, *S. oregana var. calva* is known only to occur at six sites (populations) in the mid-elevation wetlands and moist meadows of the Wenatchee Mountains in central Washington state (USDI 2001a). The only unit included in this BA where the species has been documented is the Okanogan-Wenatchee NF. *Sidalcea oregana* var. calva is most abundant in moist meadows that have surface water or saturated upper soil profiles during spring and early summer. It may also occur in open conifer stands dominated by ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*) and on the margins of shrub and hardwood thickets. Populations are found at elevations ranging from 1,900 to 4,000 feet. Soils are typically clay-loam and silt-loams with low moisture permeability.

Reasons for Decline – The primary threats to this species include alterations of hydrology, rural residential development and associated activities, competition from native and alien plants, recreation, fire suppression, and activities associated with fire suppression. To a lesser extent threats include livestock grazing, road construction, and timber harvesting and associated impacts including changes in surface-runoff in the small watersheds in which the plant occurs (USDI 1999b).

Recovery Measures – The area designated as critical habitat for the Wenatchee Mountains Checker-Mallow includes all of the lands that have the primary constituent elements below 1,000 m (3,300 ft) within the Camas Creek watershed and in the small tributary within Pendleton Canyon before its confluence with Peshastin Creek, and includes: (1) The entire area encompassed by the Camas Meadow Natural Area Preserve, which is administered by the WDNR; (2) two populations located on Forest Service land; (3) the small drainage north of the Camas Land, administered by the WDNR; (4) the population on private property located in Pendleton Canyon; and (5) the wetland complex of these watersheds necessary for providing the essential habitat components on which recovery and conservation of the

species depends (USDI 2001a). Portions of the designated critical habitat are presumably unoccupied by *Sidalcea oregana var. calva* at present, although the entire area has not been recently surveyed. Soil maps indicate that the entire area provides suitable habitat for the species, and there may be additional, but currently unknown, populations present (USDI 2001a).

9. Rough Popcornflower (*Plagiobothrys hirtus*)

Listing Status and Description –The rough popcornflower was federally listed as endangered in January, 2000 (US Fish and Wildlife Service 2000). This species is also on the state of Oregon's State Endangered Plant list. A recovery plan was published for the species on July 28, 2003 (US Fish and Wildlife Service 2003).

Rough popcornflower can be a perennial, growing to 70 cm tall, with dozens of flowering stems and hundred of flowers, or can be a diminutive annual with only a few flowers (Amsberry 2001). At Popcorn Swale Preserve, rough popcornflower generally reaches peak growth and flowering by mid-June. By July 1, many plants have dropped seed and are senescing. By July 15, rough popcornflower generally appears gray-brown and crispy although a rare flower or two may be found low to the ground in moister, shaded areas. Although most plants are dormant by mid-July, perhaps around one percent of individuals may still be green and actively growing and flowering.

Rough popcornflower, like most borages, can potentially produce four nutlets per flower (Smith 1977). In most sites, copious numbers of mature seeds were observed from mid-June through early September, but plants in a few wetter habitats delayed seed maturation until the beginning of August. The number of seeds produced by individual plants is largely controlled by the number of flowers produced, and correspondingly, large plants produce more flowers.

This herb is endemic to seasonal wetlands in the interior valley of the Umpqua River in southwestern Oregon between Yoncalla and Wilbur, Oregon. Known occurrences for the plant are associated with Calapooya, Sutherlin, and Yoncalla creek drainage systems in Douglas County. Rough popcornflower habitat has been characterized as open seasonal wetlands at elevations ranging from 30 to 270 m (98 to 886 ft). Populations are known to occur on six different soil types (Conser silty clay loam, Bashaw silty clay loam, Brand silty clay loam, , Nonpareil loam, Oakland silt loam, and Sibold fine sandy loam) but there is a positive correlation only for Conser silty clay loam (Fish and Wildlife Service 2000). Seasonal flooding and fire are natural ecological functions considered necessary for long term population viability of the plant. These processes maintain the open habitat upon which the species is dependent and limit competition from invasive native and non-native species.

The wetland plant community at rough popcornflower habitats may include red-root yampa, a federal species of concern, great camas (*Camassia leichtlinii var. leichtlinii*), Douglas meadowfoam (*Limnanthes douglasii*), California oatgrass, one-sided sedge (*Carex unilateralis*), pointed rush (*Juncus oxymeris*), meadow barley (*Hordeum brachyantherum*), and Cusick's checkermallow (*Sidalcea cusickii*). Bottomland riparian ash woodland along Sutherlin, Calapooya, and Yoncalla creeks provides cover for abundant Columbia white-tail deer (*Odocoileus virginianus leucurus*).

Population Trends and Distribution – Rough popcornflower occurs in only 17 isolated patches of habitat in the vicinity of Sutherlin and Yoncalla, Douglas County, Oregon (Table 1). A total of 20,147 plants are estimated to occur on approximately 16 ha (40 ac). Fifteen of the 17 patches are on private or commercial land, including three patches managed by The Nature Conservancy. Two patches occur on state land managed by ODOT and are conserved under State law. The Nature Conservancy, ODOT, and ODA Plant Conservation Program have initiated monitoring, life history studies, and transplantation experiments with the objective to increase population sizes on habitat patches. Two additional populations have been introduced on the Roseburg District, BLM lands. Monitoring and enhancement is on-going for these populations. The BLM intends to introduce at least one more population of rough popcornflower within suitable habitat. These introduced populations will need to persist for at least five years before they will be considered successfully established.

Reasons for Decline – Most of the mapped historic occurrences of the species have been destroyed or deteriorated by development in the vicinity of the town of Sutherlin in the last twenty years. Destruction of wetlands due to drainage for agricultural uses. Pools adjacent to altered land may also be affected due to the changes in hydrology (USFWS 2003b). Wetland destruction due to urban development (USFWS 2000c). Heavy spring and summer grazing by cattle and sheep. Limited grazing may help to control exotic weeds and remove thatch buildup (USFWS 2000c). Invasive exotic weeds such as teasel (*Dipsacus fullonum*), knapweed (*Centaurea sp*.), Eurasian blackberry (*Rubus discolor*), and pennyroyal (*Mentha pulegium*) (USFWS 2000c). Fire suppression resulting in encroaching native oaks and ash trees which shade Plagiobothrys hirtus ssp. hirtus (USFWS 2000c). Reduced gene flow due to habitat fragmentation (USFWS 2000c). Rough popcornflower is threatened by habitat loss or degradation, livestock grazing, and competition from native and non-native plant species.

Recovery Measures – Ten populations of rough popcornflower are currently protected from development. One population is on land managed by Douglas County Soil and Water Conservation District. Three are on ODOT right-of-ways and two are on land managed by The Nature Conservancy at the Popcorn Swale Preserve. One population occurs on City of Sutherlin land. Three populations were introduced to Roseburg BLM. A recent inventory for new and known populations was conducted throughout the range in 2005 by ODA. Documentation of the distribution and abundance of rough popcornflower began in 1995 and has continued annually, except for 2001 for the TNC and the BLM populations. In June 2003, TNC counted 13,065 plants at Popcorn Swale Preserve, but by June 2005 the number was down to 10,000.

10. Macdonald's Rockcress (*Arabis mcdonaldiana Eastwood)*

Listing Status and Description – McDonald's rock-cress was federally listed as endangered without critical habitat in 1978. A recovery plan was published for the California populations in 1990. McDonald's rock-cress is one of several closely related endemic species (species restricted to a well-defined geographic area) which have evolved in the Siskiyou Mountains region of southwest Oregon and northwest California. This species was not discovered in Oregon until 1980. It is an attractive plant, as are many of the endemic rock-cress species of the Siskiyou Mountains. Taxonomic studies are currently underway to investigate the relationship of the Oregon population to those in California.

Population Trends and Distribution – This species is restricted to Curry County in Oregon on U.S. Forest Service and private land and in adjacent Del Norte County, California. It has also been reported from Mendocino County, California. McDonald's rock-cress is s perennial species in the mustard family (*Brassicaceae*). This species has a branched caudex (short, vertical, often woody stem at or just beneath the ground surface) and several simple stems that measure 5-20 cm (2-8 in) in height. The lower leaves are in rosettes (a cluster of leaves in a circle), are spatulate (rounded above and narrowed to the base), measure 1-2 cm (0.4-0.8 in) long and 4-7 mm (0.2-0.3 in) wide, are toothed, and are essentially smooth. The petals are rose or purple in color and measure 9-11 mm (0.35-0.43 in) long. The fruits are siliques (elongate, dry, and open at maturity) that measure 3-4 cm (1.2-1.6 in) long. Flowering typically occurs from late April through June. This species is distinguished from other rock-cress species by being almost glabrous (without hairs or glands) and by possessing spatulate basal leaves 1-2 cm (0.4-0.8 in) long. McDonald's rock-cress occurs on serpentine soils (high in magnesium, iron, and certain toxic metals). This species is found below 1500 m (4920 ft) elevation in dry, open woods or brushy slopes, with sanicles (*Sanicula spp.),* violets (*Viola spp*.), and onions (*Alium spp*.).

Reasons for Decline – Mining activities and collection of specimens has contributed to the decline of this species.

Recovery Measures – None to date.

11. Gentner's fritillary (*Fritillaria gentneri*)

Listing Status and Description – Gentner's fritillary was federally listed as endangered on December 10, 1999 (64 FR 237) without critical habitat designation. The species is also on the State of Oregon's State Endangered Plant list. A recovery plan for the species was published on July 21, 2003. Gentner's fritillary is a perennial herb arising from a fleshy bulb producing numerous small rice-grained bulblets. The plant also produces several large scales surrounded by 10 to 150 small rice-grained bulblets per plant (USFWS 2003a). Gentner's fritillary forms large maroon to bright reddish flowers with yellow mottles that are easily observed in the early spring. The flowers are solitary, or in bracted racemes, 1 to 7 (rarely more) on long slender pedicels. The 2.5 to 4.0 cm bell-shaped flower has segments that bend more or less outward, at times straight, but are not strongly recurved like the common scarlet fritillary (*Fritillaria recurva*).

The fritillary emerges from the ground in early February, flowers from mid-April to early June, and is dormant from mid-August to mid-January. Non-flowering fritillaries greatly outnumber flowering plants in natural populations, and are recognizable only by their single ovate to lanceolate basal leaf, indistinguishable from several other common related fritillaries. Due to poor and erratic seed production, bulblet production and disbursement are the principal means of Gentner's fritillary propagation.

Recent research (Amsberry and Meinke 2002) has documented erratic and extremely low seed production in the species. This research has indicated that the plant is largely reproducing asexually. Pollination studies by the ODA and Oregon State University (Amsberry and Meinke, 2002) conducted in the Jacksonville Woodlands and the Jacksonville Cemetery did not produce a single viable seed.

A population of fritillaries consists of plants at three different life stages: flowering plants, vegetative mature plants, and vegetative juvenile plants. Using data provided by Brock and Knapp (2000), it is estimated that each flowering fritillary located in a population represents an estimated 40 plants from all three life stages.

Gentner's fritillary occurs in a variety of habitats including oak woodlands dominated by Oregon white oak (*Quercus garryana*), mixed hardwood forest dominated by California black oak (*Quercus kelloggii*), Oregon white oak, and madrone (*Arbutus menziesii*), and coniferous forests dominated by madrone and Douglas-fir (*Pseudotsuga menziesii*). The 25 soil types that the plant has been known to occur on are Abegg, Beckman-Colestine complex, Brader-Debenger complex, Caris-offennbacher complex, Cornutt-Dubakelia complex, Dubakella-Pearsoll complex, Farva, Heppsie, Heppsie-McMullin complex, Holland, Langellain, Langellain-Brader complex, Manita, McNull-Medico complex, McMullin-Rockoutcrop complex, McNull, McNull-Medco complex, McNull-McMullin complex, Ruch, Tallowbox, Tatouche, Vannoy, Vannoy-Voorhies complex, Woodseye-rockoutcrop complex and Xerothents-Dumps complex (USDI 2003). The soil types most commonly supporting the plant are Vannoy and Vannoy-Voorhies complex.

Population Trends and Distribution – There are approximately 90 populations of Gentner's fritillary. The largest single documented occurrence to date for Gentner's fritillary (Pilot Rock Lower, Cascade Siskiyou National Monument, Medford District, BLM) contained 600 flowering plants in 2004 (Brock and Callagan 2004). The larges area occupied by Gentner's fritillary is at the Jacksonville Woodlands with plants distributed sparsely over approximately 100 acres. The smallest population known is one plant (Brock and Callagan 2004). A total of 1952 flowering plants were observed on BLM lands in 2004. Seven new populations were found during the field season of 2003 on Medford BLM lands. Currently perilously small, widely scattered populations with one to five flowering adult each comprise an estimated 80 percent of the entire population.

Gentner's fritillary occurs in Jackson and Josephine counties in Oregon and in northern Siskiyou County in California and is often associated with open oak woodlands. The range of the fritillary extends from just below the California border in Siskiyou County to Applegate Lake and Pilot Rock north to the communities of Butte Falls, Sunny Valley, and Galice. Most known sites on federal land occur near the communities of Jacksonville, Ruch, Rogue River, Gold Hill, Sam's Valley, Grants Pass, and Merlin. Large areas of suitable habitat on private lands within the range have not been surveyed and may be occupied.

Reasons for Decline – Habitat loss is the main threat to this species. Habitat loss due to ongoing or future development may occur at 42 percent of the known occupied sites (64 FR 237, 1999). Gentner's fritillary populations are often directly impacted by development in the form of housing construction, cemetery expansion, trail maintenance, road widening, landfill expansion, power line maintenance, water system construction, and agricultural conversions (64 FR 237, 1999). These activities primarily occur on private lands. Between 1941 and the present, the plant has been extirpated from eight of 114 known populations due to developmental expansion.

Recreational collection of plants could adversely affect the species, especially along roads, where the plant is more observable and most vulnerable. Because the species occurs in

small, isolated clusters, an entire patch could be decimated in one gathering, extirpating the plant from that area.

Fritillaries appear to be a strongly preferred food choice by deer, which go to great lengths to eat flower stalks. Predation could conceivably reduce plant numbers and productivity. Many plant flowers are browsed before producing mature fruit. Many of the plants that were tagged for seed collection by Wayne Rolle, in 1988, had the capsules eaten by wildlife before the seed capsules matured (64 FR 237, 1999). Since the species does not appear to produce viable seeds, floral and/or upper stem herbivory may yield little impact. Intensive grazing (including trampling) by livestock at some sites may pose a much greater threat than browsing by deer (USFWS 2003a).

Private land owners are not required to protect State or federally listed plant species, except where projects are associated with federal funds or permits. As a result the plant receives nearly no protection from its State or federal status as endangered on private lands.

Fire exclusion has altered suitable habitat for the plant by permitting open oak woodland habitats to become more thickly wooded and less grassy. This transition can result in partial to total exclusion of plants. At the same time, the increase of homes in the area makes prescribed burning difficult. This has reduced suitable habitat for the plant while a less-than-optimal habitat condition is achieved that is also susceptible to catastrophic fire.

Of 40 monitored plant populations in 2003 by BLM contracts, 36 have less than 100 flowering individuals and 23 have zero to two flowering plants (Brock and Callagan 2003). The threat of extinction due to naturally occurring demographic and environmental events reduces the viability of the species as a whole. Because most plant sites occupy small areas, naturally occurring environmental events could also play a role in extirpation. Small clusters can disappear with one environmental event, such as erosion. Gentner's fritillary sites are small and isolated from each other due to habitat fragmentation. This isolation could inhibit re-colonization to other suitable areas and could result in a permanent loss of localized occurrences once they fall below a critical level.

Recovery Measures –Most Gentner's fritillary populations occur on Federal lands and are protected from development. The Medford BLM manages the majority of known Gentner's fritillary sites by performing annual monitoring, funding research to determine life history dynamics and funds recovery actions such as habitat restoration and population augmentation. All ground disturbing activities that are carried out or permitted on BLM lands are surveyed for Gentner's fritillary. The BLM will protect or conserve any listed plants that are located on BLM administered land.

ODOT also manages two Gentner's fritillary site on highway right-of-ways and has designated Special Management Areas (SMA) at the two locations. Management under the SMAs calls for annual or biennial monitoring and suspension of spraying, ditching, disking, or mowing activities to conserve the populations. ODOT also surveys suitable habitat for Gentner's fritillary for presence of new populations prior to ground disturbing activities.

The City of Jacksonville has developed a management plan to address restoration of a Gentner's fritillary population due to accidental construction of a road through the middle of

a populations and subsequent infestation of the noxious weed, Centaurea solstitialis (yellow star thistle). Currently the yellow star thistle is nearly under control and the population is being carefully monitored.

12. Nelson's checkermallow (*Sidalcea nelsoniana*)

Listing Status and Description – Nelson's checkermallow was listed as Threatended on February 12, 1993 (58 FR 8242) without designated critical habitat. This species is also on the state of Oregon's State Threatened Plant list. A recovery plan for the species was finalized on September 28, 1998.

Nelson's checkermallow is a perennial herb in the mallow family (*Malvaceae*). It has tall, lavender to deep pink flowers that are borne in somewhat open clusters 50 - 150 cm (19.2 – 48 in) tall at the end of short stalks. Plants are partially dioecious, in that they have either perfect flowers (male and female) or pistillate flowers (female only). The plant can reproduce vegetatively, by rhizomes, and by seeds, which drop near the parent plant. Flowering typically occurs from late May to mid-July, but may extend into September in the Willamette Valley. Fruits have been observed as early as mid-June and as late as mid-October. Coast Range populations generally flower later and produce seed earlier, probably because of the shorter growing season. Seed production for a Nelson's checkermallow plant is typically high. An average plant may produce between 300 and 3000 seeds, but could potentially exceed 10,000 seed (Gisler and Meinke 2004). The limiting factor of Nelson's checkermallow seed production is weevil damage. Weevils typically associated with the plants in the wild often infest flowers and eat flowers. Early in seed production, weevils often consume developing embryos and may account for 80 percent to 100 percent loss of pre-dispersal seed (Gisler and Meinke 2004).

Population Trends and Distribution – Nelson's checkermallow primarily occurs in Oregon's Willamette Valley, but is also found at several sites in Oregon's Coast Range and at two sites in the Puget Trough of southwestern Washington. The plant's range extends from southern Benton County, Oregon, north to Cowlitz County, Washington, and from central Linn County, Oregon, west to the crest of the Coast Range. The species is known to occur in 65 occurrences within five relict population centers in Oregon and Washington and occupy approximately 273 acres (110 hectares) (USFWS 1998).

Reasons for Decline – A serious long-term threat to all Willamette Valley prairie species is the change in community structure due to plant succession. The vast majority of Willamette Valley prairies would likely be forested if left undisturbed. The natural transition of prairie to forest in the absence of disturbance such as fire will lead to the eventual loss of these prairie sites unless they are actively managed (Franklin and Dyrness 1973, Johannessen *et al.* 1971, Kuykendall and Kaye 1993).

Habitats occupied by Nelson's checker-mallow contain native grassland species and numerous introduced taxa. In some areas, habitats occupied by Nelson's checker-mallow are undergoing an active transition towards a later seral stage of vegetative development, often due to the encroachment of non-native, invasive species (i.e., brush competition). Invasive woody species of concern include non-native plants such as Himalayan blackberry (*Rubus discolor*), multiflora rose (*Rosa multiflora*), European hawthorn (*Crataegus monogyna*), and Scotch broom (*Cytisus scoparius*). Invasive native species include Oregon ash, Douglas

hawthorn (*Crataegus douglasii*), Nootka rose (*Rosa nutkana*) and Douglas spiraea (*Spiraea douglasii*).

Due to this rapid invasion by woody vegetation (especially Scotch broom) in some areas and the suppression of natural fire regimes, secondary successional pressures on these plant populations are expected to increase over time. Habitat conversion via succession and/or agricultural activities poses measurable threats to the long-term stability of Nelson's checker-mallow populations.

Agricultural and urban development have modified and destroyed habitats, fragmenting populations into small, widely scattered patches. In the Willamette Valley, extirpation is an ongoing threat to many Nelson's checker-mallow occurrences on private lands, roadsides, and undeveloped lots zoned for industrial and residential development. Within the genus Sidalcea, the actual sex ratio (the number of functionally pistellate to perfect flowers) of a population may be a strong contributing factor to its genetic vigor or vulnerability such that the ratio of pistellate to perfect flowers may ultimately control the amount and quality of seeds produced regardless of habitat quality (Gisler and Meinke 1995). Likewise, seed predation by weevils prior to seed dispersal may also be a factor controlling seed production (Gisler and Meinke 1998).

Prior to European colonization of the Willamette Valley, naturally occurring fires and fires set by Native Americans maintained suitable Nelson's checkermallow habitat. Current fire suppression practices allow succession of trees and shrubs in Nelson's checkermallow habitat. Remnant prairie patches in the Willamette Valley have been modified by livestock grazing, fire suppression, or agricultural land conversion. Stream channel alterations, such as straightening, splash dam installation, and rip-rapping cause accelerated drainage and reduce the amount of water that is diverted naturally into adjacent meadow areas. As a result, areas that would support Nelson's checkermallow are lost.

The most serious management threat related to and land use faced by the 29 populations on private lands which are not subject to state and federal laws governing listed plant species. 17 years of population observation has documented the ongoing disturbance or complete extirpation of populations on private land due to non-industrial timber harvest operations, development, herbicide application, agricultural activities, and other land-use practices (CH2M Hill 1996) Although numerous checkermallow occurrences are on public lands many are threatened by inadvertent disturbance from roadside maintenance, herbicide application and mowing, soil cultivation, ditching, and other habitat modification.

Recovery Measures – A recovery plan has been written for Nelson's checker-mallow (USFWS 1998) which includes criteria for delisting. The plan is currently undergoing review and updates and will be included in a new Willamette Valley multi-species recovery plan; however, the 1998 recovery criteria apply in the interim. According to the 1998 plan, Nelson's checker-mallow will be considered for delisting when at least two reserves of 0.74 ac (0.3 ha) of secured habitat are occupied by Nelson's checker-mallow plants for each of the following eight hydrological sub-basins: Wlson-Trask-Nestucca, Upper Willamette, Middle Willamette, South Santiam, Molalla-Pudding, Yamhill, Tualatin, Lower Columbia-Clatskanie, and Upper Chehalis.

Additionally, regarding each 0.74-ac (0.3-ha) reserve: At least 0.12 ac (0.05 ha) of habitat must be occupied by Nelson's checker-mallow plants; On average for any 3 consecutive years, at least 30 percent of the occupied habitat must have reproductive plants; There must be evidence of seedling establishment and survival; and The reserve population must be stable or increasing for a period of 10 years.

13. Western lily (*Lilium occidentale*)

Listing Status and Description –Western lily was listed as federally endangered on August 17, 1994 (59 FR 42176). Critical habitat has not been designated for the species. This species is also on the state of Oregon's State Endangered Plant list. A recovery plan for the species was published on March 31, 1998.

Western lily was first collected by Carl Purdy from headlands around Humboldt Bay, California. He subsequently described the plant in 1897. Western lily, an herbaceous perennial in the lily family (*Liliaceae*), grows from a short unbranched, rhizomatous bulb, reaching a height of up to 2.4 m (8 ft). Leaves grow along the stem singly or in whorls and are up to 19 cm (7.5 in) long and pointed. The nodding flowers are red, sometimes deep orange, with yellow to green centers in the shape of a star and spotted with purple. The six petals (tepals) are 3 to 4 cm (1 to 1.5 in) long and curve strongly backwards. Fruit capsules become erect and may produce over 100 seeds when mature. This species can be distinguished from similar native lilies by the combination of pendent red flowers with yellow to green centers in the shape of a star, highly reflexed petals, non-spreading stamens closely surrounding the pistil.

Like other lilies, the western lily has hermaphroditic flowers (producing both pollen and seeds). The plant reproduces primarily by seed, but asexual reproduction is possible from detached bulb scales growing into new plants. A bulb scale is formed in the fall, and the first true leaf emerges the following spring. In cultivation, lilies may take 4 to 5 years to flower for the first time (Schultz 1989), and may live for 25 years or more (Kline 1984). Populations of non-flowering lilies may persist for many years under closed forest canopies (Imper *et al.* 1987).

In nature, western lily shoots emerge from the ground anywhere from late March to late May, with emergence occurring generally two to three weeks later in the northern part of the range compared to farther south. From June to July, green buds turn red for 3 to 5 days, open over a period of 1 to 2 days, and the nodding flowers will last for 7 to 10 days. After the floral parts have fallen off, capsules enlarge to maturity over a period of 40 to 50 days. Seeds are primarily dispersed by wind and gravity, mostly within a 4-m (13-ft) radius. Usually in September, the above ground portion of the plants die back and individuals become dormant underground as rhizomes or bulbs. Dead, above-ground shoots may persist for one or more years in protected sites before they collapse and decompose. From late September to February plants are usually dormant.

Hummingbirds are the primary pollinator of the lily, but some bees and other insects may also occasionally transfer pollen (Skinner 1988, Schultz 1989). Low fruit set in isolated plants or those concealed in dense vegetation stresses the importance that the flowers are suitably presented to hummingbirds (Schultz 1989).

Juvenile plants are often observed near flowering adult lilies. In suitable habitat, there are often more juvenile plants than adult flowering plants. At some sites, particularly the sites with more than 200 plants, the majority of plants were non-flowering, which is probably an indication of stress (Schultz 1989).

Genetic differentiation is highly probable in lily populations. Throughout the range of the lily, populations are often small and liable to be subject to random genetic drift, are geographically isolated, occur in areas with unique soil development and microclimates, and have observable differences in morphologic traits (Schultz 1989). These factors indicate a significant degree of genetic differentiation in the species across its range.

Lily populations appear to have been maintained in the past by occasional fires, at least at some sites in Oregon, and by grazing. Among the most serious current threats is loss of habitat due to ecological succession facilitated by aggressive fire exclusion and removal of grazing. What effects these vegetation changes have had on hydrological aspects of lily habitat, and vice versa, are not well understood.

The lily is found at the edges of sphagnum bogs, in forest or thicket openings along the margins of ephemeral ponds and small channels, coastal prairies, scrublands, and forest openings near the ocean where fog is common. Bogs where the plant is often found are composed of poorly drained, slightly acidic, highly organic soils, usually underlain by an iron pan, or poorly permeable clay layer.

Population Trends and Distribution – Western lily appears to be declining across much of its range (D. Imper, pers. comm. 2005). Of the 62 recorded historical lily populations, nearly half (29) of the sites appears to have been extirpated. Of the remaining 33 reported sites, five have not been surveyed recently and thus it is unknown if plants are still present. Only two sites have as many as 1,000 individuals, 14 sites have between 100 and 999, and 12 sites had 99 or fewer (D. Imper, pers. comm. 2005). Most locations of known lily occurrences and population counts are described in the western lily recovery plan (USFWS 1998b). Several sites have been added and others updated since the recovery plan publication date, for example, since 1989, an estimated 1,000 to 2,000 flowering plants were discovered at a site near Crescent City, California, where none were previously known (D. Imper, pers. comm. 2005).

Western lily populations are found at low elevations, from almost sea level to about 100 m (328 ft) in elevation, and from ocean-facing bluffs to about 6 kilometers (4 miles) inland. The lily is distributed along the coast from Hauser, Coos County, Oregon to Loleta, Humboldt County, California. The Hauser Bog is the northernmost population of western lily and is part of Recovery Area 1 (USFWS 1998b). The plant is currently known from 7 widely separated regions, and has been reported from 62 mostly small, isolated, densely clumped populations (D. Imper, pers. comm. 2005).

Reasons for Decline – The primary threat to the lily is human modification or destruction of habitat. The lily is limited to coastal habitat which is currently undergoing intense development pressure. The species' bog and coastal prairie/scrub habitat occurs on level marine terraces that are desirable for coastal development because of the gentle topography and proximity to the ocean.

From the 1940s to the present, conversion of bog habitat to cranberry farms, roads, and residential dwellings has eliminated suitable lily habitat as well as some populations of the plant in the area from Bandon south to Cape Blanco (Schultz 1989). In the Bandon area alone, 1,600 acres have been converted to cranberry farms, much of them in low depressions with Bandon Silty Loam soils, and therefore could be suitable for the western lily (Bandon, Oregon 2005). The largest known population and three smaller populations near Crescent City, California are currently threatened by habitat degradation due to watershed development. Other threats include forest succession and livestock grazing. These activities primarily occur on private lands. Clearing and draining along the Elk and Six Rivers for livestock grazing have eliminated many of the once numerous populations there. As recently as 1992, a lily population within the city of Brookings was inadvertently destroyed.

Recreational collection of lilies could adversely affect the species, especially along roads, where it is more observable and most vulnerable. Because the species occurs in small, isolated clusters, a collector could decimate an entire clump in one gathering, extirpating the plant from that area.

Years of fire exclusion have led to changes in lily habitat structure and composition. Fire exclusion has altered suitable habitat for the lily by permitting open coastal prairie and wetland habitats to become more thickly wooded. This transition can result in partial to total exclusion of lilies. Removal of livestock has had the same effects. At the same time, the increase of homes in the area makes prescribed burning difficult. This has removed suitable habitat for the lily and has simultaneously produced a less-than-optimal habitat condition that is also susceptible to catastrophic fire. Gorse is a highly fire prone and aggressive noxious weed, occurring in coastal habitat, that threatens not only to replace lily populations, but chemically and ecologically alter suitable habitat.

Although probably not as serious as other threats, grazing by vertebrates (elk, deer, voles, and domestic cattle) and invertebrates (beetle, moth, or butterfly larvae) has been documented for the lily. Of these grazers, deer may represent a major threat, at least in California. Even if not lethal, deer remove a considerable fraction of flowers and fruit, thus seriously reducing the reproductive output at many sites. Deer herbivory has occurred at nearly all sites, and has numerous times eliminated over half a population's annual seed production.

The threat of extinction due to naturally occurring demographic and environmental events reduces the viability of the species as a whole. Because most lily sites occupy small areas, naturally occurring environmental events could also play a role in extirpation. Small clusters can disappear with one environmental event, such as erosion. Many lily sites are small and isolated from each other due to habitat fragmentation. This isolation could inhibit re-colonization to other suitable areas and could result in a permanent loss of localized occurrences once they fall below a critical level.

Recovery Measures – In California, private individuals, in conjunction with Humboldt State University and the California Department of Fish and Game, have had a formal management plan in place since 1987 for the Table Bluff Ecological Reserve (Imper *et al.* 1987). Since that time, considerable work has been done to recover the lily at Table Bluff and an extensive

yearly monitoring record has been generated at this site and three nearby sites (U.S. Fish and Wildlife Service 1998). Various experimental habitat manipulations and monitoring are occurring in California at Table Bluff and in the vicinity of Humboldt Bay.

In Oregon, The Nature Conservancy has monitored and managed a small population at Bastendorff Bog since 1985. ODOT has also managed a population in their right-of-way near Hauser by improving habitat through vegetation control. Oregon Parks and Recreation Department has begun restoration of a lily population near Brookings, Curry County, by improving habitat through vegetation control. The Coos Bay BLM has updated a 1995 management plan that now includes provisions for the restoration of lily habitat at the New River ACEC that includes implementing conservation measures and public outreach activities as recommended in the 1998 lily recovery plan. The Coos Bay BLM also has funded a lily propagation study on the New River ACEC in conjunction with the Berry Botanic Garden (Guerrant 2004).

14. Willamette Valley Daisy (*Erigeron decumbens var. decumbens*)

Listing Status and Species Description – The Willamette Valley daisy was listed as endangered, without critical habitat, on January 25, 2000 (USFWS 2000b). This species is also on the state of Oregon's State Endangered Plant list. A recovery plan has not yet been developed for the species. A critical habitat determination was proposed for the species on November 2, 2005 (USFWS 2005b).

The Willamette daisy is a taprooted perennial herb in the sunflower or daisy family (*Asteraceae*). It grows 1.5 to 6 cm (0.6 to 2.4 in) tall, with erect to sometimes prostrate stems at the base. The basal leaves often wither prior to flowering and are mostly linear, 5 to 12 cm (2 to 5 inches) long and 3 to 4 mm (0.1 to 0.2 inches) wide. Flowering stems produce two to five heads, each of which is daisy-like, with pinkish to pale blue ray flowers and yellow disk flowers. Ray flowers often fade to white with age (Siddall and Chambers 1978). The morphologically similar Eaton's fleabane (*E. eatonii*) occurs east of the Cascade Mountains, while the sympatric species Hall's aster (*Aster hallii*) flowers later in the summer. In its vegetative state, the Willamette daisy can be confused with Hall's aster, but close examination reveals the reddish stems of Hall's aster in contrast to the green stems of the Willamette daisy (Clark *et al.* 1993).

The Willamette daisy typically flowers throughout June and July with pollination carried out by syphrid flies and solitary bees (Ingersoll *et al.* 1995, Jackson 1996). The daisy produces and subsequently disperses large quantities of wind-dispersed seed in July and August. The seeds of the daisy are achenes, like those of other Erigeron species, and have a number of small capillary bristles (the pappus) attached to the top, which allow them to be distributed by the wind. Due to the small size and number of these bristles, the seeds do not fly well in the wind, so seed distribution is quite restricted.

The Willamette daisy is capable of spreading vegetatively through rhizomes over very short distances of less than 10 cm (4 in) and is commonly found in large clumps scattered throughout a site (Clark *et al.* 1993).

Willamette daisy responds positively to late spring and early summer rains. Studies conducted at the Willow Creek Preserve indicate that not all individuals of the Willamette

daisy bloom every year, and that some individuals may remain dormant for an entire growing season (Kagan and Yamamoto 1987).

Population Trends and Distribution – The Willamette daisy is endemic to the Willamette Valley of western Oregon. Herbarium specimens show a historical distribution of Willamette daisy throughout the Willamette Valley; frequent collections were made in the period between 1881 and 1934, yet no collections or observations were recorded from 1934 to 1980 (Clark *et al.* 1993, Gisler and Meinke 2004). The species was rediscovered in 1980 in Lane County, Oregon, and has since been identified at 48 sites on 93.6 ac (37.9 ha).

Population size may fluctuate substantially from year to year. Monitoring at the Oxbow West site, near Eugene, found 2,299 Willamette daisy plants in 1999, 2,912 plants in 2000, and only 1,079 plants in 2001 (Kaye and Brandt 2005). The population at Baskett Butte declined to 48 percent of the original measured population between 1993 and 1999 (Clark 2000, Ingersoll *et al.* 1995). Detecting trends in Willamette daisy populations is complicated by the biology and phenology of the species. For instance, Kagan and Yamamoto (1987) found it difficult to determine survival and mortality between years because of irregular emergence and sporadic flowering from year to year. They suggested that some plants probably lie dormant during some years, as indicated by the sudden appearance of large plants where they were not previously recorded, and the disappearance and later re-emergence of large plants within monitoring plots. In addition, Clark *et al.* (1993) stated that non-reproductive individuals can be very difficult to find and monitor due to their inconspicuous nature, and that the definition of individuals can be complicated when flowering clumps overlap.

The Willamette daisy is primarily found in wet prairie grasslands, but is also found at a few drier upland prairie sites. The wet prairie grassland community, which was historically maintained by periodic flooding and fires, is characterized by the dominance of tufted-hairgrass, California oatgrass, and a number of Willamette Valley endemic forbs.

Reasons for Decline – Like many native species endemic to Willamette Valley prairies, the Willamette daisy is threatened by habitat loss due to urban and agricultural development, secondary successional encroachment of habitat by trees and brush, competition with non-native weeds, and small population sizes (Kagan and Yamamoto 1987, Clark *et al.* 1993, Gisler and Meinke 2004). The Fish and Wildlife Service (2000) estimated that habitat loss is occurring at 80 percent of remaining 84 remnants of native prairies occupied by Willamette daisy and Kincaid's lupine. The Fish and Wildlife Service (2000) also stated that 24 of the 28 extant Willamette daisy populations occur on private lands and, "without further action, are expected to be lost in the near future". Although populations occurring on private lands are the most vulnerable to threats of development (state and federal plant protection laws do not apply to private lands), publicly owned populations are not immune from other important limitations to the species. For instance, Clark *et al.* (1993) identified four populations protected from development on public lands (Willow Creek, Basket Slough NWR, Bald Hill Park, and Fisher Butte Research Natural Area), but stated that even these appear to be threatened by the proliferation of non-native weeds and successional encroachment of brush and trees. Likewise, vulnerability arising from small population sizes and inbreeding depression may be a concern for the species, regardless of land ownership, especially among 17 of the 28 remaining sites that are smaller than 8 ac (3.5 ha) (Fish and Wildlife Service

2000). Given the predominance of privately-owned populations, land ownership represents a serious obstacle to conservation and recovery of Willamette daisy.

Recovery Measures – Extensive research has been conducted on the ecology and population biology of the Willamette daisy, effective methods for habitat enhancement, and propagation and reintroduction techniques (Clark *et al.* 1995, Ingersoll *et al.* 1995, Clark *et al.* 1997, Clark *et al.* 2000, Kaye and Kuykendall 2001b, Leininger 2001, Kaye *et al.* 2003, Kaye and Brandt 2005). The results of these studies have been used to direct the management of Willamette daisy populations at Baskett Slough NWR, Eugene BLM, and Willamette Valley TNC preserves.

Several studies have investigated the feasibility of growing Willamette daisy in controlled environments for augmentation of wild populations. Cold stratification or seed-coat scarification is necessary for successful germination (Clark *et al.* 1995, Kaye and Kuykendall 2001b). Stem and rhizome cuttings have also been used successfully to establish plants in the greenhouse (Clark *et al.* 1995, Wilson *et al.* 2001). Attempts to establish Willamette daisy at new sites has shown that transplanting cultivated plants is much more effective than sowing seeds directly (Kaye and Brandt 2005).

The Fish and Wildlife Service's Partners for Wildlife Program works with private landowners to restore and conserve wildlife habitat. During the 2004 fiscal year, the Partners program worked on eight projects in Benton and Marion Counties, Oregon that restored 340 ac (137.6 ha) of wet prairie, oak savannah and upland prairie habitats, some of which will benefit Willamette daisy (A. Horstman, pers. comm. 2004).

15. Bradshaw's lomatium (*Lomatium bradshawii*)

Bradshaw's lomatium (also known as Bradshaw's desert-parsley) was listed as endangered, without critical habitat designation, on September 30, 1988 (USFWS 1988). This species is also on the state of Oregon's State Endangered Plant list. A recovery plan for the species was published on August 13, 1993.

Bradshaw's lomatium is a member of the Apiaceae (*Umbelliferae*) or the umbel or parsley family. The plant is a low, upright perennial arising from a long slender taproot that displays pale-yellow flowers. The plant's leaves are smooth, minutely inter-divided, glossy bluish-green, and strictly basal.

Bradshaw's lomatium flowering period peaks around the middle of April and beginning of May, but flowers may be observed as early as the first week of April through the end of May (Kagan 1980). The plant sets seed towards the middle of May and produces seed until dormancy in mid June. Over 30 species of bees, flies, wasps and beetles have been observed visiting the flowers (Kaye and Kirkland 1994, Jackson 1996). The very general nature of the insect pollinators probably buffers Bradshaw's lomatium from the population swings of any one pollinator (Kaye 1992).

Bradshaw's lomatium does not spread vegetatively and depends exclusively on seeds for reproduction (Kaye 1992). The large fruits have corky thickened wings, and usually fall to the ground fairly close to the parent. Fruits appear to float somewhat, and may be distributed

by water. Research has demonstrated that Bradshaw lomatium seed does not persist long in a seed bank and will usually germinate in one season (Kaye 1992).

Bradshaw's lomatium is restricted to wet prairie habitats often associated with tufted-hairgrass (*Deschampsia caespitosa*). In wetter areas, Bradshaw's lomatium occurs on the edges of tufted-hairgrass or sedge bunches in patches of bare or open soil. In drier areas, it is found in low areas, such as small depressions, trails or seasonal channels, with open, exposed soils. These sites have heavy, sticky clay soils. Most of the known Bradshaw's lomatium populations occur on seasonally saturated or flooded prairies, which are found near creeks and small rivers in the southern Willamette Valley. The population patterns appear to follow seasonal, microchannels in the tufted-hairgrass prairies, but whether this is due to dispersal or habitat preference in not clear (Kaye 1992, Kaye and Kirkland 1994).

The species generally responds positively to disturbance. Low intensity fire appears to stimulate population growth of Bradshaw's lomatium. The density and abundance of reproductive plants increase following fires (Pendergrass *et al.* 1999, Caswell and Kaye 2001), although monitoring showed the effects to be temporary, dissipating after 1 to 3 years. Frequent burns may be required to sustain population growth, as determined from population models (Caswell and Kaye 2001).

Population Trends and Distribution – Bradshaw's lomatium was never widely collected, and there were no known collections between 1941 and 1969, leading to the assumption that the taxon might be extinct. By 1980, following a study of the species, six populations of the species had been located, including one large population. Since 1980, over 40 new sites have been discovered, including three large populations.

For many years Bradshaw's lomatium was considered a Willamette Valley endemic, its range limited to the area between Salem and Creswell, Oregon (Kagan 1980). However, in 1994, two populations of the species were discovered in Clark County, Washington. The Oregon Natural Heritage Information Center (ORNHIC) currently lists 47 occurrences of Bradshaw's lomatium in three populations centers located in Benton, Lane, Linn, and Marion Counties, Oregon on 324 acres (131 ha) (ORNHIC 2005). Most of these occurrences are small, ranging from about 10 to 1,000 individuals, although the largest site contains over 100,000 plants. The two Washington occurrences are larger in population size, with one site estimated to have over 800,000 individuals (WNHP 2004b).

Reasons for Decline –The remaining Bradshaw's lomatium populations are threatened by development, pesticides, encroachment of woody and invasive species, herbivory, and grazing. The majority of Oregon's Bradshaw's lomatium populations are located within a 16-km (10-mile) radius of Eugene. The continued expansion of this city is a potential threat to the future of these sites. Even when the sites themselves are protected, the resultant changes in hydrology caused by surrounding development can alter the species' habitat (Meinke 1982, Gisler and Meinke 2004). The majority of sites from which herbarium specimens have been collected are within areas of Salem or Eugene which have been developed for housing and agriculture (Siddall and Chambers 1978b). Many Bradshaw's lomatium populations occur near roadways and other areas that are sprayed with pesticides. There is concern that these pesticides will kill the pollinators necessary for plant reproduction. Bradshaw's lomatium does not form a seed bank, therefore, any loss of

pollinators (and subsequent lack of successful reproduction) could have an immediate effect on population numbers (Kaye and Kirkland 1994).

One of the most significant threats is the continued encroachment by woody vegetation. Historically, Willamette valley prairies were periodically burned, either by wildfires or by fires set by Native Americans (Johannessen *et al.* 1971). Since Euro-American settlers arrived, fire suppression has allowed shrubs and trees to invade grassland habitat, which will ultimately replace the open prairies (USFWS 1993).

Recovery Measures –Extensive research has been conducted on the ecology and population biology of Bradshaw's lomatium (Kagan 1980, Kaye 1992, Kaye and Kirkland 1994, Kaye and Meinke 1996, Caswell and Kaye 2001, Kaye and Kuykendall 2001b, Kaye and Brandt 2005). The results of these studies have been used to direct effective methods for habitat enhancement, propagation, and reintroduction techniques for management of the species at wet prairie sites.

Studies of the effects of cattle grazing on Bradshaw's lomatium populations show mixed results. Grazing in the springtime, when the plants are growing and reproducing, can harm the plants by biomass removal, trampling and soil disturbance; however, late-season livestock grazing, after fruit maturation, has been observed to lead to an increase in emergence of new plants, and the density of plants with multiple umbels, although it did not alter survival rates or population structure (Drew 2000). It is possible that the increase in seedlings may be due to small disturbances in the soil, a reduction of shading by nearby plants, and reduced herbivory by small mammals.

During the 2003 and 2004 fiscal years, the Partners program worked on 10 projects in Benton, Lane, Polk and Marion Counties, Oregon that restored 295 acres of wet prairie habitats, some of which will benefit Bradshaw's lomatium and other native prairie species (A. Horstman, pers. comm. 2004).

16. Cook's Lomatium (*Lomatium cookii)*

Listing Status and Description – Cook's lomatium (also known as Cook's desert-parsley) was listed as federally endangered without critical habitat designation on December 7, 2002 (67 FR 68004). This species was also listed on the state of Oregon's State Endangered Plant list. A recovery outline for this species was finalized on June 12, 2003.

Cook's lomatium is a small perennial plant in the parsley family (Apiaceae). James Kagan first collected Cook's lomatium in 1981 from vernal pools in the Agate Desert, Jackson County, Oregon, and subsequently described the species (Kagan 1986a). Additional populations were found at French Flat in the Illinois Valley, Josephine County, Oregon in 1988 (ONHP 1998).

Cook's lomatium is an upright 15 to 50 centimeter (cm) (6 to 30 inch [in]) tall perennial herb with a slender, twisted taproot. The taproot often branches at or below ground level, forming multiple stems. The leaves are smooth, minutely inter-divided, glossy bluish-green, and strictly basal. The pale yellow flowers are clustered into small umbels (flower clusters). Each flowering stalk produces either primarily male or female flower clusters. An umbel of female flowers will develop boat-shaped fruits 0.8 to 1.3 cm (0.3 to 0.5 in) long with

thickened margins. The flowering stalk very rarely forms leaves, unlike the closely associated *Lomatium utriculatum* (foothills-parsely). The branching taproot distinguishes Cook's lomatium from Bradshaw's lomatium (indigenous to wet prairies from southern Willamette Valley, Oregon to southwest Washington) and *Lomatium humile* (alkali desert parsely) (found in vernal pools in northern California) (Kagan 1986a). Recent genetic research has shown Cook's lomatium to be most closely related to Bradshaw's lomatium (Gitzendanner 2003).

Cook's lomatium flowers from late March to May and is pollinated entirely by insects. The plant produces abundant viable seeds that will often drop within close proximity to the parent plant. A single large adult plant has occasionally been found with up to 100 seedlings growing within 30 cm (11.8 in) of its leaf base (M. Sullivan, pers. comm. 2004). As seeds are buoyant, a probable mode of seed dispersion is via surface water flow. Other possible modes of dispersal are through gopher and mole subsurface excavations, ingestion by birds, insects, and small mammals, and human associated transportation of seeds via muddy shoes, tires, and farm equipment. It is likely that a majority of Cook's lomatium seed germinates each year.

Fire has played a significant historical role in the shaping of Klamath Mountain grassland habitats. Such woody early successional shrubs as *Ceanothus cuneatus* (wedge-leaved buckbrush), *Arctostaphylos spp*. (manzanita), and the exotic Cytissus spp. (broom) compete for space and sunlight with Cook's lomatium in the Illinois Valley. Eventually these shrubs will completely shade out populations of Cook's lomatium and effectively fragment habitat or displace the plant entirely. An historical fire cycle had most likely prevented such shrubs from colonizing the majority of the species' habitat in the past.

Population Trends and Distribution – In the Illinois Valley the 24 extant populations of Cook's lomatium are closely associated with seasonal wet meadows, stream banks, and forest openings on the lower valley floor. Populations range from the Selma area south to the French Flat area. Throughout the Illinois Valley range of Cook's lomatium, 16 populations occur on BLM administered land. Eight of these populations occur at the French Flat Area of Critical Environmental Concern (ACEC), four near Eight Dollar Mountain, and four near Rough and Ready Botanical Area. Two populations of Cook's lomatium overlap both BLM and State lands in the Illinois Valley. Four populations of Cook's lomatium overlap both BLM and private lands. Two populations of Cook's lomatium occur on State land.

In the Rogue Valley, 12 Cook's lomatium populations are located primarily in the central Agate Desert area with one large population occurring near the Rogue Valley Airport.

Cook's lomatium in the Illinois Valley grow on seasonally wet soils. For much of its range in the Rogue River Valley, the plant occurs on upland mounds, at the bottom of rocky vernal pools, and on vernal pools flanks. It occurs in either strongly expressed or weakly expressed vernal pool formations and appears to tolerate various types of disturbance.

In the Rogue River Valley, populations of Cook's lomatium are found in shallow Agate-Winlo complex in sparse prairie vegetation. Common plant associates include *Lupinus bicolor* (bicolor lupine), *Colinsia sparsiflora* (sparse-flowered collinsia), *Clarkia purpurea* (purple clarkia), *Erodium cicutarium* (filaree), foothills desert-parsely, *Achnatherum*

lemmonii (Lemmon's needlegrass), *Poa bulbosa* (bulbous bluegrass), *Brodiaea elegans* (elegant brodiaea), *Madia spp* (tarweed), *Lasthenia californica* (goldfields), *Hemizonia fitchii* (Fitch's tarweed), and *Plagiobothrys spp* (popcornflower).

In the Illinois Valley, Cook's lomatium occurs in open wet meadows and along roadsides adjacent to meadows on Brockman clay loam, Josephine gravelly loam, Pollard loam, Eightlar extremely stony clay, Takilma cobbly loam, Abegg clay loam, and Newberg loam soils. Brockman clay loam soils in the French Flat area average 24 to 35 inches in depth. These seasonally wet soils have the ability to block water permeability through the soil, similar to the Agate Desert vernal pools, but lack that region's distinctive mound and swale topography.

Soils in the Illinois Valley are partially derived from serpentine formations that occur on surrounding slopes and hilltops. Common species in the Illinois Valley associated with Cook's lomatium include *Danthonia californica* (California oatgrass), *Chlorogalum pomeridianum* (soap plant), *Plagiobothrys bracteatus* (bracted popcornflower), *Hesperichiron californica* (hesperichiron), *Horkelia californica* (California horkelia), *Calochortus uniflorus* (short-stemmed mariposa lily), and wedge-leaved buckbrush. Two rare plants that may occasionally occur with Cook's lomatium in the Illinois Valley are *Senecio hesparius* (western senecio) and *Microseris howellii* (Howell's microseris).

Reasons for Decline –Specific threats to Cook's lomatium are off-road vehicle use, mining, road construction, logging in surrounding forests and meadows, livestock grazing, woody plant encroachment, invasion of non-native annual grasses and herbs, herbicide spraying, and dredging for gold in surrounding hills (USFWS 2002). Off-road vehicle tires create large ruts and can fracture the clay hardpan layer when soils are moist. This allows water to drain, and compromises plant survival. It is estimated that off-road vehicle use has caused the drainage of 6 hectares (15 acres) from French Flat in 2000 (USFWS 2002) and by 2004 has drained an additional 4 hectares (10 acres) (M. Mousseaux, pers. comm. 2004).

Recovery Measures – Of the four Cook's lomatium populations on Oregon Department of Transportation (ODOT) administered land, one has become extirpated. ODOT has developed three Special Management Areas. The largest known plant populations are at The Nature Conservancy's Agate Desert Preserve and at the Medford Airport. The largest locations of Cook's lomatium in the Illinois Valley occur at French Flat.

Seeds from three locations in the Rogue River Valley and two locations in Josephine County (French Flat) are stored at the Berry Botanic Garden. Germination requirements of the plant are largely unknown. Initial attempts by the Berry Botanical Garden were inconclusive. Protocols for propagation and reintroduction are likely similar to Bradshaw's lomatium, but still need to be developed. One site in French Flat is designated as an ACEC by the BLM. A section 6 grant was awarded to the ODA in 2005 to investigate cultivation and reintroduction techniques for this plant.

The Nature Conservancy protects Cook's lomatium at two preserves. Stabilization and expansion of endangered plants has been a conservation objective at the Agate Desert and Whetstone Savanna Preserve. Monitoring for effects of burning and mowing are performed annually at the two preserves (D. Borgias, pers. comm. 2004).

ODOT protects a Cook's lomatium population near Cave Junction by limiting maintenance activities during the growing season, restricting herbicide use, and finding solutions to anticipated maintenance impacts to the plants (K. Cannon, pers. comm. 2002).

17. Large-flowered Woolly Meadowfoam (*Limnanthes floccosa ssp. grandiflora*)
Listing Status and Description – Large-flowered woolly meadowfoam was listed as federally endangered on December 7, 2002 (67 FR 68004) without designated critical habitat. This species is also on the state of Oregon's State Endangered Plant list. A recovery outline for this species was finalized on June 12, 2003.

The plant is a 3 to 15-cm (2 to 6-in) tall herbaceous annual; with 1 to 5 cm (0.2 to 2 in) leaves divided into 5 to 9 segments. The leaves, stems, and lower sepals are sparsely covered with short white, fuzzy hairs. The off-white petals have two rows of hairs near their base and are nearly even with the sepals, unlike the more common woolly meadowfoam, *Limnanthes floccosa ssp. floccosa*, which has hairless petals that exceed the sepals in length. The petals of meadowfoam are 0.75 to 0.9 cm (0.30 to 0.35 in) and are slightly shorter than the sepals. Meadowfoam produces one to three flowers per flower stalk; each flower will produce a cluster of 1 to 5 hard nutlets by mid-May that will quickly drop in the drying mud. Over much of its range, meadowfoam is restricted to the relatively wetter, inner fringe of vernal pools in the Rogue Valley plains.

Meadowfoam typically begins flowering in March, reaches peak flowering in April, and may continue into May if conditions are suitable. Nutlets are produced in late April, and the plants begin to die back by mid-May or when the soil becomes dry (D. Borgias, pers. comm. 2004). Nutlets of meadowfoam apparently are dispersed by water; they can remain afloat for up to three days. However, the nutlets of the plant are normally dispersed only short distances. Thus, meadowfoam nutlets would not be expected to disperse beyond their pool or swale of origin. Birds and livestock are potential sources of long-distance seed dispersal, but specific instances of dispersal have not been documented (Jain 1978).

Population Trends and Distribution – Meadowfoam numbers fluctuate annually depending on the seasonal precipitation and temperature, therefore the population status of the species will vary as well from year to year. In grazing allotments, sudden increases or declines in population density may be due to intensity, seasonality, and duration of grazing. In general, numbers of annual plants, such as *Limnanthes floccosa ssp. grandiflora*, may fluctuate more widely than those of perennial plants, such as Cook's lomatium. The year 2000 was a productive year for the species due to the wet conditions, but in 2001, a dry year, population numbers of the plant declined in many areas. In 2000, with average winter precipitation, numbers of plants recorded at selected vernal pools in the Agate Desert Preserve totaled 68,111, but in 2001, with an unusually dry winter, numbers of recorded plants dropped to 39,031. However, in 2002, average rainfall figures were still below normal, the population increased to 63,752 plants (D. Borgias, pers. comm. 2004). Year-to-year changes of this magnitude may be within the normal range of variation for this annual plant, but if the habitat is reasonably protected from degradation or fragmentation and the seed source protected, a population should persist.

Meadowfoam is endemic to the Rogue River Plains of Jackson County at elevations of 366 - 400 m (1,200-1,310 ft), within an 20,510 ac (8,300 ha) landform within the Agate Desert, and within the vicinity of Eagle Point and White City, Oregon (Figure II-2).

The plant occupies the Upper and the Middle Rogue sub basins (fourth-field Hydrologic Unit Codes) of the Rogue River. Meadowfoam has no significant ecological, genetic, or geographic barriers separating its 21 extant populations apart from development and road systems. The historical distribution of meadowfoam in the Rogue Valley occurs in nine areas. Fifteen populations of the plant occur in the central Agate Desert area, one population occurs near the Rogue Valley Airfield, and an additional five populations of meadowfoam occur in the Rogue River Valley areas north of Table Rock have one population each. An additional population was recorded in Eagle Point vicinity in 1927, but the approximate site location has been developed and suitable vernal pool habitat is no longer present. In the Agate Desert, all known populations of meadowfoam comprise 80 hectares (198 acres). Three new locations were identified in the spring 2004, all at wetland mitigation sites. Population of meadowfoam can range from under 50 to 100,000 individuals (ORNHIC 2004).

Reasons for Decline – Specific threats to meadowfoam are fragmentation due to road construction, housing, industrial and commercial development, off-road vehicle damage, fill and contaminant dumping, invasion of non-native annual grasses and herbs, herbicide spraying, and poorly managed livestock grazing (U.S. Fish and Wildlife Service 2002). Recently a known meadowfoam population in the Agate Desert near Table Rocks Road was destroyed due to disposal of contaminants (perhaps herbicide) that removed native vegetation from a 0.75 acre (0.3 ha) portion of vernal pools. The source of the spill has not yet been determined. Recreational off-road vehicle activities have impacted two meadowfoam populations in the White City area.

Recovery Measures –Through conservation easements and agreements with various parties, protection of meadowfoam and its habitats is currently being pursued. The TNC owns and manages two preserves in the area and manages a conservation easement for a third site. The Agate Desert Preserve, the Whetstone Savanna Preserve, and the Rogue River Plains Preserve total 346 ac (140 ha) in the Agate Desert, of which 252 ac (102 ha) are vernal pool habitat (D. Borgias, pers. comm. 2004). At each of the sites the TNC performs annual monitoring and performs periodic restoration activities such as burning, mowing, and controlled grazing.

Large flowered woolly meadowfoam populations occurring on two ODOT SMAs in the Agate Desert and at the Denman Wildlife Area, owned by the ODFW are protected from development.

Meadowfoam seed collected from several areas in the Agate Desert is currently stored at the Berry Botanical Garden. However, the plant is not yet a sponsored species and not fully funded for germination trials or range-wide seed collection (E. Geurrant, pers. comm. 2004).

18. **Applegate's Milk-vetch (*Astragalus applegatei)***
Listing Status and Description – Applegate's milkvetch was federally listed as endangered without critical habitat in 1993 (U.S. Fish and Wildlife Service 1993). A recovery plan was published in 1998 (U.S. Fish and Wildlife Service 1998).

Population Trends and Distribution – Applegate's milkvetch is a slender perennial in the pea family (*Fabaceae*) with stems 3-4 dm (12-16 in) long. The leaves are typically 3.5-7 cm (1.4-2.8 in) long with 7-11 leaflets. The petals are whitish, measuring up to 7 mm (0.3 in) long. The tip of the keel is faintly lilac- tinged. The fruit is a pod and is widely spreading or declined. Dehiscence (pod opening at maturity) starts at the top of the pod and continues downward. Applegate's milkvetch typically flowers from June to early August. Applegate's milkvetch occurs in flat-lying, seasonally moist, strongly alkaline soils dominated by greasewood (*Sarcobatus vermiculatus*) with sparse, native bunch grasses and patches of bare soil. This species is historically known from only four sites, near the city of Klamath Falls in Klamath County, Oregon, approximately 1250 m (4,100 ft) above sea level. The largest population is located near Ewauna Lake in Klamath Falls; a significant portion of the site this population occurs on is owned by The Nature Conservancy.

Reasons for Decline – Urban development, agriculture, weeds, fire suppression, flood control and land reclamation have contributed to the decline of this species.
Range

Recovery Measures – None to date.

18. Malheur Wire-lettuce (*Stephanomeria malheurensis)*
Listing Status and Description – Malheur wirelettuce was federally listed as endangered with critical habitat in 1982 (U.S. Fish and Wildlife Service 1982). A recovery plan was published in 1991 (U.S. Fish and Wildlife Service 1991).

Population Trends and Distribution – Malheur wirelettuce occurs at only one location on approximately 70 acres of public lands managed by the BLM. The first discovery of Malheur wirelettuce was in 1966 when seeds of this species were collected with those from a population of its ancestral plant, small wirelettuce. This species is an annual and its numbers vary greatly from year to year, depending largely on the amount of precipitation prior to and during the spring growing season. In 1974, the population was estimated at 228 plants and in 1975 the numbers grew to 1,050. During the 1980's, very low numbers of plants were found, and in 1985, 1986 and 1999, no plants were observed. During this time when the species numbers dwindled to zero, cheatgrass (*Bromus tectorum*) an extremely aggressive non-native grass species dramatically increased at the site. A reintroduction program was begun in April 1987 and 1000 seedlings obtained from the Berry Botanic Garden were transplanted into study plots at the site. Of these plants, 412 survived and one wild plant was found. During subsequent years, efforts have been undertaken to remove cheatgrass from around existing plants and study plots; however, numbers of Malheur wirelettuce remain low.

Malheur wirelettuce is an annual plant in the composite family (*Asteraceae*). It can reach 5 dm (20 inches) in height. This species forms a rosette of hairless leaves that arise from its base. The single stems are many-branched with scale-like leaves. Flower heads are either

numerous and clustered, or solitary on short stems. The strap-shaped petals are pink, white, or rarely orange-yellow. Flowering typically occurs in July and August.
The Malheur wirelettuce is co-located with an ancestral relative, small wirelettuce (*Stephanomeria. exiqua ssp. coronaria*); however, the two species do not interbreed. While the Malheur wirelettuce is self-pollinating, its ancestral relative is not.

Malheur wirelettuce occurs in the high desert of the northern portion of the Great Basin and is located in an area south of Burns, Oregon. It occurs on top of a dry, broad hill on volcanic soil intermixed with layers of limestone. Dominant plants at the site are big sagebrush (*Artemisia tridentata*), gray rabbitbrush (*Chrysothamnus nauseosus*), green rabbitbrush (*Chrysothamnus viscidiflorus*), and, more recently, cheatgrass. Malheur wirelettuce may be one of the few species able to survive on and around the otherwise barren harvester ant hills at the site.

Reasons for Decline – Malheur wirelettuce is in great danger of extinction due to its small population size. Natural fluctuations in population numbers that occur in response to variations in annual rainfall and spring frosts are particularly problematic for small populations. The species is also vulnerable to habitat alteration; surface mining for zeolite was a potential threat at the time of listing. Other immediate threats include competition from cheatgrass and predation by native herbivores such as black-tailed jackrabbits.

Recovery Measures – Critical habitat for Malheur wirelettuce was designated at the time of listing in 1982. This designation identifies the specific area containing the necessary physical and biological requirements for the conservation of the species. The designation of critical habitat provides additional protection for the species. The area within the designated critical habitat was set aside to allow for natural expansion of the population and to provide a buffer against potential adverse impacts from activities on adjacent lands. In 1984, the Bureau of Land Management (BLM) designated the known location of Malheur wirelettuce as the South Narrows Area of Critical Environmental Concern. The 160-acre area has been fenced since 1974 to prevent grazing by livestock. Monitoring of Malheur wirelettuce population is regularly conducted by BLM botanists. In 1986 the Service completed the Malheur Wirelettuce Recovery Plan which identified various tasks that are necessary to recover the species. The primary tasks are to maintain and enhance existing populations and habitat, conduct systematic searches for new populations, secure any newly found populations, and develop management and monitoring programs for the species. The U.S. Fish and Wildlife Service, in cooperation with the BLM, developed the "Study Plan for *Stephanomeria malheurensis*" to identify research needs and management options for the maintenance of a viable self-perpetuating population of Malheur wirelettuce.

20. Golden paintbrush (*Castilleja levisecta*)

Listing Status and Description – Golden paintbrush was federally listed as endangered, without critical habitat, on June 11, 1997. This species is also on the state of Oregon's State Endangered Plant list. A recovery plan was published for the species on August 23, 2000.

Golden paintbrush is a perennial herb that often forms 5-15 un-branched stems (USFWS 2000a). The plant grows up to 51 cm (20 in) cm tall and is covered with soft, slightly sticky hairs. Golden paintbrush flowers are mostly hidden by showy golden-yellow bracts, hence its name. The plant flowers from April to June. Fire is thought to have historically played a

key role in the maintenance of the seasonally wet open prairie habitats occupied by this species.

Population Trends and Distribution – The taxon is a regional endemic with a historic range west of the Cascade Mountain Range from the southern tip of Vancouver Island, Canada to Linn County, Oregon. In Washington, the species occurs in the Puget Trough physiographic province. The taxon is believed to be extirpated from the Willamette Valley physiographic province of Oregon. Historically, golden paintbrush was found as far north as the Puget Trough of Washington and British Columbia, and as far south as the Willamette Valley of Oregon. Most populations are found on the islands that make up the San Juan Islands. The southern-most extant occurrence of golden paintbrush is in Thurston County, Washington.

Reasons for Decline – Prairie destruction due to residential, commercial, or agricultural use is a threat at five of the six privately owned sites (USFWS 2000a). Many populations have destroyed by the conversion of its native prairie habitat to agricultural, residential, and commercial uses. The decline of golden paintbrush is also correlated with fire exclusion. Fire disturbance is an integral component of the prairie ecosystem, maintaining grassland by preventing the successional encroachment of woody shrubs and trees. As a direct consequence of these land-use changes, golden paintbrush has not been seen in Oregon for over 40 years and is now endangered in Washington. High intensity, hot-burning fires resulting from years of fire suppression and plant material build-up can completely eliminate plants and to some extent a seed bank. In communities evolved to periodic fire conditions, hot-burning fires may kill the plants (USFWS 2000a). Competition from non-native, invasive species such as Hieracium pilosella (mouse-ear hawkweed), *Cytisus scoparius* (Scotch broom) and *Leucocephalum vulgare* (ox-eye daisy), and other non-native plants can severely degrade golden paintbrush habitat (Wentworth 2000). An increasing cover of native shrubs is also of concern at some sites. Herbivory by rabbits and deer, and trampling by recreationists can retard flower output during the growing season and undermine seed production (Wentworth 2000).

In the absence of active management, fairly vigorous populations of *Castilleja levisecta* have rapidly declined to extinction within a few decades. Alarmingly, these declines did not result from overt habitat destruction, but from the 'invisible' threats associated with low population numbers, in-breeding depression, fire-suppression and weed invasion. Presently, no site contains enough golden paintbrush individuals to be immune to drastic, irreversible declines.

Recovery Measures – Both federal agencies and private parties are vital in the conservation of the nine remaining populations in Washington and two remaining populations in British Columbia. Whidbey Island Naval Air Station monitors and manages a large population on its land. A private landowner, Robert Pratt, specified in his will that 147 acres of his estate, which contained a significant golden paintbrush population, would go to a nonprofit conservation group. Upon his death in 1999, The Nature Conservancy acquired this land and worked with the National Park Service to purchase another 380 adjoining acres. Congress appropriated funds for the Pratt reserve, and The Nature Conservancy borrowed the remaining money needed to expedite this purchase. In southern Vancouver Island, the Garry Oak Ecosystems Recovery Team is working to save over 100 endangered species, including golden paintbrush. These efforts are essential for the continued survival of golden paintbrush. Steps to increase population sizes and establish new populations are necessary to

ensure long term survival of golden paintbrush. The University of Washington's Center for Urban Horticulture, also a Participating Institution of the Center for Plant Conservation, is actively involved in these efforts.

Monitoring and management occurs regularly at Whidbey Island Naval Air Station. A large golden paintbrush population is monitored and managed by The Nature Conservancy at the Pratt Preserve. Sites in British Columbia are in designated "Ecological Reserve" land. Entry is restricted and plant collection and resource destruction are not allowed (USFWS 2000a). Recently studies to assess the potential for golden paintbrush to establish in the Willamette Valley, conducted in the Willamette Valley in Oregon, concluded that establishment could be successful following specific propagation prescriptons (Lawrence 2005).

21. Kincaid's lupine (*Lupinus sulphureus ssp. kincaidii*)

Listing Status and Description – Kincaid's lupine was listed as threatened, on January 25, 2000 (USFWS 2000b). This species is also on the state of Oregon's State Threatened Plant list. Designated critical habitat was proposed for Kincaid's lupine on November 2, 2005 (USFWS 2005b). A recovery outline was finalized for this species on March 22, 2006.

Kincaid's lupine is a long-lived perennial species with a maximum reported age of 25 years. Individual plants are capable of spreading by rhizomes, producing clumps of plants exceeding 20 meters (m) (33 feet [ft]) in diameter. Population counts are thus unreliable, and apparently large populations may consist of few genetic individuals. Leaves are oval-palmate, with very narrow leaflets. The small, purplish-blue pea flowers grow in loose racemes that are 15.2 to 20.3 cm (6 to 8 in) tall. The flowering period has been reported from May to July (Eastman 1990) and from April to June (Hitchcock *et al.* 1961), but generally occurs during May and June. Above-ground portions of the plant usually wither and die by mid-August (USFWS 2005a). Self-incompatible, Kincaid's lupine must obtain pollen from another individual plant to produce fertile seeds and is therefore, dependent on solitary bees and flies for pollination. Seed set and seed production are low, with few flowers producing fruit from year to year and each fruit containing an average of 0.3 to 1.8 seeds. Seeds are dispersed from fruits that open explosively upon drying. Kincaid's lupine is the primary host food plant for Fender's blue caterpillars, and the two species are currently known to co-occur at 25 sites on approximately 279 ac (113 ha) across their ranges.

Population Trends and Distribution – Kincaid's lupine occurs in 76 remnant upland prairie occurrences, totaling approximately 1,150 ac (465 ha) in size, scattered across six counties (Lewis County, Washington, and Yamhill, Polk, Benton, Lane, and Douglas Counties, Oregon) (USFWS 2005b). Within the Willamette Valley, Kincaid's lupine occupies 86 habitat patches totaling approximately 345 ac (140 ha) in size. In the Umpqua Valley, Douglas County, Oregon, Kincaid's lupine occupies eight small patches, averaging 14 ac (5.7 ha) in size, and in Lewis County, Washington, three tiny patches, totaling approximately 0.49 ac (0.2 ha) in size.

Reasons for Decline – Prairie has been lost due to fire suppression and subsequent woodland succession. Most Willamette Valley prairies are thought to be early seral habitats, requiring natural or human- induced disturbance, particularly fire, for their maintenance (Franklin and Dyrness 1973). Before European settlement, the native Kalapuya people are attributed with maintaining prairie habitats through prescribed burning (Boyd 1986). A serious long-term

threat to all Willamette Valley prairie species is the change in community structure due to plant succession. Without active management, the natural succession of prairie to shrub/forest by the invasion of native species, such as Oregon ash (*Fraxinus latifolia*), Douglas hawthorn (*Crataegus douglasii*), Nutka rose (*Rosa nutkana*) and Douglas spiraea (*Spiraea douglasii*), will lead to the eventual loss of these prairie sites (Hammond and Wilson 1993; Kuykendall and Kaye 1993). The presence of invasive non-native woody species, such as Himalayan blackberry (*Rubus discolor*), multiflora rose (*Rosa multiflora*) and Scotch broom (*Cytisus scoparius*), exacerbate this problem. Shrub and tree intrusion has been documented on most of the relic prairie sites occupied by Kincaid's lupine and Fender's blue butterfly (USFWS 2005a).

Over 80 percent of the remaining upland prairies (mostly in the Willamette Valley) where these species is known to occur are threatened by agriculture and forest practices, development, grazing, and road construction and maintenance. Kincaid's lupine is thought to have originally been widely distributed on upland prairie habitats throughout the Willamette Valley, with the lupine extending into the Umpqua Valley, Oregon.

Kincaid's lupine is generally associated with native fescue upland prairies that are characterized by heavier soils, with mesic to slightly xeric soil moisture levels. At the southern limit of its range, the subspecies occurs on well-developed soils adjacent to serpentine outcrops where the plant is often found under scattered oaks (Kuykendall and Kaye 1993). Within the Willamette Valley Kincaid's lupine occurs in generally open upland prairie and open oak savannah. Kincaid's lupine is thought to have historically colonized areas along the edge of oak woodlands throughout upland prairies. Schultz (1998) theorizes that lupine patches were historically distributed no greater than 0.5 kilometers (km) (0.3 miles [mi] apart, allowing dispersal of Fender's blue butterfly between lupine patches.

Fence rows, pastures, and intervening strips of land along agricultural fields and roadsides are often the only remaining refugia for native upland prairie plants. Therefore, native endemic plants often occur in small and fragmented populations. Generally, the direct and indirect effects of small population size on most species of plants and animals include decreased dispersal ability, decreased rate of genetic exchange, a resultant loss of population viability and vigor, and a hastening towards extinction (Gilpin and Soule 1986).

The modern use of herbicides for highway or roadway maintenance, farming practice, or other land uses for weed control and landscape maintenance purposes is further exacerbating the precarious survival of these remnant plant populations. That is, some of the remnant Kincaid's lupine populations occur within weedy sites, and spraying nonspecific contact herbicides eliminates all existing plant species.

Recovery Measures – Several Kincaid's lupine populations occur on Federal lands. In Douglas County approximately eight populations occur on BLM and one site occurs on Forest Service land. In Lane County approximately ten populations occur on Federal lands.

Extensive research has been conducted on the ecology and population biology of Kincaid's lupine, effective methods for habitat enhancement, and propagation and reintroduction techniques (Erhart 2000, Leininger 2001, Kaye and Kuykendall 2001a, Wilson *et al.* 2003).

The results of these studies have been used to direct the management of Kincaid's lupine populations at Baskett Slough NWR, Eugene BLM, and Willamette Valley TNC preserves.

Several studies have investigated the feasibility of growing Kincaid's lupine in controlled environments for augmentation of wild populations. Cold stratification or seed-coat scarification is necessary for successful germination (Kaye and Kuykendall 2001a). In-situ seed propagation has also been conducted with some success in establishing plants (Severs 2003). On BLM lands, a two-year reintroduction effort of Kincaid's lupine has proven remarkably successful and has even attracted the endangered Fender's blue butterfly (Institute for Applied Ecology 2002). Additional attempts to establish Kincaid's lupine at new sites has shown that sowing seed in combination with direct transplanting of cultivated plants is much more effective than sowing seeds alone (Kaye and Brandt 2005).

E. Insects and Mullosks

1. Vernal pool fairy shrimp (Branchinecta lynchi)

Listing Status and Description – The Service listed the fairy shrimp as a threatened species primarily due to the present or threatened destruction, modification, or curtailment of their habitat or range. On August 8, 2003, the Service issued a final rule designating critical habitat for 15 vernal pool species, including fairy shrimp. A total of approximately 1,184,513 acres of land falls within the boundaries of designated critical habitat. Approximately 7,574 acres occur in Oregon and 1,186,969 acres occur in California (USFWS 2003).

Fairy shrimp is the only species addressed in the Service's 2003 critical habitat designation regarding vernal pool species occurring in Oregon. Four critical habitat units in Oregon are designated as essential to the conservation of fairy shrimp, and there are 29 units in California. The Oregon units are comprised of 7,574 acres in Jackson County. These units occur approximately 125 miles north of the nearest unit designated for this species in California. The Service identified critical habitat areas essential to the conservation of fairy shrimp to reflect the species geographic distribution and varying habitat types and species associations across its range.

Population Trends and Distribution – The vernal pool fairy shrimp is a member of the aquatic crustacean order *Anostraca*, in the *Branchinectidae* family. The species are endemic to vernal pools, an ephemeral freshwater habitat. The fairy shrimp are ecologically dependent on seasonal fluctuations in their habitat, such as absence or presence of water during specific times of the year, duration of inundation, and other environmental factors that include specific salinity, conductivity, dissolved solids, and pH levels. They are sporadic in their distribution, often inhabiting only one or a few pools in otherwise more widespread vernal pool complexes. Although the species has been collected from large vernal pools it tends to occur in smaller, frequently measuring less than 0.05 acre (<200 square meters) and shallower (mean of 5 cm) pools (Helm 1998). Genetic characteristics, as well as ecological conditions, indicate that populations are defined by pool complexes rather than by individual vernal pools.

Fairy shrimp inhabit vernal pools with clear to tea-colored water, most commonly in grass-or mud-bottomed swales, or basalt flow depression pools in unplowed grasslands. This species has a sporadic distribution within vernal pool complexes wherein the majority of pools in a

given complex typically are not inhabited by the species. Fairy shrimp typically are found at low population densities. Eggs are speculated to be dispersed by "hitching a ride" on the legs or feet of wading birds or other animals passing through the pool, or by animals that ingest the eggs. They can mature quickly, with populations persisting in short-lived shallow pools, but they also can persist later into the spring where pools are longer lasting.

At the time they were listed, there were 32 known populations of the vernal pool fairy shrimp, all within California. They were subsequently discovered in vernal pools of the Agate Desert landform in southern Oregon. Little is known about the intimacy of the relationship between fairy shrimp living in ephemeral pools and the surrounding terrestrial ecosystem.

Reasons for Decline – FWS determined that "the habitat of these animals is imperiled by a variety of human-caused activities, primarily urban development, water supply/flood control activities, and conversion of land to agricultural use. Habitat loss occurs from direct destruction and modification of pools due to filling, grading, discing, leveling, and other activities, as well as modification of surrounding uplands that alters vernal pool watersheds." Maintaining fairy shrimp across their full geographic distribution would make the species less susceptible to environmental variation or negative impacts associated with human disturbances or natural catastrophic events across the species entire range at any one time (Helm 1998).

Recovery Measures – The following critical habitat unit descriptions are taken from the Service's final rule designating critical habitat for vernal pool species in California and southern Oregon (USFWS 2003):

> Unit 1A, B, C, D, E, F, and G, North Agate Desert Unit, Jackson County (2,130 ac). This unit consists of seven subunits, all located to the north of Little Butte Creek. This unit represents the northern limit of the species' distribution. It is of sufficient size to sustain the natural ecosystem processes (e.g., fires) that have historically influenced vernal pool habitat, and is separated from the nearest other unit designated for Oregon, Unit 4, by over 2 miles. Three of the subunits are west of the Rogue River, and the remaining four are to the east. All but one of these subunits is located to the south of U.S. Route 234 (Sam's Valley Highway). The one remaining unit is located to the east of the Rogue River, about 1.5 miles north of the confluence with Reese Creek.
>
> Unit 2A, B, C, D, and E, White City East Unit, Jackson County (2,251 ac)
> This unit consists of five subunits, located east of U.S. Route 62 (Crater Lake Highway) and south and southeast of Dutton Road. This unit provides the easternmost extent of the species' range in Oregon. It represents a significant component of the species' original range in the State and is of a sufficient size to sustain the natural ecosystem processes (e.g., fires) that have historically influenced vernal pool habitat. The largest and easternmost of the subunits occurs just to the east and north of Agate Lake. It is separated by more than 1 mile from Unit 3, White City West, and by approximately 3.5 miles from the North Agate Desert Unit.
>
> Unit 3A, B, and C, White City West Unit, Jackson County (2,301 ac)

This unit consists of three subunits, located west of Agate Road, south of the Rogue River, and east of Bear Creek. This unit contains the least fragmented intact examples of the original Agate Desert mounded vernal pool grassland habitat. It is of sufficient size to sustain the natural ecosystem processes (e.g., fires) that have historically influenced vernal pool habitat; it is separated from the White City East Unit by more than 1 mile and from the Table Rocks Unit by over 1.5 miles. Taken together, the designated Agate Desert units (Units 1–3) comprise a functional vernal pool complex consisting of vernal pools, mounded grassland and associated uplands, where natural processes, including connectivity, function within or near the natural range of variability. Each of the three designated Agate Desert units is essential to the conservation of vernal pool fairy shrimp in the Agate Desert area.

Unit 4A and B, Table Rocks Unit, Jackson County (892 ac). This unit consists of two subunits, located on two flat-topped mesas known as Upper and Lower Table Rocks, situated north and west of the Rogue River. These rimrock features are remnants of ancient lava flows that filled portions of the Rogue River nearly 10 million years ago. Subsequent erosion of softer geologic layers has left these harder andesite (volcanic rock) formations rising some 800 feet above the present Rogue Valley. Vernal pools on the Table Rocks differ from those of the Agate Desert, in that they are formed over an impervious layer of bedrock. This unit represents a unique habitat for vernal pool fairy shrimp in Oregon. The Table Rocks Unit is disjunct from the North Agate Desert Unit by over 2 miles, and from the White City West Unit by approximately 1.5 miles

The vernal pool habitat within these four units was selected based on information provided by a wetland function and values assessment and habitat integrity analysis completed in 1999. Information describing the physical (i.e., parcel size, presence of intact hydrology) and biological (i.e., species diversity, presence and composition of native vegetation) condition of the vernal pool habitat, species inventory information detailing the presence fairy shrimp, cook's lomatium and meadowfoam, and parameters describing the potential long term sustainability of habitat (defensibility of the parcel, ownership, and positioning of the parcel relative to nearby habitat parcels) was used to identify specific parcels for inclusion as critical habitat.

IV. Action Area and Environmental Baseline

A. Description of Action Area

This Biological Assessment covers those portions of Oregon and Washington wherever FS, BLM and Coquille administrative units are found. It also covers portions of administrative units that are primarily located in Oregon and Washington, but overlap into California (Rogue/Siskiyou NF), Nevada (Lakeview and Vale BLM District) and Idaho (Wallow Whitman NF). This BA covers the above projects that occur within the range of listed species under the ESA of 1973 as amended and current critical habitat. Further, the programmatic area includes non-federal lands where activities help achieve aquatic restoration goals on FS, BLM and Coquille administered lands. To be included, such non-federal land projects must follow all aspects of the proposed action described in this ARBA.

Contained within the geographic area, site-specific Action Areas are located in fish and non-fish bearing streams, riparian areas, and uplands that have a direct link to restoration of aquatic habitat. The Action Area includes all areas to be affected directly or indirectly by the programmatic activities and not merely the immediate project area. Pre-implementation analysis of effects within the action area will determine take of listed specie(s) and overall take of the project.

B. Environmental Baseline for ESA Listed Species

This BA will only address the environmental baseline for species and critical habitat that aquatic restoration projects May Affect, Likely to Adversely Affect. The 'environmental baseline' includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). This BA describes the environmental baseline in terms of the biological requirements for habitat features and processes necessary to support all life stages of ESA/MSA listed species within the action area. When the environmental baseline departs from those biological requirements, the adverse effects of a proposed action on a specie(s) or its habitat are more likely to jeopardize the listed specie(s) or result in destruction or adverse modification of a critical habitat.

The biological requirements of salmon and steelhead in the action area vary depending on the life history stage present, and the natural range of variation present within that system (Spence *et al*. 1996). Generally, during spawning migrations, adult salmon require clean water with cool temperatures and access to thermal refugia, dissolved oxygen near 100% saturation, low turbidity, adequate flows and depths to allow passage over barriers to reach spawning sites, and sufficient holding and resting sites. Anadromous fish select spawning areas based on species-specific requirements of flow, water quality, substrate size, and groundwater upwelling. Embryo survival and fry emergence depend on substrate conditions (e.g., gravel size, porosity, permeability, and oxygen concentrations), substrate stability during high flows, and, for most species, water temperatures of 13°C or less. Habitat requirements for juvenile rearing include seasonally suitable microhabitats for holding, feeding, and resting. Migration of juveniles to rearing areas, whether the ocean, lakes, or other stream reaches, requires access to these habitats. Physical, chemical, and thermal conditions all may impede movements of adult or juvenile fish.

Each fish species considered in this BA resides in or migrates through the action area. Thus, for this action area, the biological requirements for fish are the habitat characteristics that support: (1) successful spawning; (2) rearing; and (3) successful juvenile and adult migrations. Water quality, natural cover, substrate, and forage are the habitat features most likely to be affected by the proposed action, and are the focus of the effects analysis.

The quality and quantity of fresh water habitat in much of Oregon and Washington has declined dramatically in the last 150 years. Land management activities that have degraded habitat of salmonids (and other native fishes) include water withdrawals, unscreened water diversions, hydropower development, road construction, timber harvest, stream cleaning of large wood, splash dams, mining, farming, livestock grazing, outdoor recreation, and urbanization (USDA and USDI 1994; Lee *et al*. 1997; Spence *et al*. 1996). In many river basins, land management activities have: (1) Reduced connectivity (i.e., the flow of energy, organisms, and materials)

between streams, riparian areas, floodplains, and uplands; (2) elevated fine sediment yields, filling pools and reducing spawning and rearing habitat; (3) reduced instream and riparian large wood that traps sediment, stabilizes stream banks, and helps form pools; (4) reduced or eliminated vegetative canopy that minimizes temperature fluctuations; (5) caused streams to become straighter, wider, and shallower, which has the tendency to reduce spawning and rearing habitat and increase temperature fluctuations; (6) altered peak flow volume and timing, leading to channel changes and potentially altering fish migration behavior; (7) altered floodplain function, water tables and base flows, resulting in riparian wetland and stream dewatering; and (8) degraded water quality by adding heat, nutrients and toxicants (USDA and USDI 1994; Henjum 1994; Lee *et al* . 1997; McIntosh *et al* . 1994; Rhodes *et al* . 1994; Spence *et al* . 1996).

While there has been substantial habitat degradation across all land ownerships, including Federal and Coquille lands, habitat in many headwater stream segments is generally in better condition than in the largely non-Federal lower portions of tributaries (Lee *et al*. 1997). Because Federal lands are generally forested and situated in upstream portions of watersheds, FS and BLM lands now contain much of the highest quality salmon and steelhead habitat remaining in Oregon and Washington.

ESA wildlife species and critical habitat that aquatic restoration projects May Affect, Likely to Adversely Affect are: Northern Bald eagle, marbled murrelet, and Northern spotted owls. Bald eagle declines are due in part to habitat loss (from timber harvest, recreational and urban development, and mineral exploration and extraction) and are the greatest long-term threat to bald eagle populations, even though shooting is the greatest single cause of mortality. Murrelet declines are due to old-growth coniferous forest habitat loss as well as predation by corvids. From 1974 through 1993, approximately 64% of the nests failed where nest success/failure was documented, and 57% of those that failed were due to predation (primarily by ravens, crows, and jays) (USFWS 1997).

Northern spotted owl declines on FS, BLM and Coquille Tribal lands are due in part to the high density of barred owls, loss of habitat due to wildfire, harvest of NSO habitat, poor weather conditions, and forest defoliation caused by insect infestations (Buchanan *et al*. 2006).

V. Effects of the Programmatic Actions

Each of the programmatic actions listed in Table 4 may have varying degrees of direct and indirect effects to aquatic and terrestrial ESA listed species and their Critical Habitat (CH) and Essential Fish Habitat (EFH). Direct effects cause an immediate impact. Indirect effects are those effects that occur later in time. Effects of concern under this programmatic consultation are those resulting from short-term habitat removal or degradation or impacts that cause changes to listed species' growth, reproduction, survival. The aquatic conservation measures and project design criteria discussed in Chapter II, sections A and B are intended to minimize potential adverse direct and indirect project effects to ESA/MSA listed species, species proposed to be listed as threatened or endangered, CH, and EFH.

The effects of restoration activities on individual fish, CH, and EFH are described in context of the Matrix of Pathways and Indicators (MPI) developed by FWS and NOAA Fisheries (1999). Part A of this chapter will describe the MPI and the rationale for a "May Affect, Likely to Adversely Affect" (LAA) determination for ARBA projects. Part B of this chapter includes full

descriptions of each MPI indicator, the ways in which the proposed ARBA actions will affect the indicators, and conclusions regarding ESA effects to the species and designated critical habitat. Part C of this chapter describes the relationship between use of the MPI to determine effects to listed fish species and analyses for effects to CH and EFH. In another way, the analysis of effects to listed species using the MPIs is used to determine the effects to CH and/or EFH.

A. Process for Assessing Effects of the 17 Project Actions using the Matrix of Pathways and Indicators

1. **Matrix of Pathways and Indicators** – The effects of the programmatic action will be analyzed using the MPI. The following MPI indicators were used in this analysis: 1) Temperature; 2) Turbidity; 3) Chemical Contamination/Nutrients; 4) Physical Barriers; 5) Substrate/Sediment; 6) Large Wood; 7) Pool Frequency and Quality 8) Off-Channel Habitat; 9) Refugia; 10) Width/Depth Ratio; 11) Streambank Condition; 12) Floodplain Connectivity; 13) Changes in Peak/Base Flows; 14) Increase in Drainage Network; 15) Road Density and Location; 16) Riparian Reserves; 17) Disturbance History; 18) Fish Population Characteristics. Category number 18 incorporates four FWS indicators: Subpopulation Size, Growth and Survival, Life History, and Genetic Integrity.

   The effects analysis is organized around the following seven MPI Pathways:

   i. **Water Quality**
      1) Temperature, 2) Turbidity, 3) Chemical Concentration/Nutrients
   ii. **Habitat Access**
      4) Physical Barriers
   iii. **Habitat Elements**
      5) Substrate/Sediment; 6) Large Wood; 7) Pool Frequency and Quality; 8) Off-Channel Habitat; 9) Refugia;
   iv. **Channel Condition and Dynamics**
      10) Width/Depth Ratio 11) Streambank Condition 12) Floodplain Connectivity
   v. **Flow/Hydrology**
      13) Changes in Peak/Base Flows; 14) Increase in Drainage Network
   vi. **Watershed Condition**
      15) Road Density and Location; 16) Riparian Reserves; 17) Disturbance History
   vii. **Fish**
      18) Fish Population Characteristics

2. **ARBA Projects are Considered LAA as a Result of Negative Impacts to Water Quality and Habitat Element Indicators and Handling of ESA-listed Fish –** As implemented under the project design criteria in Table 4, all ARBA activities will or have the potential to result in negative impacts to the baseline condition of MPI indicators, resulting in a conclusion of "May Affect, Likely to Adversely Affect" for ESA-listed fish species and designated critical habitat, and "May Adversely Affect" for EFH. Regarding the Matrix of Pathways and Indicators, the ARBA Team determined that the Water Quality (Turbidity) and Habitat Elements (Substrate/Sediment) pathways will be negatively impacted. The ARBA Team arrived at this conclusion because all proposed actions will occur either in the stream channel or up to the stream channel's bankfull and wetted width, all of which can result in increased stream turbidity/sediment or disturbance of ESA-listed fish. In another way, the ARBA does not contain more

restrictive project design criteria that limit the area and manner in which projects can be implemented to ensure that project effects would be discountable or insignificant and result in an NLAA effect determination. This provides a project coordinator the maximum flexibility to design and implement an aquatic restoration action in a manner that addresses a limiting factor to the greatest degree possible.

Even though all ARBA actions will be considered as LAA, the ARBA Team acknowledged that not all LAA actions are equivalent in the duration and magnitude of the ESA effect. Therefore, the ARBA activity categories have been segregated into two groups. The difference between the two groups in duration and magnitude of adverse effects forms the basis for determining the number of projects in each group that can be implemented.

As described in Chapter II, Group One is comprised of those restoration categories that include the use of heavy machinery along or within the bankfull channel. Sustained use of heavy equipment will result in either project related sediment introduced into the stream during the low flow period for periods up to two hours in length and/or entering the stream as a result of run-off from precipitation. There will be short-term riparian disturbance. Harm or harassment of ESA-listed fish will occur from the capture and transport from the project site of fish for certain Group 1 actions prior to activities or indirectly by displacement or injury during project implementation activities. As a result, the ARBA Team created a threshold of effects for Group One projects: no more than five miles of stream-flow can be affected by ARBA project-related turbidity (sediment plumes) within a 5th field watershed each year.

As a guide to the number of Group One projects that can be reasonably expected to occur within a 5th field watershed each year, the ARBA Team estimated that each individual project (as described in Table 4) could result in a sediment plume of up to ½ mile downstream from the project site. As such, a FS or BLM administrative unit or Coquille Indian Tribe can conduct 10 Group One projects per 5th field watershed each year and remain reasonably assured that the 5-mile turbidity limit will not been exceeded. However, this is a conservative estimate and is to be used only as a precautionary measure. If more than 10 projects are proposed for a 5th field watershed, a FS or BLM administrative unit or the Coquille Indian Tribe must rely on their professional experience to determine if additional projects, beyond 10, can be implemented without exceeding the 5-mile limit. For instance, a large wood placement project conducted in a bedrock stream system will likely result in far less than a ½ mile long sediment plume. Therefore, it could be determined that more than 10 Group One projects could occur within a 5th field watershed without exceeding the five-mile turbidity limit. The justification for conducting more than 10 Group One projects should be documented and presented to the Level I Team.

Group Two includes ARBA categories that typically occur outside of the bankfull channel. In contrast to Group One activities, Group Two activities will result in smaller amounts of sediment entering stream channels and smaller turbidity plumes, generally resulting from run-off rather than at the time of project implementation. Small amounts of herbicides for certain invasive plant treatments may be introduced into the stream during the low flow period and/or entering the stream as a result of run-off from

precipitation. There will be minor, short-term disturbance of riparian areas. There will be no direct take of ESA-listed fish due to fish handling. However, there will likely be harm and/or harassment for short periods of time resulting from certain survey and monitoring activities in and adjacent to the stream channel where fish are present, and fish may be displaced for short periods of time due to the small turbidity plumes. In other words, project related sediment introduced into the stream will occur at isolated sites and settle within a short distance of the project site (far < ½ mile attributed to Group One projects); turbidity will last only a few minutes (far < 2 hours for Group One projects); and harassment of fish will be of short duration and for fewer fish (far < several hours over periods of several days for Group One projects). Consequently, except for Riparian Area Invasive Plant Treatments, there is no limit as to the number and extent of Group Two projects that may be conducted within a 5th field watershed as long as these actions do not result in an adverse effect for terrestrial species and/or their critical habitat.

B. Effects of ARBA Programmatic Activities on Matrix Indicators

The following discussion presents the effects of programmatic activities described in Table 4 on individual MPI Indicators. Under each of the Matrix or Pathway headings, the effects analysis will address both the Group One and Group Two activity categories. Activities are intended to "Enhance" conditions at the site scale and move the 5th field watershed baseline towards a "Restore" rating over the long-term. All of these programmatic actions may result in some degree of short-term adverse effects to fish or their habitat.

1. **Water Quality Pathway**

   a. **Indicator Description –** The description of the following three pathway indicators provides the ways in which they serve as essential ecological functions necessary for the overall viability of fish stocks: Water Temperature, Sediment/Turbidity, and Chemical Contamination/Nutrients.

   i. **Water Temperature –** Water temperatures affect the survival and production of fish throughout all life stages. For instance, a study of Chinook salmon survival from fertilization to hatching demonstrated that those eggs incubated at 15.0˚C had a 23% survival rate while those incubated at 9.9 and 11.4˚C had a 49 and 50% survival rate, respectively (Garling and Masterson 1985). In Chum salmon, embryo survival was demonstrated to be highest at 11˚C (Murry and McPhail 1988), hatching success of rainbow trout reaches its maximum at 10-12˚C (McCullough 1999), and preferred temperatures for bull trout ranges are 2-4˚C (McPhail and Murray 1979). Next, changing water temperatures affect juvenile fish. Juvenile (fry, fingerling, parr) Chinook demonstrate optimum growth between 10.0-15.6˚C (Armour 1990). Growth drastically declines or ceases at 19.1˚C (Armour 1990) and is accompanied by decreased feeding, increased stress, and warm water diseases. Juvenile bull trout are usually found in water temperatures below 12˚C (Goetz 1994). Finally, at a certain point, temperatures become lethal for all fish. McCullough (1999), citing numerous studies, stated that temperatures above 21˚C equal or exceed incipient lethal temperatures for Columbia River Chinook stocks and steelhead stocks migrating during the summer season. The best bull trout habitat in Oregon streams seldom exceeded 15˚C (Buckman et al. 1992; Ratliff 1992; Ziller 1992).

ii. **Turbidity –** Increased levels of sedimentation often have adverse effects on fish habitats and riparian ecosystems. Fine sediment deposited in spawning gravels can reduce egg survival and developing alevins (Everest et al. 1987; Hicks et al. 1991) by reducing the availability of dissolved oxygen in the gravel. Primary production, benthic invertebrate abundance, and thus, food availability for fish may be reduced as sediment levels increase (Cordone and Kelley 1961; Loyd et al. 1987) due to reductions in photosynthesis within murky waters. Social (Berg and Northcoate 1985) and feeding behavior (Noggle 1978) can be disrupted by increased levels of suspended sediment. Pools, which are an essential habitat type, can be filled by sediment and degraded or lost (Kelsey et al. 1981; Megahan 1982).

iii. **Chemical Contamination/Nutrients –** Aquatic ecosystem perturbations related to chemical contamination include thermal pollution, toxicity due to organic compounds and heavy metals, organic wastes and resulting changes in dissolved oxygen, acidification, and increased eutrophication. Sources of these chemical inputs commonly result from industry, urban development and agriculture. It is clear from the growing body of literature that salmon may influence the food webs, trophic structure, nutrient budgets, and possibly the productivity of freshwater and terrestrial systems, although the effect varies widely between systems and is contingent upon timing, scale, retention mechanisms, alternative nutrient sources, and baseline limiting factors (Gende et al, 2002). Reduced inputs of salmon-derived organic matter and nutrients (SDN) may limit freshwater production and thus establish a negative feedback loop affecting future generations of fish. Restoration efforts use the rationale of declining SDN to justify artificial nutrient additions, with the goal of reversing salmon decline. Biological responses to this method have also been documented (Roni et al, 2002). Elevated primary production and density of invertebrates have been associated with carcass additions (Wipfli et al. 1999). While evidence suggests that fish and wildlife may benefit from increases in food availability as a result of carcass additions, stream ecosystems vary in their ability to use nutrients to benefit salmon. Moreover, the practice may introduce excess nutrients, disease, and toxic substances to streams that may already exceed proposed water quality standards (Compton 2006).

b. Long-term Benefits of ARBA Activities to the Water Quality Pathway

i. **Group One Projects –** The ARBA Team (BLM, FS, FWS, NOAA Fisheries) determined that numerous Group One ARBA activity categories will provide immediate benefits to Water Quality conditions: Large Wood, Boulder and/or Gravel Placement; Headcut Stabilization and Associated Fish Passage; Bank Restoration; Road Treatments (roads encroaching into the bankfull channel); Floodplain Overburden Removal.

In general, large wood and boulder placement will enhance nutrient retention, while headcut stabilization, bank restoration, floodplain overburden removal, and road treatments (primarily road treatments) projects will decrease direct sediment inputs into the stream channel, thereby reducing stream turbidity.

ii. **Group Two Projects –** Several Group Two activities will provide immediate benefits to the Water Quality Pathway and include the following: In-channel Nutrient Enhancement, Riparian and Upland Juniper Treatment, Riparian Exclusion Fencing, Road Treatments (roads outside of bankfull channel);

Management of Recreation Impacts. The In-channel Nutrient Enhancement projects will increase marine-derived nutrient loading to freshwater environments primary production. The remaining projects will decrease sediment transport into the stream channels, thereby reducing stream turbidity.

c. **Short-term Negative Impacts of ARBA Activities to the Water Quality Pathway**
As described above, ARBA activity categories are expected to benefit Water Quality. In acquiring these benefits, short-term negative impacts are expected. Such effects will be minimized by incorporating PDCs and CMs described in Chapter II, Table 4, into project design and implementation

i. **Group One Projects –** The ARBA Team determined that all Group One activity categories are known to increase short-term sediment loads into the stream channel during project implementation. Increased sediment loads would result from the use of large equipment within the stream channel and/or within bankfull width, causing soil disturbance and transport within the stream system. The ARBA Team also concluded that these activities are unlikely to have negative impacts to stream temperatures because only minimal amounts of vegetation will be removed. Further, the ARBA team determined that chemical contamination/nutrients will not be affected because such actions are not expected to introduce chemicals into the project area. Therefore the following analysis will focus on activity impacts to the Turbidity Indicator.

The sediment plume from Group One projects will likely be limited to the immediate vicinity (approximately ½ mile downstream) and should dissipate within a few hours. Short-term inputs of sediment could result from instream structure placement, opening of side channels, road treatments, and other Group One projects that occurs inside the bankfull area. The amount, extent, and duration of fine sediment inputs and turbidity are related to the following: soil type; the amount of soil disturbance; whether restoration is in or out of the wetted channel; the sensitivity of the channel banks to erosion and other disturbances; the amount of time it takes for disturbed areas to re-vegetate and stabilize; and the probability of precipitation events before disturbed areas are re-vegetated or stabilized.

The increased stream turbidity may deposit fine coats of sediment on channel substrate a short distance downstream, encourage fish to move downstream, and alter behavior patterns for a short time. Because the work will be conducted during the in-water work periods (a time when spawning is not expected and after emergence of fry), the project should not interfere with spawning, egg development, and the sac fry life stage. In cases of fall-spawning fish, the fine layer of sediment deposited on channel substrate will be cleared away as the fish construct redds. It is anticipated that all project related sediment will be flushed out during the first fall/winter/spring high flows after project completion, and site restoration conservation measures are expected to prevent future project related sediment inputs into the stream. Therefore, long-term impacts to turbidity and spawning gravels are not expected.

ii. **Group Two Projects –** Part a. applies to Group Two activity categories, excluding Riparian Area Invasive Plant Treatment. Part b. applies to the Riparian Invasive Plant Treatment category.

a. **Group Two Activities (excluding Riparian Area Invasive Plant Treatment) –** Most of the Group Two activities will be conducted outside of the bankfull channel and PDCs and CMs will guide project design and implementation. In regards to stream temperature, the ARBA Team determined that Riparian Vegetation Treatment (non-commercial), Riparian and Upland Juniper Treatment (non-commercial), and Riparian Vegetation Treatment (controlled burning) will result in reduced shade on a limited basis and in such a manner as to have minor negative impacts to water temperature; these impacts will be ameliorated through growth of desired riparian vegetation and associated structure. Likewise, the ARBA Team concluded that Group Two projects will have insignificant negative impacts to Chemical Contamination/Nutrients. The ARBA Team also concluded that those Group Two activities that may occur inside the bankfull channel (Irrigation Screen Installation and Replacement, In-Channel Nutrient Placement, Estuary Restoration) will also have insignificant negative impacts to these two water quality indicators.

However, because the PDCs and CMs do not preclude working to the bankfull channel mark, bare soil as a result of riparian vegetation treatments, exclusion fencing, road treatments, and management of recreation impacts may introduce sediment into the streambed and water column, resulting in negative impacts to the Turbidity indicator. The manner in which these activities are carried out will generally not result in sediment entering the stream at the time of project implementation, but as a result of run-off later in time. Estuary projects could result in increased sediment into the water column. However, tidal waters typically carry high sediment loads, so the overall contribution of sediment to the water column from this project type is considered to be insignificant.

There will likely be harm and/or harassment for short periods of time resulting from certain monitoring/inventory activities (as well as treatment of emergent invasive plants) in and adjacent to the stream channel where fish are present, and fish may be displaced for short periods of time due to the small turbidity plumes. Since fine sediments will likely enter the stream channel as suspended sediment during the first few rainfall events during periods with increased stream flow, it is unlikely that there will be detectable amounts of fine sediments deposited on the streambed.

b. **Riparian Area Invasive Plant Treatment** – This section will discuss the effects to stream temperature, turbidity, and chemical contamination.

Regarding temperature, most mechanical and herbicidal treatments of invasive plant species in riparian areas are not likely to decrease shading of streams. However, in some situations, decreased shading is likely to result, increasing the amount of incident solar radiation reaching the stream, and resulting in

increased water temperatures. Significant shade loss is likely to be rare, occurring primarily from treating streamside knotweed and blackberry monocultures, and possibly from cutting streamside woody species (tree of heaven, scotch broom, etc.). The loss of shade would persist until native vegetation reaches and surpasses the height of the invasive plants that were removed. Shade recovery may take one to several years, depending on the success of invasive plant treatment, stream size and location, topography, growing conditions for the replacement plants, and the density and height of the invasive plants when treated.

This programmatic activity will move the baseline for this indicator towards a "Restore" rating by allowing reestablishment of conifers and other shade producing vegetation in areas currently infested by invasive plants. Isolated incidents of short-term, localized water temperature increases may occur, as discussed above.

Next, one of the criteria for selecting the invasive plant treatment methods included in this program was their low potential for creating ground disturbance and resulting stream turbidity. Ground disturbance of an extent that may cause localized increases in fine sediment deposition or turbidity is likely to occur only under some circumstances. Hand pulling of emergent vegetation is likely to result in localized turbidity and mobilization of fine sediments.

Hand pulling or site preparation (for replanting) that is extensive, intensive, and immediately adjacent to a stream course could plausibly cause localized instream fine sediment or turbidity increases. However, hand pulling or site preparation of a magnitude likely to generate biologically relevant sediment and turbidity increases is not likely to occur due to the difficulty in treating large sites by hand. Large infestation sites are more likely to be treated using tools (mowing, discing, broadcast herbicide application, etc.) not included in this programmatic activity description, and thus would go through separate ESA consultation.

Biological controls typically work slowly over a period of years, and only on target species, and are thus unlikely to lead to bare ground and surface erosion that would increase fine sediment and turbidity.

Treatment of knotweed and other streamside invasive species with herbicides (by stem injection or spot spray) is likely to result in biologically relevant, short-term increases in fine sediment deposition or turbidity when treatment of locally extensive streamside monocultures occurs.

Hand pulling of emergent vegetation is likely to result in localized turbidity increases and mobilization of fine sediments. The degree of effect will be proportionate to the extent of the infestation treated, type of substrate in which the plants are rooted, rooting depth, whether a hand tool is required for pulling (weed wrench, shovel, etc.), and similar factors. Some hand pulling

treatments are likely to result in short-term adverse effects to listed fish in the vicinity of the treatment area.

Other manual, mechanical, solarization, and herbicide (cut-stump, and wicking/wiping) treatment methods are unlikely to cause fine sediment or turbidity increases. Seed clipping, stabbing, girdling, and cutting typically do not involve ground disturbance or result in bare ground. Solarization may result in bare ground, but is typically small-scale, treating less than 0.1 acres at a time at individual sites.

Riparian area invasive plant treatment will be conducted in a manner as to "Maintain" current turbidity conditions. As discussed above, localized short-term effects are likely to result only from herbicide treatment of locally extensive streamside monocultures.

Finally, herbicides included in this invasive plant programmatic activity were selected due to their low to moderate aquatic toxicity to listed salmonids. The associated application methods were selected for their low risk of contaminating soils and subsequently introducing herbicides to streams. However, direct and indirect exposure and toxicity risks are inherent in some application scenarios, and are discussed below.

Aquatic labeled glyphosate and aquatic labeled imazapyr are the only herbicides to be applied within stream channels. Both can be applied up to 15 feet from the edge of water using hand-held, hand-pumped spray bottles, and to the edge of water using wicking and wiping application methods in both perennial and intermittent channels.

Aquatic labeled glyphosate is the only herbicide to be used for treatment of emergent knotweed. Treatment will primarily be by stem injection, but treatment of smaller plants will occur by spot spray or wicking/wiping.

Cut-stump and hack & squirt applications are limited to imazapyr, metsulfuron methyl, and glyphosate (without surfactant or aquatic labeled). Wicking and wiping applications are limited to chlorsulfuron, clopyralid, aquatic labeled glyphosate, imazapyr, sethoxydim, metsulfuron methyl, and sulfometuron methyl. Spot applications are limited to chlorsulfuron, clopyralid, aquatic labeled glyphosate, imazapyr, sethoxydim, metsulfuron methyl, and sulfometuron methyl.

Analysis conducted for the USFS Region 6 Invasive Plant EIS BA (USFS 2005) characterized the risk associated with the above listed herbicides to listed aquatic species. The potential for exposing aquatic organisms (fish, invertebrates, algae, and macrophytes) to sub-lethal concentrations of herbicides following broadcast treatment of a 10 acre streamside area was analyzed for 10 different herbicides.

Under the application scenario analyzed in the USFS Region 6 BA, chlorsulfuron, clopyralid, metsulfuron methyl, imazapyr and sulfometuron methyl were not identified as posing a significant risk of causing sub-lethal effects to listed aquatic species. Plausible risk of sub-lethal effects to listed aquatic species under the application scenario modeled for the USFS Regional BA was identified for glyphosate (including aquatic labeled and without surfactant) and sethoxydim.

The risk of adverse effects from the toxicity of herbicides and other compounds present in formulations to listed aquatic species is mitigated in this programmatic activity by reducing stream delivery potential by restricting application methods. Cut-stump, hack & squirt, stem injection, and wicking/wiping applications occurring outside of stream channels have a low potential for delivering herbicides to soils, where they would be available for leaching into streams. In addition, glyphosate generally has low soil mobility due to high sorption to soil particles. Based on extrapolation of hazard quotient calculations from the USFS Regional BA and water contamination rates from the SERA risk assessments, adverse effects to water quality from cut-stump, hack & squirt, stem injection, and wicking/wiping applications occurring outside of stream channels are not likely to occur. In addition to PDC mitigations, the combination of lower amounts of herbicide contacting soil (the USFS and SERA analyses assumed broadcast spray application) and likelihood of lower application rates (due to more efficient application) will reduce the amount of herbicide delivered into streams from cut-stump, hack & squirt, stem injection, and wicking/wiping applications occurring outside of stream channels.

Acute toxicity classifications discussed below are based on LC50 values as summarized in Table 10. Acute toxicity classifications for each herbicide are listed in Table 11.

Table 10. Aquatic Acute Toxicity Categories

Toxicity Category	Aquatic Organism LC_{50} Value (mg/liter)
very highly toxic	<0.1
highly toxic	0.1-1
moderately toxic	>1-10
slightly toxic	>10-100
practically non-toxic	>100

Adapted from Information Ventures, 1995.

The toxicity risk for listed fish species identified in the USFS Region 6 BA for glyphosate application was due to high broadcast application rates allowed by the label, rather than high glyphosate toxicity. The acute toxicity of aquatic labeled glyphosate is classified as “slightly/moderately toxic”. Glyphosate stem injected into knotweed is generally unavailable for delivery to streams, but stream introduction is likely following treatment of emergent plants from leakage at injection sites and release following plant death. Spot spray

treatment of knotweed plants immediately adjacent to or emergent from streams is likely to result in some introduction of glyphosate to streams.

Aquatic labeled glyphosate and aquatic labeled imazapyr applied to dry portions of perennial streams have a high potential to result in delivery of herbicide and associated compounds to stream water following rainstorms, by surface runoff, inundation of treated plants, or both. Concentrations of glyphosate near sites of introduction are likely to exceed effect threshold levels under some circumstances, but will dilute rapidly with mixing into the stream thalweg.

The toxicity risk for listed fish species identified in the USFS Region 6 BA for sethoxydim is primarily due to the presence of naphtha solvent in the formulated product (Poast). The Poast formulation containing the naphtha solvent is approximately 200 times more toxic than sethoxydim alone (SERA 2001). The acute toxicity of sethoxydim alone is classified as "practically non-toxic" (LC50 value of 265 mg/l), whereas the acute toxicity of the formulated product (Poast) is classified as "moderately toxic" (LC50 value of 1.2 mg/l). Mitigations included in the invasive plant activity description are designed to allow the naphtha solvent to volatilize, markedly reducing its' availability for delivery to streams.

Table 11. Herbicide Acute Toxicity to Salmonids

Herbicide	LC_{50} Value (mg/l)	Acute Toxicity Category
Chlorsulfuron	40	Slightly toxic
Clopyralid	103	Practically non-toxic
Glyphosate	10	Slightly/moderately toxic
Imazapyr	>100	Practically non-toxic
Metsulfuron methyl	150	Practically non-toxic
Sethoxydim	1.2 (formulation) 265 (herbicide only)	Moderately toxic Practically non-toxic
Sulfometuron methyl	12.5	Slightly toxic

There is a greater than discountable risk of indirect introduction of herbicides to streams containing ESA-listed fish and their designated critical habitat resulting from herbicide applications that occur within the bankfull width of tributary intermittent channels. The PDC allow applications of herbicides at maximum label rates within intermittent channels by spot spray (hand-pump spray or squirt bottles only), cut-stump, hack & squirt, and wicking/wiping. Given the programmatic nature of this activity, and extensive geographic coverage, it is likely that circumstances will arise where substantial treatment of invasive plant infestations occurs within intermittent or ephemeral channels tributary to streams with ESA-listed fish and their designated critical habitat. According to the "first flush" phenomenon described by Caltrans (2005), the highest concentration of herbicide occurs in the first storm event following

application. The highest concentration occurs during the ascending limb of the hydrograph, when the flow in the channel is low compared to later in the storm runoff event. In addition, herbicide mixtures are likely to occur in the runoff from some treated intermittent channels due to PDC allowing application of aquatic glyphosate, metsulfuron, and sulfometuron within the same intermittent channel. Since instream herbicide concentrations (and thus hazard quotients) are potentially high for the initial runoff in these "first flush" events in some situations, but cannot currently be calculated (due to unknown site conditions), some level of adverse effects to fish present at intermittent/occupied perennial stream confluences is considered likely to occur.

Increased nutrient loads in streams can lead to algal blooms, increased biological oxygen demand, water chemistry effects, and changes in biota. The treatment methods included in this activity description are generally only appropriate for invasive plant treatments of small to moderate size and intensity, and increased inputs of nutrients to streams from decaying plants sufficient to significantly affect listed fish are not likely to occur.

Riparian area invasive plant treatment will be conducted in a manner as to "Maintain" long-term water quality with respect to chemical contamination and nutrients, with limited short-term adverse effects. As discussed above, the combination of application methods, low toxicity herbicides, and PDC are likely to restrict adverse effects from herbicide exposures on listed fish to infrequent, short-term occurrences.

2. **Habitat Access Pathway**

a. Indicator Description – The description of the following pathway indicator provides the ways in which it serves as an essential ecological function necessary for the overall viability of fish stocks: Physical Barrier.

i. **Physical Barriers –** Human constructed physical barriers within the stream channel, such as culverts and irrigation weirs, as well as other barriers, such as head cuts, can impair sediment and debris transport, migration routes, life history patterns, and population viability. First and second order streams, which generally include permanently flowing non-fish bearing streams and seasonally flowing or intermittent streams, often comprise over 70 percent of the cumulative channel length in mountain watersheds in the Pacific Northwest (Benda et al. 1992). These streams are the sources of water, nutrients, wood, and other vegetative material for streams inhabited by fish and other aquatic organisms (Swanson et al. 1982; Benda and Zhanag 1990; Vannote et al. 1980). Decoupling the stream network (through physical barriers) can result in the disruption and loss of functions and processes necessary for creating and maintaining fish habitat. Further, physical barriers prevent the movement of fish in their fulfillment of life history functions. Culverts, for instance, prevent juvenile fish from reaching rearing habitats (Furniss et al. 1991) and have blocked significant amounts of historical anadromous salmonid habitat (Roni et al. 2002). Even more, barriers restrict the expression of various life history forms within a species. Migratory movements of fluvial or adfluvial forms of bull trout, for example, can be restricted or prevented, and such a loss of life

history forms restricts the full potential of fish production. Finally, strong populations rely on unimpeded access between watershed reserves, those areas of high quality habitat occupied by viable subpopulations, for dispersion and genetic interchange (Noss et al. 1997).

b. Long-term Benefits of ARBA Activities to the Habitat Access Pathway

i. **Group One Projects –** Four Group One ARBA activity categories will restore fish passage into previously occupied habitat for all life stages of native fish: Headcut Stabilization and Associated Fish Passage, Fish Passage Culvert and Bridge Projects, Irrigation Screen Installation and Replacement (weir removal), and Estuary Restoration (tide gate removal). As described above, resulting benefits include providing uninhibited stream access for migrating and rearing fish, restoring continuous paths for wood, nutrients, sediments, and other vegetative material essential for quality fish habitat.

ii. **Group Two Projects –** No Group Two projects are intended for or designed to restore fish passage.

c. Short-term Negative Impacts of ARBA Activities to the Habitat Access Pathway

As described above, ARBA activity categories are expected to benefit Habitat Access. In acquiring this benefit, short-term negative impacts are expected. Such impacts will be minimized by incorporating PDCs and CMs described in Chapter II, Table 4, into project design and implementation.

i. **Group One Projects –** Of the 10 Group One activity types, the ARBA Team determined that only three activities—Fish Passage Culvert and Bridge Projects, Irrigation Screen Installation and Replacement (weir removal), and Estuary Restoration (tide gate removal)—may temporarily restrict habitat access during project implementation. Coffer dams and water diversion structures associated with these activities may temporarily block (few weeks) fish movement up and downstream through the construction area. Because the road crossing, weirs, and tide gates to be repaired serve as an existing fish passage barrier, coffer dams and diversion structures may not be any more of a barrier than the current road crossing or weir structure. Otherwise, none of the Group One activity types are expected to result in barriers to fish movement during any life stages and will therefore have no negative impacts to these indicators.

ii. **Group Two Projects –** Because all Group Two activities will be conducted outside of the bankfull channel and/or are guided by appropriate PDCs and CMs, the ARBA Team determined that these activities will not result in barriers to fish passage during or after project construction.

3. Habitat Elements Pathway

a. Indicator Description – The descriptions of the following five indicators provide the ways in which each indicator serves as an essential ecological function necessary for the overall viability of fish stocks: Substrate/Sediment; Large Wood; Pool Frequency and Quality; Pool; Off-channel Habitat; Refugia.

i. **Substrate/Sediment** (excerpts from Rieman and McIntyre 1993) – This indicator is similar to "Sediment" in that it addresses fines and their effects on fish habitat. Unlike "Sediment," which addresses spawning and incubation, the substrate indicator assesses fines and their effects on rearing habitat within channel substrate.

The NMFS (1996) notes that rearing capacity of salmon habitat decreases as cobble embeddeness levels increase, resulting from increased sedimentation. Furthermore, over wintering rearing habitat within substrate may be a limiting factor to fish production and survival, and the loss of this over wintering habitat may result in increased levels of mortality during rearing life stages. Likewise, when the percent of fine sediments in the substrate was relatively high, rearing bull trout were also less abundant (USDI 1998b).

ii. **Large Wood (LW) –** Large wood in streams is an important roughness element influencing channel morphology, sediment distribution, and water routing (Swanson and Lienkaemper 1978, Bisson et al. 1987). Large wood influences channel gradient by creating step pools and dissipating energy (Heede 1985), lengthens streams by increasing sinuosity (Swanston 1991), and serves as an important agent in pool formation (Montgomery et al.1995). In low order streams, in particular, LW collects sediment and larger substrates during high flow events (Keller et al. 1985) and can account for 50% of the sediment/substrate storage sites (Megahan 1982). Further, LW is instrumental in nutrient retention by capturing and storing salmon carcasses (Cederholm and Peterson 1985) and allochthonous materials, a primary energy source for smaller rivers and streams (Gregory et al. 1991). The resulting effect of LW on fish habitat is significant. Crispin et al. (1993) noted increased salmon spawning activity in an area where gravels accumulated behind LW. Bjornn and Reiser (1991) cited several studies that documented an increase in fish densities with higher levels of LW, and Fausch and Northcote (1992) documented that Coho salmon and cutthroat trout production was greater in LW-dominated streams, where pools, sinuosity, and overhead cover were greatest. The role of LW decreases as streams become larger, because greater currents will carry LW out of the active channel and onto the banks (Murphy and Meehan 1991).

iii. **Pool Frequency and Quality –** Pools are considered to be one of the most important habitat elements and are the preferred habitat type by most fish (Bestcha and Platts 1986), offering low velocity refuges, cooler stream temperatures during summer months, and overwintering habitat (Reeves et al. 1991). Salmonid density is positively correlated to pool volume and frequency; pool loss reduces the production capability of salmonid habitat (Everest et al., 1985; Sedell and Everest, 1990; MacDonald et al., 1991; Nickelson et al., 1992a; Fausch and Northcote, 1992). Availability of pools during summer low flow periods can be a limiting factor in survival and production of salmonids (Reeves et al., 1990). In reference to spawning, pool tailouts, where gravel is deposited, are important areas for redd construction, and the pool bodies provide rearing habitat for juveniles and holding habitat for adults (Bjornn and Reiser 1991). Further, Sedell et al. (1990) describes pools as being important refuges from drought, fire, winter icing, and other disturbances. When pool numbers, volume, depth, and complexity increase, the stream's capacity to support a diversity of species and life stages increases (Bisson et al. 1992; Bjornn and Reiser 1991). In general, pool quality is directly related to decreased surface area and increased depth, overhead cover (Fausch and Northcote 1992), presence of LW, and undercut banks, especially in lower gradient streams. Further, pools of all shapes and sizes are needed to accommodate the various life history stages of fish, thereby allowing for juveniles to occupy pools absent of larger predatory fish (Bestcha and Platts 1986).

iv. **Off-channel Habitat –** Off-channel habitats—comprised of alcoves, side channels, freshwater sloughs, wetlands or other seasonally or permanently flooded areas—are important rearing sites for juvenile fish (Roni et al. 2002). Roni et al. (2002) noted that most off channel habitat research focused on coho salmon, noting that juveniles are much more reliant on this habitat type for over-winter rearing and growth than other salmonids, such as cutthroat trout and Chinook salmon.

v. **Refugia –** Refugia, or designated areas providing high quality habitat, either currently or in the future, are a cornerstone of most species conservation strategies. Although fragmented areas of suitable habitat may be important, Moyle and Sato (1991) argue that to recover aquatic species, refugia should be focused at a watershed scale. Naiman et al. (1992) and Sheldon (1998) noted that past attempts to recover fish populations were unsuccessful because the problem was not approached from a watershed perspective. Noss et al. (1997) provides additional information, listing several principals that should be considered when evaluating reserves (refugia). First, refugia should be well distributed across a landscape, the idea being that widely distributed subpopulations will not experience catastrophic or adverse impacts across its entire range. Some subpopulations will escape the impact, eventually re-colonize the affected area, and sustain the population as a whole. Second, large reserves are better than small ones, because there is a greater opportunity for habitat diversity and larger population size. As a result, genetic variability within a population will be optimized, promoting increased adaptability to environmental change. Thirdly, refugia that are closer together are better than those farther apart. A short distance between refugia promotes dispersion and genetic interchange. If enough interchange occurs between refugia, fish are functionally united into a larger population that can better avoid extinction.

b. Long-term Benefits of ARBA Activities to the Habitat Elements Pathway

i. **Group One Projects –** Numerous Group One ARBA activity categories will provide immediate benefits to Habitat Element conditions: Large Wood, Boulder, and/or Gravel Placement; Reconnection of Existing Side Channels and Alcoves; Headcut Stabilization and Associated Fish Passage; Bank Restoration; Road Treatments (roads encroaching into the bankfull channel); Floodplain Overburden Removal; Legacy Structure Removal. In general, large wood and boulder placement will enhance habitat elements described in the Large Wood indicator above, while Reconnection of Existing Side Channels and Alcoves will increase adult and juvenile rearing habitat as described in the Off-channel habitat indicator above. Headcut stabilization, bank restoration, and road treatments (primarily road treatments) projects will decrease direct sediment inputs into the stream channel, thereby enhancing conditions for juvenile rearing within channel substrate. Floodplain overburden removal will not only reduce sediment inputs into the stream channel, such projects will increase floodplain connectivity and the potential for the development of off-channel habitat.

ii. **Group Two Projects –** Several Group Two activities will provide immediate benefits to Habitat Elements and include the following: Estuary Restoration; Riparian and Upland Juniper Treatment, Riparian Exclusion Fencing, Road Treatments (roads outside of bankfull channel); Management of Recreation Impacts. With the exception of Estuary Restoration, each of these projects will

decrease sediment loads into the stream channels, thereby improving rearing conditions within the channel substrate. Estuary restoration will enhance off-channel habitat for rearing salmonids.

c. Short-term Negative Impacts of ARBA Activities to the Habitat Element Pathway – As described above, ARBA activity categories are expected to benefit Habitat Element indicators. In acquiring these benefits, short-term negative impacts are expected. Such impacts will be minimized by incorporating PDCs and CMs described in Chapter II, Table 4, into project design and implementation.

i. **Group One Projects** – Of the seven matrix indicators, the ARBA Team determined that negative impacts would occur only to Substrate/Sediment. Further, the Team determined that all 10 Group One activity categories are known to increase short-term sediment loads into the stream channel during project implementation. Increased sediment loads would result from the use of large equipment within the stream channel and/or within bankfull width, causing soil disturbance and transport within the stream system. The ARBA Team also concluded that these Group One activities are unlikely to have negative impacts to the remaining indicators of this pathway as ARBA projects are intended to enhance such indicators. Therefore the following analysis will focus on activity affects to the Substrate/Sediment indicator.

   The sediment plume from Group One projects will likely be limited to the immediate vicinity (approximately ½ mile downstream) and should dissipate within a few hours. Short-term inputs of sediment could result from instream structure placement, opening of side channels, road treatments, and other Group One projects that occurs inside the bankfull area. The amount, extent, and duration of fine sediment inputs and turbidity are related to the following: soil type; the amount of soil disturbance; whether restoration is in or out of the wetted channel; the sensitivity of the channel banks to erosion and other disturbances; the amount of time it takes for disturbed areas to re-vegetate and stabilize; and the probability of precipitation events before disturbed areas are re-vegetated or stabilized. These effects apply to Riparian Area Invasive Plant Treatment projects; refer to the Water Quality pathway, Section B. 1 of this chapter.

   The increased stream turbidity may deposit fine coats of sediment on channel substrate a short distance downstream, encourage fish to move downstream, and alter behavior patterns for a short time. Because the work will be conducted during the in-water work periods (a time when spawning is not expected and after emergence of fry), the project should not interfere with spawning, egg development, and the sac fry life stage. In cases of fall-spawning fish, the fine layer of sediment deposited on channel substrate will be cleared away as the fish construct their redds. It is anticipated that all project related sediment will be flushed out during the first fall/winter/spring high flows after project completion, and site restoration conservation measures are expected to prevent future project related sediment inputs into the stream. Therefore, long-term negative impacts to Substrate/Sediment are not expected.

ii. **Group Two Projects –** Because most of the Group Two activities will be conducted outside of the bankfull channel and PDCs and CMs will be guide project design and implementation, the ARBA Team determined that these activities will

have minimal (if any) negative impacts to any of the Habitat Element indicators. The ARBA Team also concluded that those Group Two activities that may occur inside the bankfull channel (Irrigation Screen Installation and Replacement, In-Channel Nutrient Placement, Estuary Restoration) will also have minimal (if any) negative impacts to these indicators. Since fine sediments will likely enter the stream channel as suspended sediment during the first few rainfall events during periods with increased stream flow, it is unlikely that there will be detectable amounts of fine sediments deposited on the streambed. Therefore, substrate composition should not change. Estuary projects could result in increased sediment into the water column. However, tidal waters typically carry high sediment loads, so the overall contribution of sediment to the water column from this project type is considered to be insignificant.

Biological and herbicide treatments do not kill invasive species immediately. As treated vegetation dies and loses root strength, soil can be moved into surface water through water movement or wind. However, a substantial amount of vegetation die-off beside a stream would be necessary to significantly increase sediment delivery and turbidity. It is unlikely that such a situation would occur, but may on a limited basis. Biological controls typically work slowly over a period of years and only on specific target species, so biological controls are not likely to increase fine sediment and turbidity. Some applications of non-selective herbicides (for example, the broadcast glyphosate application modeled in the BA) in riparian areas or areas hydrologically connected to streams are likely to result in increased fine sediment delivery and increased turbidity and sediment in channel substrate. Many herbicides are selective, acting only on specific groups of plants and leaving non-target species on the treatment site. Selective herbicides are less likely to influence sediment delivery or turbidity.

4. **Channel Conditions and Dynamics Pathway**

   a. **Indicator Description –** The descriptions of the following three pathway indicators provide the ways in which each indicator serves as an essential ecological function necessary for the overall viability of fish stocks: Width/Depth Ratio; Streambank Condition; Floodplain Connectivity.

   i. **Width/Depth Ratios –** The width to depth ratio is an index value that helps describe the shape of a stream channel, and is the ratio of bankfull width to mean bankfull depth (Rosgen 1996). Both measurements are based on bankfull flow or its indicators. In short, bankfull flow is the channel forming flow that transports the bulk of available sediment over time (Wolman and Miller 1960). In another way, bankfull flows are those that transport sediment from upstream reaches, forming and removing channel bars, doing the work that forms the morphological characteristics of a channel (Dunne and Leopold 1978). Relatively small width/ depth values are indicative of stream stability, and Rosgen (1996) suggests that width to depth ratios can be used as a surrogate to stream stability. Finally, Bestcha and Platts (1986) state that as width to depth ratios increase, the stream becomes shallower and may result in a loss of pools.

   ii. **Streambank Condition –** Streambank condition is related to its ability to dissipate stream power. For many stream channels, riparian vegetation with woody root masses, along with instream debris, serve as physical barriers to erosive and

downcutting forces of stream power (Bestcha and Platts 1986). Further, the stems of herbaceous and woody plants, residing on the stream bank, provide additional roughness to dissipate stream power and capture suspended sediments (Elmore and Bestcha 1987). When these roughness elements are removed, however, a streambanks ability to withstand stream power is decreased, resulting in bank erosion, relatively higher width to depth ratios, and possible channel incision. Even if streambanks are in good condition, increased peak flows can damage banks and cause channel incision. Finally, streambanks that are in good condition can provide quality fish habitat through undercut banks and overhanging vegetation (Bestcha and Platts 1986).

iii. **Floodplain Connectivity –** Leopold (1994) defines a floodplain as a level area near a river channel, constructed by the river in the present climate and overland flow during moderate flow events. When a stream can readily access its floodplain during high flow events, the stream will overflow its banks and spread across the floodplain, dissipating stream energy, depositing sediments, accessing side channels. Bestcha and Platts (1986) suggest that for a floodplain to be effective in sorting and capturing flood-born sediment it must have roughness elements, such as trees and other debris. Floodplains or riparian areas adjacent to stream channels serve as water storage sites—water collected from flooding and precipitation—which can increase subsurface flow to the stream channel (Elmore and Bestcha 1987), especially important to augmentation of low stream flows during summer months. Side channels associated with floodplains offer refuge areas to juvenile salmonids during high flow events (Roni et al. 2002).

b. Long-term Benefits of ARBA Activities to the Channel Condition and Dynamics Pathway

i. **Group One Projects –** All Group One projects will enhance one or more of the indicators under the Channel Condition and Dynamics Pathway. Each of these projects will occur within the bankfull channel and immediate floodprone area and are intended to restore channel, bank, and floodplain areas to more natural conditions. As a result, such ARBA projects are expected to decrease width/depth ratios, improve streambank condition, and increase floodplain connectivity.

ii. **Group Two Projects –** All Group Two projects, with the exception of Irrigation and Screen Replacement, In-channel Nutrient Placement, and Restoration Project Survey and Monitoring, are expected to enhance one or more of the indicators under the Channel Condition and Dynamics Pathway. These projects will promote the growth of riparian vegetation, which should lead to improved bank conditions and width/depth ratios. Several of these projects—estuary and road projects—will remove floodplain fill material, thus restoring floodplain dynamics.

c. Short-term Negative Impacts of ARBA Activities to the Channel Condition and Dynamics Pathway – As described in 4. b. above, ARBA activity categories are expected to benefit Channel Conditions and Dynamics. In acquiring these benefits, the ARBA Team determined that Group One and Group Two ARBA activity categories will not result in negative impacts to any of the three pathway indicators as no projects will increase width/depth ratios, decrease streambank condition, and disconnect floodplains.

5. **Flow Hydrology Pathway**

   a. **Indicator Descriptions –** The descriptions of the following two pathway indicators provide the ways in which each indicator serves as an essential ecological function necessary for the overall viability of fish stocks: Changes in Peak/Base Flows and Increase in Drainage Network.

      i. **Changes in Peak/Base Flows** – Many stream reaches with historic natal habitat in the analysis area have flows reduced significantly during the summer low flow period. Many riparian wetlands, such as wet meadows, have been damaged by grazing, mining, road construction, and logging in the analysis area as consistently indicated by field reviews (Beschta et al., 1991; Beschta et al., 1993). This loss of wetland function has probably contributed to reducing summer low flows in natal habitat. Although data are sparse, peakflows may occur a week or two earlier in the year in some managed watersheds year than in unmanaged watersheds. McIntosh (1992) found that the annual peakflows currently occur about 2 weeks earlier in the Grande Ronde than historically. Some heavily logged drainages may have increased summer low flows; summer low flow has increased in the some parts of the Grande Ronde over the past 50 years (McIntosh, 1992). However, the increases in low flows do not appear to have improved salmonid survival because the water quality is so poor and stream habitats have been heavily degraded due to upstream logging, grazing, and road construction (Anderson et al., 1993; McIntosh et al., 1994).

      ii. **Increase in Drainage Network –** Wemple et al. (1996) documented that 57% of a road system within a watershed, located in the western Cascades of Oregon, was hydrologically connected to the stream network by roadside ditches draining directly into streams and roadside ditches draining into relief culverts with gullies below their outlets. Thus, an increase in road densities led to an associated increase in drainage density by up to 50%. High-density road systems have been linked to changes in the hydrograph or magnitude and timing of flow events. For instance, in an Oregon Coast Range watershed, Harr et al. (1975) showed that peak flows increased significantly after road building converted at least 12% of the area to road prisms. The causal effects were attributed to increased surface compaction, which reduces water infiltration, resulting in excess water being carried down the road, drainage ditches, and relief culverts into the stream network. Jones and Grant (1996) documented that peak flows increased by 50% in a watershed within a five year period following road construction and logging. The longevity of the hydrologic changes are as permanent as the roads, and until a road is removed and natural drainage patterns are restored, the road will continue to affect the routing of water through a watershed.

   b. **Long-term Benefits of ARBA Activities to the Flow/Hydrology Pathway**

      i. **Group One Projects –** Numerous Group One ARBA activity categories will provide immediate benefits to the Flow/Hydrology Pathway: Reconnection of Existing Side Channels and Alcoves; Estuary Restoration (tide gate removal); Road Treatments (roads encroaching into the bankfull channel); Floodplain Overburden Removal. Each of these projects will enhance floodplain connectivity, thereby addressing wetland functions described under Peak/base Flows above. Road Treatments will provide additional benefits in that they will reduce the drainage network, thereby directly addressing issues discussed in the Drainage Network category above.

ii. **Group Two Projects –** Estuary Restoration projects will restore both marine and freshwater flow into floodplain areas, addressing wetland functions as described in the Peak/base Flow category above. Road Treatments (primarily upland treatments projects) will reduce the drainage network and promote more natural flow regimes, a relevant issue discussed in the Drainage Network category above, and Floodplain Overburden Removal projects will enhance floodplain connectivity.

c. Short-term Negative Impacts of ARBA Activities to the Flow Hydrology Pathway – As described above, ARBA activity categories are expected to benefit Peak/base Flows and Drainage Network categories. In acquiring these benefits, the ARBA Team determined that Group One and Two ARBA activity categories will not result in negative impacts to any of the three pathway indicators as no projects will not disrupt natural Peak/base Flow patterns or increase the Drainage Network.

6. Watershed Condition Pathway

a. Indicator Description – The descriptions of the following three MPI Indicators provide the ways in which each indicator serves as an essential ecological function necessary for the overall viability of fish stocks: Road Density and Location, Riparian Reserves, and Disturbance History.

i. **Road Density and Location –** Available information consistently indicates that roads are one of the greatest sources of habitat degradation in managed watersheds, especially when they are within riparian zones (Geppert et al., 1984; Furniss et al., 1991). Roads significantly elevate on-site erosion and sediment delivery for the life of the road (USFS, 1981; Geppert et al., 1984; USFS et al., 1993). Studies consistently indicate that roads increase the frequency of mass failures in mountainous terrain (Dunne and Leopold, 1978; Megahan et al., 1978; Geppert et al., 1984; Furniss et al., 1991). Mass failure volumes from roads are orders of magnitude greater than from undisturbed areas on a per unit area basis (Dunne and Leopold, 1978; Megahan et al., 1978; Geppert et al., 1984; Furniss et al., 1991). Road crossings cause extreme increases in sediment delivery (Fowler et al., 1987). Roads also disrupt subsurface flows (Megahan, 1972). Roads increase peakflows (King and Tennyson 1984; King, 1989; USFS et al., 1993). Roads within riparian zones reduce shading and disrupt LWD sources for the life of the road (USFS et al., 1993). These effects of roads degrade habitat by increasing fine sediment levels, reducing pool volumes, increasing channel width and exacerbating seasonal temperature extremes.

ii. **Riparian Areas –** The following discussion was adapted from FEMAT (1993). Riparian areas are those portions of watersheds that are directly coupled to streams and rivers, the portions of watersheds required for maintaining hydrologic, geomorphic, an ecological processes that directly affect streams, stream processes, and fish habitats. The network of Riparian Reserves—comprised of all stream orders both intermittent and perennial—allow for connectivity of the aquatic ecosystem within a watershed. Riparian areas are shaped by disturbances characteristic of upland ecosystems, such as fire and windthrow, as well as disturbance processes unique to stream systems, such as lateral channel erosion, peakflows, deposition by floods and debris flows. The near-stream riparian areas—floodplains—may contain an increased diversity of plant species and extensive hydrologic nutrient cycling interactions between groundwater and riparian vegetation. This vegetation, ranging from conifers to deciduous hardwoods,

provides allochthonous (organic debris) to stream channels and associated aquatic invertebrate communities. Further, riparian vegetation moderates light levels and stream temperature, helps armor stream banks with extensive root systems, and contributes large wood into the stream channel.

iii. **Disturbance History –** Information for this section was acquired from Reeves et al. (1995). Even though the article was directed at anadromous salmonids, the discussion can readily apply to most PNW fish stocks. Riverine-riparian ecosystems within the PNW used by anadromous salmonids naturally experience periodic catastrophic disturbances, which then moved through a series of recovery states over a period of decades to centuries, resulting in a landscape that varies in suitability for salmonids. Disturbance can be categorized as being pulse or press disturbances. A pulse disturbance is one that allows an ecosystem to recover to pre-disturbance conditions, and a press disturbance is one that prohibits an ecosystem from rebounding to pre-disturbance conditions. The dominant pulse disturbances in which the PNW salmonids are adapted to include natural fire regimes, fire related landslides, and floods, all working in concert in a manner that produce habitat patches, varying in quality and quantity. In short, fires would burn through an area, landslides would then transport wood and sediment into the streams, and floods would distribute the sediment and debris throughout stream networks. In the Oregon coast range, the amount of sediment and large wood found in streams could be correlated to occurrence of the last stand replacement fire. This pulse disturbance regime, or varying forms thereof, was altered with the onset of fire suppression and extensive timber harvest. The resulting effects are different from the natural pulse regime in that sediment is transported in the system without wood, the interval between disturbances has been drastically reduced in most cases, and harvest and road construction is widely distributed, resulting in chronic sedimentation across a larger landscape.

b. Long-term Benefits of ARBA Activities to the Watershed Condition Pathway

i. **Group One Projects –** Four Group One activity categories are expected to provide immediate benefits to the Watershed Condition Pathway: Reconnection of Existing Side Channels and Alcoves; Bank Stabilization; Floodplain Overburden Removal; Estuary Restoration (tide gate removal); Road Treatments (primarily road treatments within the bankfull channel). All of these activities will promote growth of riparian vegetation, thus improving riparian conditions as described under the Riparian Area category. Road treatments projects will reduce the potential for negative impacts as described in the Road Density and Location category as well as restoring processes that would occur under a more natural Disturbance Regime.

ii. **Group Two Projects –** All Group Two projects, with the exception of Irrigation and Screen Replacement and Restoration Project Survey and Monitoring, are expected to enhance one or more of the indicators under the Watershed Condition Pathway. These projects will promote the growth of riparian vegetation, which will result in benefits described under the Riparian Area category. The vegetation treatment projects as well as the road treatment projects are intended to recreate upland conditions—vegetative and road densities—which promotes a pulse disturbance regime as described under the Disturbance History category. Several

of these projects—estuary and road projects—will remove floodplain fill material, thus restoring floodplain dynamics.

c. **Short-term Negative Impacts of ARBA Activities to the Watershed Conditions Pathway** – As described in above, ARBA activity categories are expected to benefit Watershed Condition categories. In acquiring these benefits, the ARBA Team determined that Group One and Group Two ARBA activity categories will not result in negative impacts to any of the three pathway indicators as no projects will increase road density, increase press disturbance regime processes, or degrade riparian conditions.

7. **Fish Population Characteristics**

a. Indicator Description – The descriptions of the following MPI provides the way in which the indicator serves as an essential ecological function necessary for the overall viability of fish stocks.

i. **Fish Population Characteristics –** There are four key indicators of bull trout subpopulations that the USFWS considers important in evaluating subpopulation trends and the likelihood for species persistence at the watershed scale. Subpopulation size is evaluated relative to the habitat capacity and overall demographics (balanced representation of all life stages) to assess the reproductive potential of a subpopulation. Subpopulation growth and survival are evaluated to characterize the relative resilience and likelihood of recovery of a subpopulation from a disturbance that reduces the subpopulation size. The life history diversity (presence of migratory life history) and isolation characteristics of a subpopulation are evaluated to ensure the connectivity between adjacent subpopulations. Finally, subpopulation persistence and genetic integrity is evaluated by considering the risk of hybridization (gene introgression) and the previous assessments of subpopulation size, growth and survival, and life history diversity and isolation characteristics.

b. Long-term Benefits of ARBA Activities to the Fish Pathway – All Group One and Two ARBA activities are intended to enhance or mimic aquatic habitat forming processes within a watershed as a means to create better habitat for ESA- and/or MSA-listed fish. As a result, habitat capacity will increase at the site-specific and watershed scale. Over time, when numerous 5th field watersheds are enhanced through ARBA projects, habitat capacity will improve at the sub-basin level—4th field watershed. With this increased capacity at the site, watershed, and sub-basin scale, the likelihood that a subpopulation can survive a natural or anthropogenic disturbance will be enhanced. For instance, if a major disturbance, such as a catastrophic wildfire, occurs in a 5th field watershed, nearby watersheds will continue to provide quality habitat for fish within those areas and possibly fish from the disturbed area.

Furthermore, the ARBA activities are expected to promote habitat diversity and convert degraded and simplified aquatic ecosystems to ones that are dynamic and complex. For instance, large wood and boulder placement projects will be directed, in part, at bedrock stream channels—characterized by bedrock substrate, low pool frequencies, and wide, shallow, and straight channels. These projects will result in a variety of channel substrates, increased pool frequencies, decreased width/depth ratios, increased stream

sinuosity, improved hiding cover, nutrient retention, and more, all of which promote habitat diversity and diversity within a subpopulation.

Terrestrial habitats will benefit by those restoration activities proposing to restore or enhance riparian and upland areas. These activities will help restore the composition and structural diversity of native plant communities and hydrologic functions in riparian and upslope areas.

c. Short-term Negative Impacts of ARBA Activities to the Fish Pathway – As described above, ARBA activity categories are expected to benefit the Fish Pathway. In acquiring these benefits, short-term negative impacts are expected. Such impacts will be minimized by incorporating PDCs and CMs described in Chapter II, Table 4, into project design and implementation.

The impacts of project related Turbidity and Substrate/Sediment were presented in the Water Quality and Habitat Elements pathways, respectively. Only short-term negative impacts are expected. Therefore, sediment/turbidity and other impacts from ARBA activities should have insignificant effects on subpopulation growth, survival, life history diversity, and genetic integrity.

For all Group One ARBA activities, fish may be incidentally injured or killed by heavy equipment that operates in or along the stream channel. Several Group One projects such as Fish Culvert and Bridge Projects, in-channel weir removal under the Irrigation Screen Installation and Replacement category, and tide gate removal under the Estuary Restoration category will involve fish salvage. Fish salvage (isolation, capture, and handling) will occur when diverting a stream around a project site to minimize adverse impacts. The fish would be netted and placed back into the stream in a secure location. Fish handling has the potential to result in fish injury or death. Mortality may be immediate or delayed. Handling of fish increases their stress levels and can cause a variety of injurious conditions, including reduced disease resistance, osmoregulatory problems, decreased growth, decreased reproductive capacity, and increased mortality (Kelsch and Shields 1996). There is a potential for a small number (up to five percent) of juvenile fish that are present in the dewatered section to avoid being captured and relocated, and thus die because they remain undetected in stream margins under vegetation, rocks, or gravels. The length of a dewatered section can reach 200', sometimes more.

C. Effects on Aquatic Species Critical Habitat and Essential Fish Habitat

A thorough MPI analysis for project effects to aquatic species yields an adequate and effective analysis of project effects to the features and functions of Primary Constituent Elements (PCEs) for critical habitat and EFH. Based on the crosswalk analysis between pertinent MPI indicators and PCEs, effects to PCEs from each of the 19 programmatic activity types are fully consistent with those effects identified for ESA listed fish species. For instance, an ESA "likely to adversely affect" determination based upon an analysis of habitat indicators corresponding to "waters" and "substrate" in the definition for EFH, results in a "may adversely affect" EFH determination. Table 12 describes the crosswalk for listed salmonids and Table 13 describes the process for Bull Trout.

Table 12. Crosswalk between Critical Habitat PCEs and MPI for ESA Salmon Species	
Primary Constituent Elements	**MPI Pathways, Indicators that Crosswalk with PCEs**
Spawning Habitat, as defined by water quality, water quantity, substrate	**Water Quality**: Temperature, Suspended Sediment, Substrate **Flow/Hydrology**: Change in Peak/Base flows **Habitat Elements**: Substrate/Embeddedness
Rearing as defined by adequate water quantity and floodplain connectivity	**Channel Conditions and Dynamics**: Floodplain connectivity **Flow/Hydrology**: Change in Peak/Base flow
Rearing as defined by adequate water quality and forage	**Water Quality**: Temperature, Substrate **Habitat Elements**: Large wood, Pool Frequency and Quality, Off-channel Habitat
Rearing as defined by adequate natural cover	**Habitat Elements**: Large wood, Pool Frequency and Quality, Large Pools, Off-channel Habitat
Migration as defined by habitat free of artificial obstructions, and adequate water quality, water quantity, and natural cover	**Habitat Access**: Physical Barriers **Water Quality**: Temperature **Flow/Hydrology**: Change in Peak/Base flow **Habitat Elements**: Large wood, Pool Frequency and Quality, Large Pools

Table 13. Crosswalk between Critical Habitat PCEs and MPI for Bull Trout.

Primary Constituent Element	MPI Habitat Indicators
Permanent water having low levels of contaminants such that normal reproduction, growth and survival are not inhibited	**Pathway:** Water Quality **Indicator:** chemical contamination/nutrients
Water temperatures ranging from 2 to 15C (36 to 59F), with adequate thermal refugia available for temperatures at the upper end of this range. Specific temperatures within this range will vary depending on bull trout life history stage and form, geography, elevation, diurnal and seasonal variation, shade, such as that provided by riparian habitat, and local groundwater influence	**Pathway:** Water Quality **Indicator:** temperature
Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and instream structures	**Pathway:** Habitat Elements **Indicators:** large wood, pool frequency and quality, large pools, off channel habitat, refugia **Pathway:** Channel conditions and Dynamics **Indicators:** wetted width/maximum depth ratio, stream bank condition, floodplain connectivity
Substrates 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 substrate less than 0.63 cm (0.25 in) in diameter and minimal substrate embeddedness are characteristic of these conditions	**Pathway:** Water Quality **Indicator:** sediment **Pathway:** Habitat Elements **Indicator:** substrate embeddedness
A natural hydrograph, including peak, high, low, and base flows within historic ranges or, if regulated, a hydrograph that demonstrates the ability to support bull trout populations	**Pathway: Flow/Hydrology** **Indicator:** change in peak/base flows
Springs, seeps, groundwater sources, and subsurface water connectivity to contribute to water quality and quantity	**Pathway:** Channel Condition and Dynamics **Indicator:** floodplain connectivity **Pathway:** Flow/Hydrology **Indicator:** Change in peak/base flows

Table 13 (continued). Crosswalk between Critical Habitat PCEs and MPI for Bull Trout.	
Primary Constituent Element	**MPI Habitat Indicators**
Migratory corridors with minimal physical, biological, or chemical barriers between spawning, rearing, over wintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows	**Pathway:** Habitat Access **Indicator:** Physical barriers **Pathway:** Water Quality **Indicator:** Chemical contaminants/nutrients, temperature **Pathway:** Flow/Hydrology **Indicator:** change in peak/base flows
An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish	**Pathways:** Water Quality, Habitat Elements, Channel Condition and Dynamics, Habitat Access **Indicators:** All 13 associated with these 4 pathways

D. Summary and Conclusions for Aquatic Effect Determinations for Group One and Group Two Projects

Please refer to Chapter V, section B, for a detailed description of the beneficial effects of the actions. There are no actions that were determined to be solely beneficial. A summary of the negative impacts resulting in conclusions of LAA for effects to ESA-listed fish species, LAA for effects to critical habitat, and "May Adversely Affect" Essential Fish Habitat, are presented below.

1. **Group One Project Impacts and Effects**
   i. **Group One Project Impacts to Baseline Conditions for Matrix Indicators:** All Group One projects will result in negative impacts to the Turbidity and Substrate/Sediment Indicators in proximity to listed fish species and within designated critical habitat. The sediment plume from Group One projects will likely be limited to the immediate vicinity (conservatively estimated at no more than ½ mile downstream) and should dissipate within a few hours. The increased stream turbidity may deposit fine coats of sediment on channel substrate a short distance downstream. It is anticipated that all project related sediment will be flushed out during the first fall/winter/spring high flows after project completion, and site restoration conservation measures are expected to prevent future project related sediment inputs into the stream. Therefore, long-term impacts to turbidity and substrate/sediment, including spawning gravels, are not expected.
   ii. **Group One Project Effects to Individuals:** The turbidity plume will cause fish to move downstream, and alter behavior patterns for a short time, and heavy equipment used within the stream channel may harm and/or harass individual fish. Because the work will be conducted during the in-water work periods (a time when

spawning is not expected and after emergence of fry), the project should not interfere with spawning, egg development, and the sac fry life stage. In cases of fall-spawning fish, the fine layer of sediment deposited on channel substrate will be cleared away as the fish construct redds.

Fish Culvert and Bridge Projects, in-channel weir removal under the Irrigation Screen Installation and Replacement category, and tide gate removal under the Estuary Restoration category will involve fish salvage. Fish salvage (isolation, capture, and handling) will occur when diverting a stream around a project site to minimize adverse impacts. The fish would be netted and placed back into the stream in a secure location. Fish handling has the potential to result in fish injury or death. Mortality may be immediate or delayed. Handling of fish increases their stress levels and can cause a variety of injurious conditions, including reduced disease resistance, osmoregulatory problems, decreased growth, decreased reproductive capacity, and increased mortality (Kelsch and Shields 1996). There is a potential for a small number (up to five percent) of juvenile fish that are present in the dewatered section to avoid being captured and relocated, and thus die because they remain undetected in stream margins under vegetation, rocks, or gravels.

In conclusion, the displacement of fish during sustained periods of turbidity, handling of fish for fish salvage, and potential for incidental take due to project implementation support an effect determination of LAA for the species for Group 1 activities. Refer to Table 14 – ESA Effect Determinations for Listed Fish Species, Designated Critical Habitat, and MSA Effect Determinations for Essential Fish Habitat

iii. **Group One Project Effects to Critical Habitat:** The analysis of effects to habitat indicators corresponding to water quality and substrate components of PCEs for both anadromous salmonids and bull trout support an LAA determination for critical habitat for Group One projects. Refer to Table 14 – ESA Effect Determinations for Listed Fish Species, Designated Critical Habitat, and MSA Effect Determinations for Essential Fish Habitat

iv. **Group One Project Effects to Essential Fish Habitat:** An ESA "likely to adversely affect" determination based upon an analysis of habitat indicators corresponding to "waters" and "substrate" in the definition for EFH, results in a "may adversely affect" EFH determination. Refer to Table 14 – ESA Effect Determinations for Listed Fish Species, Designated Critical Habitat, and MSA Effect Determinations for Essential Fish Habitat

2. **Group Two Project Impacts and Effects**

i. **Group Two Project Effects to Matrix Indicators:** Part a. applies to Group Two activity categories, excluding Riparian Area Invasive Plant Treatment. Part b. applies to the Riparian Invasive Plant Treatment category.

a. **Group Two Activities (excluding Riparian Area Invasive Plant Treatment)** In regards to stream temperature, Riparian Vegetation Treatment (non-commercial), Riparian and Upland Juniper Treatment (non-commercial), and Riparian Vegetation Treatment (controlled burning) will result in reduced shade on a limited basis and in such a manner as to have minor negative impacts to water temperature; these impacts will be ameliorated through growth of desired

riparian vegetation and associated structure. Group Two actions may introduce sediment into the water column, resulting in negative impacts to the Turbidity indicator. However, because actions are generally beyond the bankfull discharge mark, this will result in lesser amounts of sediment (if any) entering the stream at the time of project implementation, relative to Group One projects. Most sediment inputs will result from run-off later in time. Fine sediments will likely enter the stream channel as suspended sediment during the first few rainfall events during periods with increased stream flow and it is unlikely that there will be detectable amounts of fine sediments deposited on the streambed.

b. **Riparian Area Invasive Plant Treatment –** Invasive plant treatment projects, in rare instances, can create isolated pockets of reduced shade, resulting from elimination of invasive plants. However, such impacts are expected to be short-lived with the ensuing growth of native vegetation. Concerning turbidity and sediment, invasive plant treatments will result in effects similar to those from other Group Two projects as described above in part a. Further, Riparian Area Invasive Plant Treatment projects will be conducted in a manner as to maintain long-term water quality with respect to chemical contamination and nutrients, with limited short-term adverse effects. As discussed in part B 1.of this chapter, the combination of application methods, low toxicity herbicides, and PDC are likely to restrict adverse effects from herbicide exposures on listed fish to infrequent, short-term occurrences.

Refer to Table 14 – ESA Effect Determinations for Listed Fish Species, Designated Critical Habitat, and MSA Effect Determinations for Essential Fish Habitat

ii. **Group Two Projects Effects to Individual Fish:** No Group Two projects will result in the capture, handling, or transport of fish. There will likely be harm and/or harassment for short periods of time (minutes rather than hours for Group One actions) resulting from monitoring/inventory activities and treatment of invasive emergent plants in and adjacent to the stream channel where fish are present, and fish may be displaced for short periods of time due to the small turbidity plumes. The magnitude of these adverse effects to the species will be considerably less than for Group One projects. Project related fine sediment introduced into the stream will result in small turbidity plumes dissipating short distances downstream from source sites during the first several run-off events (far < ½ mile for Group One projects). Harm/harassment of fish will be of short duration and for fewer fish (far < several hours over periods of several days for Group One projects). The harm/harassment identified above contributes to an LAA determination for effects to the species for Group 2 activities. Refer to Table 14 – ESA Effect Determinations for Listed Fish Species, Designated Critical Habitat, and MSA Effect Determinations for Essential Fish Habitat

iii. **Group Two Projects Effects to Critical Habitat:** The analysis of effects to the Turbidity indicator corresponding to the water quality components of PCEs for both anadromous salmonids and bull trout, supports an LAA determination for critical habitat for Group 2 projects. Refer to Table 14 – ESA Effect Determinations for Listed Fish Species, Designated Critical Habitat, and MSA Effect Determinations for Essential Fish Habitat

iv. **Group Two Projects Effects to Essential Fish Habitat:** An ESA "likely to adversely affect" determination based upon an analysis of the Turbidity indicator corresponding to "waters" in the definition for EFH, results in a "may adversely affect" EFH determination. Refer to Table 14 – ESA Effect Determinations for Listed Fish Species, Designated Critical Habitat, and MSA Effect Determinations for Essential Fish Habitat.

Table 14. ESA Effect Determinations for Listed Fish Species, Designated Critical Habitat, and MSA Effect Determinations for Essential Fish Habitat

Species	ESA Listing Status	Determination of Effects for Group One and Two Projects		
		Individuals	Critical Habitat	Essential Fish Habitat
Bull Trout (Salvelinus confluentus)	Threatened	LAA	LAA	NA
Lahontan Cutthroat Trout (Oncorhynchus clarki henshawi)	Threatened	LAA	NA	NA
Lost River Sucker (Deltistes luxatus)	Endangered	LAA	LAA	NA
Shortnose Sucker (Chasmistes brevirostris)	Endangered	LAA	LAA	NA
Warner Sucker (Catostomus warnerensis)	Threatened	LAA	LAA	NA
Oregon Chub (Orenichthys crameri)	Endangered	LAA	NA	NA
Borax Chub(Gila boraxobius)	Endangered	LAA	LAA	NA
Foskett Speckled Dace (Rhinichthys osculus ssp.)	Threatened	LAA	NA	NA
Lower Columbia River Chinook Salmon (Onchorhynchus tshawytscha	Threatened	LAA	LAA	MAA
Upper Columbia River Spring-Run Chinook (Onchorhynchus tshawytscha)	Endangered	LAA	LAA	MAA
Puget Sound Chinook Salmon (Onchorhynchus tshawytscha)	Threatened	LAA	LAA	MAA
Snake River Fall-Run Chinook Salmon (Onchorhynchus tshawytscha)	Threatened	LAA	LAA	MAA
Snake River Spring/Summer Run Chinook (Onchorhynchus tshawytscha)	Threatened	LAA	LAA	MAA
Upper Willamette River Chinook (Onchorhynchus tshawytscha)	Threatened	LAA	LAA	MAA
Lower Columbia River Chum Salmon (Onchorhynchus keta)	Threatened	LAA	LAA	NA
Hood Canal Summer Run Chum Salmon (Onchorhynchus keta)	Threatened	LAA	LAA	NA
Lower Columbia Coho Salmon (Onchorhynchus kisutch)	Threatened	LAA	NA	MAA
Southern Oregon/Northern California Coho (Onchorhynchus kisutch)	Threatened	LAA	LAA	MAA
Oregon Coast Coho Salmon (for potential re-listing) (Onchorhynchus kisutch)	NA	NA	NA	MAA
Ozette Lake Sockeye Salmon (Onchorhynchus nerka)	Threatened	LAA	LAA	MAA
Snake River Sockeye Salmon (Onchorhynchus nerka)	Endangered	LAA	LAA	MAA
Lower Columbia River Steelhead (Onchorhynchus mykiss)	Threatened	LAA	LAA	NA
Middle Columbia River Steelhead (Onchorhynchus mykiss)	Threatened	LAA	LAA	NA
Upper Columbia River Steelhead (Onchorhynchus mykiss)	Endangered	LAA	LAA	NA
Snake River Basin Steelhead (Onchorhynchus mykiss)	Threatened	LAA	LAA	NA
Upper Willamette River Steelhead (Onchorhynchus mykiss)	Threatened	LAA	LAA	NA
Puget Sound Steelhead (Onchorhynchus mykiss)	Proposed Threatened	LAA	LAA	NA
All non-listed MSA Chinook, coho, and pink salmon	NA	NA	NA	MAA

E. Effects on Terrestrial Species

For the listed wildlife species analyzed in this BA, aquatic restoration actions "may affect, likely to adversely affect" (LAA) only three bird species typically associated with noise disturbance during critical breeding times. The majority of programmatic aquatic restoration actions that take place in or near listed bird habitats can occur outside of critical nesting periods so as to avoid a LAA determination. No habitat for listed birds will be removed under this consultation. For all other listed terrestrial plant and wildlife species, aquatic restoration activities conducted under this consultation will result in a "may affect, not likely to adversely affect" determination.

1. Birds

a. **Bald Eagle –** In Oregon and Washington, the bald eagle nesting period can begin as early as January 1, and may extend until August 31. During this time, bald eagles are sensitive to human disturbance, particularly within the sight distance of nest sites. Disturbance can result in a number of situations that can impact nesting behavior and result in the subsequent mortality of young. Winter roost areas are critical to bald eagles for protection from inclement weather conditions in forest stands with favorable microclimate conditions that are located in areas with access for sources of food (such as anadromous fish runs, high concentrations of waterfowl, or mammalian carrion).

   The proposed projects in this BA are unlikely to result in removal of bald eagle nest or roost trees, or suitable habitat, because most construction activities will occur in the road prism, and generally less than 1 acre will be impacted for site preparation. The potential impacts are primarily related to disturbance from equipment and activity in close proximity to nest or roost sites during the nesting season. Implementation of the following project design criteria will help mitigate the "may affect, likely to adversely affect" determination for the bald eagle.

   Manual, mechanical, and or prescribed fire, may involve human activity or equipment that introduces an increased level of sound or visual stimuli into the environment. The disturbance from noise or activity near or within line of sight of a bald eagle nest or roost may disrupt nesting and feeding behaviors, causing them to flush from the nest or miss a feeding attempt. Biological treatments are not anticipated to have any effect on bald eagles due to the very limited human presence on the ground involved in these treatments.

   Disturbance to nesting bald eagles is expected to be rare because most of the eagles in Oregon and Washington nest outside of the action area and therefore there is a low likelihood of treatments occurring in occupied nesting territories. Most projects will be conducted along roads or in disturbed sites and bald eagle nests are often located away from these areas reducing the likelihood that treatments and bald eagle nests will intersect. National Forests on the eastern slopes of the Cascades anticipate the greatest number of invasive plant treatments and have the smallest number of bald eagles, further reducing the likelihood of eagle nests and invasive plant treatments overlapping. Bald eagles that nest near disturbed sites are often more habituated to disturbance than eagles nesting in remote locations and may be more tolerant to treatment activities.

The smoke generated from prescribed burning is not anticipated to be heavy enough to impact a bald eagle nest, due to the light nature of the fuels and therefore, adverse effects are not anticipated from smoke during prescribed burning activities.

The U.S. Forest Service found that the results of exposure scenarios to bald eagle indicate that no herbicide included in the Invasive Plant Program is likely to adversely affect bald eagle. Bald eagles are not likely to be directly sprayed or encounter vegetation that has been directly sprayed because infestations in forested habitat are not suitable for aerial applications and only aerial application could result in herbicide application in a manner likely to be encountered by bald eagles. In addition, there was no risk to bald eagles from eating contaminated fish because expected doses to fish-eating birds for all herbicides, even with very conservative assumptions, are well below any known.

Wintering bald eagles are not as restricted to one location and are not as sensitive to disturbance as nesting eagles and there will be few, if any, invasive plant treatments in the winter, therefore, no adverse effects from treatments to wintering bald eagle are anticipated.

b. **Marbled Murrelet/Designated Critical Habitat –** Potential effects of the aquatic restoration projects on the marbled murrelet are associated with disturbance associated with activities that would occur during the critical nesting period from April 1 through August 6 (restricted to no more than 5 activities that disturb MAMU per 5th HUC per year), and from Aug 7 to Sept 15 with 2 hour dawn and dusk no-fly windows. Most projects will be scheduled outside of this period due to work windows that minimize impacts on fish, but it is expected that some projects will occur during the nesting period that may adversely affect murrelets.

   Harassment could occur if (1) noise interrupts and/or precludes essential nesting and feeding behaviors, (2) noise/visual stimuli is in such close proximity to the nest that the activity is perceived as a threat and causes flushing from the nest or missed feedings, or (3) noise is loud and sudden which causes flushing from a nest (USDI 2002). Effects of harassment on murrelets could result in reduced reproduction or mortality of young due to avoidance of an area for nesting, adults flushing from the nest, increased susceptibility to predation, and aborted feeding of young, nest abandonment, and premature fledging.

   Adverse effects on marbled murrelet suitable or potential habitat, or designated critical habitat, are not expected to occur because most construction activities will occur in the road prism where vegetation has been previously altered or removed, are occurring in riparian areas where no suitable MAMU habitat occurs (e.g. pre-commercial thinning of a plantation). If suitable or potential MAMU habitat must be removed, the project falls outside the scope of this BA, and consultation must be initiated separately to address those effects.

c. **Northern Spotted Owl/Designated Critical Habitat –** Potential effects of the aquatic restoration projects on the northern spotted owl are associated with disturbance from activities that would occur during the critical nesting season (restricted to no more than 3 activities that disturb NSO per 5th HUC per year). The critical period generally occurs

from March 1 through July 15 although this period may change slightly on individual Units. Although many of the projects will be scheduled outside of this period due to work windows that minimize impacts on fish, it is expected that some projects will occur during the nesting period that may adversely affect owls.

Harassment for owls is similar to that for marbled murrelets, and could occur if (1) noise interrupts and/or precludes essential nesting and feeding behaviors, (2) noise/visual stimuli is in such close proximity to the next that the activity is perceived as a threat and causes flushing from the nest or missed feedings, or (3) noise is loud and sudden which causes flushing from a nest (USDI 2002). Effects of harassment on spotted owls could result in reduced reproduction or mortality of young due to avoidance of an area for nesting, adults flushing from the nest, increased susceptibility to predation, aborted feeding of young, nest abandonment, and premature fledging.

Adverse effects on spotted owl suitable habitat, or designated critical habitat, are not expected to occur because most construction activities will occur in the road prism, are occurring in poor quality riparian habitat (e.g., pre-commercial thinning in plantations). If occupied or un-surveyed suitable or potential habitat must be removed, the project falls outside the scope of this BA, and consultation must be initiated separately to address those effects.

Criteria NS01 and NS02 may be waived in a particular year if nesting or reproductive success surveys conducted according to spotted owl survey guidelines reveal that spotted owls are non-nesting or that no young are present that year. Waivers are valid only until March 1 of the following year. Previously known sites/activity centers are assumed occupied unless protocol surveys indicate otherwise.

2. Mammals

a. Canada Lynx – The primary potential effects on lynx from the programmatic actions are associated with disturbance. Most construction activities will occur in the road prism or poor quality riparian habitats where vegetation has been previous degraded or removed. Information in the Lynx Conservation and Assessment Strategy (Ruediger *et al.* 2000) was used to evaluate potential effects on lynx.

To date, most investigations of lynx have not shown human presence to influence how lynx use the landscape (Aubry *et al.* 2000). There have been no studies designed to determine the effects of human disturbance on lynx. Studies that have been conducted have reported anecdotal observations regarding lynx apparent tolerance of human presence. Several studies of lynx in the taiga have been conducted in areas of relatively dense rural human populations and agricultural development, suggesting that lynx can tolerate moderate levels of human disturbance. An exception to this may be activities around a den site that may cause abandonment of the site, possibly affecting kitten survival (Ruggerio *et al.* 2000). Current research indicates lynx may tolerate limited disturbance, even around active dens, but the level of tolerance is unknown.

Projects "may affect, but are not likely to adversely affect" lynx due to PDCs that ensure disturbance is avoided, via establishment of distance buffers around known lynx dens.

b. **Gray Wolf –** Gray wolves are currently rare or non-existent throughout most of the area where the aquatic restoration projects will be implemented, and it is unlikely locations will directly impact any animals or active den sites. Projects will be of relatively short duration, and should not affect prey availability or disturb wolves if animals are present in the area. Therefore, the determination of "may affect, but not likely to adversely affect" is appropriate for this species if the following is considered.

   If an active den, rendezvous site, or pack activity if identified, the project would fall outside the scope of this Biological Assessment, and a separate consultation would be required to address potential effects.

c. **Grizzly Bear** – Potential effects of the projects on grizzly bears include habitat loss and disturbance. However, the amount of habitat removal or degradation near aquatic restoration activities is expected to be minimal (less than 1 acre of low quality riparian habitat for any project). Work will not occur in areas that may affect bears during sensitive time period when animals could be present. Therefore, with implementation grizzly bear PDCs to avoid or minimize effects, the activities may affect, but are not likely to adversely affect the grizzly bear.

d. **Woodland Caribou –** Potential effects of the proposed action on woodland caribou include habitat loss and disturbance. However, the amount of habitat removal or degradation near project sites in the caribou recovery area in the Selkirk Mountains is expected to be minimal, and will not displace caribou or result in short-term degradation of riparian areas in caribou habitat. Direct mortality or sub-lethal effects are unlikely. Work will not occur in sensitive areas identified by the local wildlife biologist. Implementation of the projects as described in this BA "may affect, but are not likely to adversely affect the woodland caribou.

3. **Plants**

   For the listed plants analyzed in this BA, direct effects would occur from physical disturbance to individual plants and populations that immediately affected plant growth, survival, and or reproduction. Indirect effects would occur from project-related changes in habitat that affect the plants through time, and other changes that can influence growth and reproduction (e.g. increases or decreases in competition from other plants, the introduction of noxious weeds, increasing light to the plants from thinning, etc.).

   Field surveys for listed plants and suitable habitat will occur prior to federal activities during the growing season, before aquatic restoration activities would occur. Any listed plant or plant suitable habitat discovered during the survey that is within 0.25 miles of the proposed aquatic restoration project will cause project planners to design the restoration activity to be "not likely to adversely affect" listed plants. Knowing where the plants are and where they are not and avoiding the plants during restoration activities has proven to be the best way to facilitate conservation for these species and to meet the goals of the agencies.

F. Cumulative Effects

1. Scope

In the context of the Endangered Species Act (ESA), cumulative effects encompass the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the covered area; in this case, in the entirety of the States of Oregon and Washington, and the entire state of Washington. Future Federal actions, including those that are unrelated to the proposed action, are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

Cumulative effects, in the context of Section 7 consultation, are generic to the area of consideration and not related to the Federal action. The cumulative effects analysis is therefore independent of the specific restoration activities addressed in this programmatic BA and addresses impacts in the context of general trends in population and land-use.

2. Population Trends

Within the state of Oregon, the population is expected to increase 34 percent over the next 25 years (ODAS 1999). Washington's current population of about 5.8 million people has increased by about 1 million since 1990. Forecasts for population growth predict an additional 1.2 to 2.5 million people residing in Washington by 2020 (OFM 1999).

3. Residential, Commercial, and Infrastructure Development

Intuitively, population growth results in increasing residential and commercial development. Improvements and upgrades to infrastructure (including highways, other transportation facilities, pipelines, power lines, and power plants) will likely track closely with increased residential and commercial development. Primary pathways of potential effects of land development include the following: direct habitat loss, decreased water quality, contamination of waterways and uplands, changes to runoff patterns, habitat fragmentation, isolation of populations, and loss of habitat diversity. In general, as development increases the quantity and quality of habitat suitable for threatened and endangered species typically decreases. Based on past trends and types of development, future residential, commercial, and infrastructure development will likely lead to further habitat degradation. Actions taken to mitigate for the potential impacts of development may help slow the rate of habitat degradation.

4. Agriculture

Assuming future trends mirror the historical pattern in Oregon and Washington, substantial additional impacts to fish and wildlife due to agriculture are not expected. However, in many areas within the programmatic area, certain ongoing agricultural practices (such as irrigation, chemical application, and regular habitat disturbance in agricultural areas) are likely to prevent habitat from reaching properly functioning conditions for listed species.

5. Forestry

In Oregon and Washington, non-federal timber harvest typically involves clear-cutting. Impacts due to clear-cutting and forest roads have been well documented and such impacts are long lasting and additive. Timber harvest and associated impacts are

concentrated in western Oregon and Washington; however, timber harvest is anticipated in all of the 50 sub-basins, to varying degrees, within the programmatic area. Although the rate of harvest appears to be slowing in some areas and improved forestry practices have been implemented, the collective impacts of past and reasonably foreseeable future forestry activities are likely to result in additional future degradation of habitat for listed species.

6. **Pollutant Discharge**

Air and water pollution can degrade habitat and have lethal and sub-lethal effects on fish and wildlife. Increased human population typically causes increased air and water pollution. Developed areas also generate effluent, and runoff is often polluted with a variety of substances. In Oregon, each of the sub-basins within the programmatic area contain 303(d)- listed streams with water temperature being the most frequent parameter exceeding state standards. Other notable parameters include bacteria, dissolved oxygen, flow modification, habitat modification, nutrients, pH, sedimentation, total dissolved gas, toxics and turbidity. In a like manner, nearly 60 percent of the lakes, streams, and estuaries for which there is data fail to meet water quality standards in Washington as of 1999 (DNR 2000)

Ongoing activities in Oregon and Washington will help mitigate and/or reverse pollutant sinks and sources. The Oregon Department of Environmental Quality (DEQ), for instance, has completed TMDLs for several major basins since 1998. By 2004, DEQ will complete TMDLs in more than 40 additional basins. Even still continued pollutant discharges will likely continue in the future and are very likely to degrade habitat for listed species.

7. **Oregon and Washington Fish Recovery Efforts**

a. **Oregon –** Beginning in 1997**,** the State of Oregon developed a comprehensive aquatic conservation strategy (The Oregon Plan). The goal of the Oregon Plan is to "restore populations and fisheries to productive and sustainable levels that will provide substantial environmental, cultural, and economic benefits." Components of this plan include (1) coordination of efforts by local, state, and federal governments as well as tribal, private, and other interests, (2) development of action plans with relevance and ownership at the local level, (3) monitoring progress, and (4) making appropriate corrective changes in the future. This process included chartering 84 locally formed "watershed councils" across the State. Membership on the watershed councils includes landowners, businesses interests, agricultural interests, sport fishers, irrigation/water districts, individuals, State, Federal, and Tribal agencies, and local government officials.

Further, since 1990, the State of Oregon has taken several actions to address the conservation and recovery of bull trout. More restrictive harvest regulations were implemented beginning in 1990; by 1994 the harvest of bull trout was prohibited throughout the State with the sole exception of Lake Billy Chinook in central Oregon. Bull trout working groups have been established 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. In addition, the Oregon Department of Fish and Wildlife reduced the stocking of hatchery-

reared rainbow trout and brook trout in areas where bull trout occur, and genetic analysis for most bull trout populations was completed in 1997.

b. Washington – Washington State has developed a salmon restoration strategy to help recover dwindling fish stocks. A draft Statewide Strategy to Recover Salmon, "Extinction is not an Option," was produced by the Washington Governor's Salmon Recovery Office (Washington Governor's Salmon Recovery Office 1999) and Joint Natural Resources Cabinet. The plan describes how State agencies and local governments will work together to address habitat, harvest, hatcheries, and hydropower as they relate to recovery of listed species. While the Washington Governor's plan focuses primarily on salmon, many of the same factors affecting salmon also impact bull trout.

The Washington State legislature created the Salmon Recovery Act (ESHB 2496) and Watershed Management Act (ESHB 2514) to assist in salmon recovery efforts. The Watershed Management Act provided funding and a planning framework for locally based watershed management groups to address water quality and quantity. The Salmon Recovery Act provides direction for the development of limiting factors analyses on salmon habitat and creates a list of prioritized restoration projects. While not specifically targeting limiting factors for bull trout, these documents have played an important role in the development of bull trout recovery unit chapters.

To further enhance bull trout populations, the Washington Department of Fish and Wildlife no longer stocks brook trout in streams or lakes connected to bull trout waters. Fishing regulations prohibit harvest of bull trout, except for a few areas where stocks are considered "healthy." The Washington Department of Fish and Wildlife is also currently involved in a mapping effort to update bull trout distribution data within the State of Washington, including all known occurrences, spawning and rearing areas, and potential habitats. Likewise, the salmon and steelhead inventory and assessment program is currently updating their database to include the entire State, which consists of an inventory of stream reaches and associated habitat parameters important for the recovery of salmonid species and bull trout.

Conclusion for cumulative effects

The ESA listings of fish and wildlife species in the States of Oregon and Washington have been based, in part, on the additive impacts of growth, development, and other human activities. At this point, the trends discussed above indicate that future impacts will progress similarly, leading to additional adverse impacts on all fish and wildlife and their habitats. Changes to past development practices and fish recovery efforts in Oregon and Washington provide hope that past trends are not predictive of future circumstances.

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APPENDIX A. Interagency Regional Executives December 10, 2004 Memorandum of Direction.

United States Department of Agriculture Forest Service	United States Department of Commerce National Oceanic and Atmospheric Administration Fisheries	United States Department of the Interior Bureau of Land Management	United States Department of the Interior Fish and Wildlife Service

MEMORANDUM

DATE: December 10, 2004

TO: Forest Supervisors (Regions 1, 4, and 6), USFS
District Managers (Oregon, Washington, and Idaho), BLM
Ecological Services Project Leaders (Oregon, Washington, and Idaho), FWS
State Habitat Directors (Northwest Region), NOAA Fisheries

FROM: Jack Troyer, Regional Forester, Region 4, USFS
Linda Goodman, Regional Forester, Region 6, USFS
Abigail Kimbell, Regional Forester, Region 1, USFS
K Lynn Bennett, Idaho State Director, BLM
Elaine Brong, Oregon/Washington State Director, BLM
D. Robert Lohn, Regional Administrator, Northwest Region, NOAA Fisheries
Dave Allen, Regional Director, Pacific Region, FWS

SUBJECT: New or Expanded Programmatic Actions and Endangered Species Act Section 7 Compliance

In a December 18, 2003, Memorandum (from the Interagency Regional Executives to the Interagency Coordinators Subgroup), we commissioned an interagency team to: "Provide an assessment of programmatic consultations that could be created or expanded for Federal lands" in Oregon, Washington, and Idaho. The team has completed their assessment and provided us with a July 9, 2004, report.

We were pleased to find that the assessment team identified that NOAA's National Marine Fisheries Service (NOAA Fisheries) and the Fish and Wildlife Service (FWS) completed a combined three-state total of approximately 173 "programmatic" consultations over a five-year period. This total includes formal and informal consultations on batches of individual actions, land management plans, and many program-level actions. The scale and content of the actions addressed under these consultations varied considerably with respect to the species and critical habitat addressed, and the number and types of activities considered. The team evaluated a wide breadth of information as well as several complexity factors from which they developed conclusions and recommendations. This information provides an important perspective that can be used to identify opportunities for new or expanded programmatic actions that can be efficiently analyzed for compliance with section 7 of the Endangered Species Act (ESA).

To aid in their assessment, the team developed an Excel database that includes all of the consultations and activity types considered. The database and the team's powerpoint presentation (presented to us on July 9, 2004) are posted on the interagency ESA consultation streamlining website located at http://www.or.blm.gov/esa/index.htm. The database and powerpoint presentation are intended to serve as useful field references for expanding or developing new programmatic activities. We encourage our Level 1 and Level 2 teams to explore the following two strategies:

1. Expand on Existing Programmatic Actions

Field units should review the database and become familiar with programmatic actions that have completed consultation, are being implemented on nearby units, and that may have application to their unit. If there are applicable programs being implemented, field units should direct their Level 1 and Level 2 teams to consider how that program could be applied to their unit.

2. Develop New Programmatic Actions

Based on feedback from field staff and a high likelihood of interagency success, the assessment team recommended the development of new program-level fish habitat restoration actions to aid in the recovery of at-risk fish stocks. The assessment team also recommended the agencies draw from the recently completed programmatic consultation on culverts and other broad-scale section 7 documents to use as guides for completing programmatic consultations on new or expanded fish habitat restoration actions.

To monitor our progress on the development of new or expanded programmatic fish habitat restoration actions, we are establishing an interagency work group for Oregon and Washington. Depending upon the results of this effort, work groups in other parts of the Columbia River Basin may be established later. The Oregon/Washington work group will contact Level 1 and 2 teams to periodically review our progress on the development of new program-level fish habitat restoration actions, and will report the results to the Interior Columbia Basin Regional Executives. The interagency work group for Oregon and Washington is comprised of the following individuals:

Dallas Emch, USFS
Jim Boynton, USFS
Michael Tehan, NOAA Fisheries
Steve Landino, NOAA Fisheries
Kemper McMaster, FWS
Ken Berg, FWS
Denis Williamson, BLM
Paula Burgess, BLM

In summary, the Regional Executives support the development of program-level actions that are designed in a manner that provides for ESA section 7 consultations to be conducted efficiently. Such actions will improve our ability to meet our shared resource management goals. This is

your license to go forward to look for opportunities for expanding or developing new program-level fish habitat restoration or other types of actions, when appropriate. If you have any questions regarding this matter, please contact your agency assessment team member: Russ Strach (NOAA Fisheries) at 503-231-6266; Alan Christensen (USFS) at 503-808-2922; Dan Brown (FWS) at 503-231-6281; or Paula Burgess (BLM) at 503-808-6525.

Sincerely,

JACK G. TROYER
Regional Forester, Region 4
USDA Forest Service

LINDA D. GOODMAN
Regional Forester, Region 6
USDA Forest Service

ABIGAIL KIMBELL
Regional Forester, Region 1
USDA Forest Service USDC

D. ROBERT LOHN
Regional Administrator, Northwest Region
National Marine Fisheries Service

for ELAINE M. BRONG
State Director, OR/WA
USDI Bureau of Land Management

for K LYNN BENNETT
State Director, ID
USDI Bureau of Land Management

for DAVID B. ALLEN
Regional Director, Region 1
USDI Fish and Wildlife Service

cc:
Interagency Coordination Subgroup (ICS)
Regional Technical Team (RTT)
ICB Deputy Team
Paul Roush, BLM California

APPENDIX B. BLM Instruction Memorandum No. OR-2001-014, Policy on the Use of Native Species Plant Materials

United States Department of the Interior
BUREAU OF LAND MANAGEMENT
Oregon State Office
P.O. Box 2965
Portland, OR 97208

In Reply
Refer To:
6840 (OR931) P

December 15, 2000

EMS TRANSMISSION 12/19/2000
Instruction Memorandum No. OR-2001-014
Expires 09/30/2002

To: District Managers

From: State Director

Subject: Policy on the Use of Native Species Plant Materials

A statewide interdisciplinary team developed the following attached information as part of the Bureau of Land Management's (BLM) Plant Genetics Plan: Policy on Use of Native Species Plant Materials - Bureau of Land Management Oregon/Washington; Findings and Recommendations - Native Species Plant Materials; and Native Plant Species Program Guidelines - Western Oregon.

The objectives for the use of native species plant materials is to conserve biological diversity and maintain the adaptive capability of ecosystems, plant communities, and species. Districts are encouraged to develop supplies and use native species plant materials. The long-term goal is the general use of adapted native plant materials.

The draft of this policy was reviewed by the Districts in September 1998. It has also been peer reviewed. If you have questions on this material please contact Joan Seevers in Medford, Oregon at (541) 858-2276 or the State Office at 503-952-6048.

Signed by Edward W. Shepard Acting Associate State Director	Authenticated By Markie Warren

3 Attachments
1- Policy on Use of Native Species Plant Materials (7 pp)
2- Findings and Recommendations (2 pp)
3- Native Species Plant Program Guidelines (7 pp)

Distribution
WO-230 (Room204 LS) – 1

POLICY ON USE OF NATIVE SPECIES PLANT MATERIALS
BUREAU OF LAND MANAGEMENT OREGON/WASHINGTON

EXECUTIVE SUMMARY

This is a policy for Oregon/Washington on the use of native species plant materials. The intent is to encourage Districts to develop supplies and to use native plant materials. The long-term goal is the general use of adapted native plant materials. The timeframe to reach this goal will vary according to individual Districts. Proposed actions involving non native or naturalized plant materials should be analyzed through the National Environmental Policy Act (NEPA) process. The delegation of authority to approve plant and animal introduction, transplant, reestablishment and augmentation are explained in this policy and Bureau of Land Management (BLM) Manual 1745.16.

Recommendations to expedite the implementation of BLM's native species program include: coordination to facilitate the availability of native species plant materials; genetic studies and development of interagency transfer guidelines for native species plant materials; and training and workshops in each District for education, interagency coordination, and information exchange. The appendix contains definitions and an explanation of the authorities for establishing and implementing the native species program.

INTRODUCTION

BLM Manual 1745 established policy and guidance on the introduction, transplant, augmentation, and reestablishment of plants (exotic, native, and naturalized species). Current Resource Management Plans (RMPs) emphasize the principles of ecosystem management. Native species are an inherent part of ecosystems. Native species are also a part of the objectives and management for many of the resource programs and are being used in watershed restoration projects. Westside RMPs specify that the impacts from non natives in Late Successional Reserves (LSRs) will be evaluated.

This document defines policy and objectives, and includes discussion topics. Definitions and the authorities for implementing a native plant species program are in the appendix. Recommended guidelines for the development and implementation of a native plant species program in western Oregon are available in a separate document. These guidelines were written for western Oregon conditions. Guidelines for eastern Oregon will be developed in FY 2001.

Several documents were considered in development of this policy: *BLM Manual 1745- Introduction, Transplant, Augmentation, and Reestablishment of Fish, Wildlife, and Plants;* Eugene and Coos Bay District policies on native plant restoration; BLM California *Policy On The Use Of Native Plant Materials*; U.S. Forest Service Region 5 and 6 policies on the use of native plants; BLM OR/WA *Standards For Rangeland Health And Guidelines For Livestock Grazing Management*; and the BLM *Emergency Fire Rehabilitation Handbook - H1742*.

POLICY

Native species shall be used unless, through the NEPA process, it is determined that: (1) Suitable native species are not available; (2) The natural biological diversity of the proposed management area will not be diminished; (3) Exotic and naturalized species can be confined within the proposed management area; (4) Analysis of ecological site inventory information indicates that a site will not support reestablishment of a species that historically was part of the natural environment; (5) Resource management objectives cannot be met with native species (See BLM Manual 1745.06).

Proposed actions involving native or non native species should be analyzed and documented in accordance with the requirements of NEPA. Revegetation projects should incorporate good stewardship practices of early planning, interdisciplinary review, implementation, evaluation, and periodic reporting. This policy applies to BLM projects and all projects which occur on BLM land; except where specifically precluded (example: such as in the case of nondiscretionary easements and right-of-ways).

OBJECTIVES

Native species plant materials are used for management actions such as, but not limited to: roadside seeding for erosion control, reforestation, fire rehabilitation, forage enhancement, noxious weed control, and vegetation community restorations (e.g., meadows, wetlands, etc.). Objectives for use of native species plant materials are:

1. To conserve biological diversity and maintain the adaptive capacity of ecosystems, plant communities, and native species. This includes maintaining the integrity of the natural genetic structure within and among populations of a species.

2. To prevent the displacement of native species through the introduction of aggressive, long lasting, or undesirable vegetation into managed and natural plant communities.

3. To develop and improve techniques for rehabilitation and restoration projects by interagency coordination, data sharing, and education on native species.

DISCUSSION

Native species in the RMPs - In the draft southeastern Oregon RMP/EIS, native species are part of the objectives and management directives for rangeland vegetation and are included in desired range of future conditions for rangeland and riparian habitats. Native species are also a component in the management directives for resources, including: ACECs, fire, rangeland vegetation, wildlife habitat, and others. The Standards For Rangeland Health and Guidelines For Livestock Grazing Management include guidelines for the use of non native vegetation in rangeland recovery.

Native species are part of the two major management concepts (Ecological Principles for Management of LSRs and the Aquatic Conservation Strategy) underlying the objectives and management actions/direction of each land use allocation in western Oregon. One of the goals

under principles for management of late successional forests is "...to maintain biological diversity associated with native species and ecosystems in accordance with laws and regulations." One of the objectives in the Aquatic Conservation Strategy is to "Maintain and restore habitat to support well distributed populations of native plant, invertebrate, and vertebrate riparian dependent species." The RMPs specify that BLM will evaluate the impacts of non native plant species existing within reserves and develop plans and recommendations for eliminating or controlling non native species which are inconsistent with LSR objectives. These evaluations are included in LSR assessments. Native species are also a component in the management actions/direction for the various resource programs (for examples see: water and soils, wildlife habitat, special areas, noxious weeds).

Benefits of native species - Native species are important in maintaining resilient, healthy, productive ecosystems. Native species have become well adapted to the local environments through natural selection and have evolved co-relationships with other plants and animals in their ecosystems. Maintenance of viable populations is considered important to maintaining ecological processes. Native vegetation is recognized by the public as an important part of the natural community.

Native species generally do not require fertilization, irrigation, and other expensive manipulations to become established and maintain viable communities. If a seed source is available on site, natural regeneration can be the easiest and least expensive option for re-vegetation.

Analysis and documentation - Introductions, transplants, and reestablishments involve the establishment of a species where it does not currently exist. Augmentation involves maintaining or enlarging a species in an existing population. All proposed introductions, transplants, re-establishments, and augmentations must be reviewed to identify and disclose their environmental consequences (see BLM manual 1745.1).

In cases where the introduction of non native vegetation is proposed, a justification shall be submitted to the State Director (as outlined in BLM Manual 1745.1). State Directors are responsible for approving the plant and animal introductions, transplants, and reestablishments. This authority cannot be re-delegated. The approval for augmenting existing populations can be re-delegated to Field Managers (see BLM manuals 1203 and 1745.16).

Native plants should always be given first consideration. However, there are certain situations where non natives may be necessary. In noxious weed control, non natives can be the best choice when effective competition is desired. On highly disturbed sites that have had their physical characteristics altered so that native vegetation can no longer survive, it may be necessary to use soil amendments or non natives to help restore the site. Non natives can be an intermediate step in establishment of native plants as a last resort in an emergency situation or used when native seed is not available or in short supply.

If a NEPA analysis determines a non native species is necessary, select a species which is consistent with the objectives of the project. Selection of the species and source of plant materials should be carefully decided because non native plant materials can be persistent, invasive, and have the potential for disrupting natural communities and processes for a long time. Non native vegetation should not aggressively compete with the naturally occurring native plant

community, invade plant communities outside the project area, persist in the ecosystem over the long-term, or exchange genetic material with local native plant species.

Constraints on the use of native plants - Barriers to the use of native plants can exist and include, but aren't limited to: lack of funding and staff time; poor germination or failed plant establishment; lack of operational knowledge, experience or facilities; extra time and higher costs needed to collect and propagate a wide variety of native plant species; and the higher costs of native species compared to some non natives. Native species plant materials are often in short supply and it may be difficult to determine if the available plant materials are adapted to the project site. Project planning, seed collection, and plant propagation span multiple years and can be difficult to coordinate.

Use of native species - Alternatives for plant materials will typically include a range of choices - non natives, naturalized species, natives of unknown or questionable sources, natives of non local sources, or known sources of adapted natives. NEPA analysis and interdisciplinary team review should be used to design the proposed action and select the appropriate plant materials.

Districts are encouraged, to the extent possible, to use adapted native plant materials. The long-term goal being the general use of adapted native plant materials. Districts should initiate or continue with development of a native species program to meet the anticipated plant materials needs. The timeframe to reach this goal will vary according to individual Districts. Some will be fully implemented in 5-to-10 years, while others will take much longer. The production of native species plant materials can be scaled up to meet the needs. The costs for native species plant materials will decrease as demand and supplies increase.

Appendix

DEFINITIONS

The terminology used in this policy is explained below. Similar terms used in other BLM and Forest Service documents are cross referenced. These are shown in parentheses next to the appropriate term. Also, see BLM Manual 1745 for additional definitions.

adapted (genetically local source within or as close as possible to project area) - The suitability of a plant to the environmental conditions. Adaptation is typically a continuum with a scale ranging from fully to moderately to poorly to not adapted. Plants which are poorly or not adapted will typically show symptoms such as poor vigor, slow growth rates, high susceptibility to diseases or insects, and lack of reproduction. Genetics plays a role in adaptation.

deployment - The process of planning the use and establishment of plant materials to a project site(s).

introduce - The establishment of a non native species into an ecosystem.

invasive - An alien species whose introduction does or is likely ti cause economic or environmental harm or harm to human health.

native (indigenous)(endemic) - Plant species (tree, shrub, forb, grass) which occurs naturally on a site or within a region. It is best to use a geographic location to explain the meaning of native e.g., native to Oregon, native to Lane County, native to the project site, etc.

natural - Occurring spontaneously without the intervention of humans.

naturalized - A non native species which has been introduced and has become established in the local plant communities.

non native species (exotic) - Plant species (tree, shrub, forb, grass) which is not naturally occurring in the geographic location. All plant species are native to at least one location. This term, like native, should be used in context to a geographic location.

origin - The location of the native parents. For natural plants it is the location of the parent plant. For non native plants it is the location from which the plants were originally introduced.

plant materials - A general term for anything which is used to establish a plant - seeds, rooted cuttings, seedlings.

rehabilitation - Improving a project site to a more desired condition than previously existed, usually as a result of a major disturbance.

restoration - Reestablishing a project site to a state similar to the previously existing natural condition using similar or identical native vegetation.

Re-vegetation - A general term for renewing the vegetation on a project site, which includes both restoration and rehabilitation.

source - The location from which plant materials are obtained. Origin and source are the same for seed collected from natural parents. If seed is collected from parents of an introduced species the source is the location of the immediate parents and the origin is the natural location (could be native, non native, or unknown origin).

transfer guidelines - Information on the appropriate movement of plant materials. Guidelines delineate the appropriate area over which plant materials can be collected and deployed (moved to for planting or establishment).

undesirable vegetation - May be a non native species, a poorly adapted source, a plant genetically changed through selection in a dissimilar environment, or plant materials which possess trait(s) that conflict with accomplishment of management objectives.

AUTHORITIES

The authorities for native species are:

National Environmental Policy Act of 1969: "Prevent or eliminate damage to the environment and biosphere...enrich...understanding of the ecological systems and natural resources important to the Nation...".

Endangered Species Act of 1973 as Amended: "...Encouraging the states and other(s)...to maintain conservation programs...to better safeguard the Nation's heritage in fish, wildlife and plants."

Federal Land Policy Management Act of 1976: "protect the quality of scientific...ecological, environmental...values, (and) where appropriate will preserve and protect certain public lands in their natural condition..."

Executive Order 11990 Protection of Wetlands:(May 24, 1977) "Maintenance of natural systems, including conservation and long-term productivity of existing flora and fauna, species and habitat diversity and stability..."

Emergency Fire Rehabilitation Handbook H-1742-1 (III.Q.2): (August 1985) "Use of native species is preferred to the use of nonnatives for rehabilitation projects."

Management of designated Wilderness Areas H-8560 (.36A.2.): (January 1990 Revisions) "Re-establishment of vegetation as a watershed-restoration measure, where there is no reasonable expectation of natural healing, will be accomplished using native or naturalized species. Overland motorized equipment will not be used where more primitive equipment can accomplish the restoration objectives."

BLM Manual 1745 Introduction, Transplant, Augmentation and Reestablishment of Fish, Wildlife and Plants: (March 1992) Establishes a national policy, provides guidelines on the use of native species, and restricts the introduction of exotic species into natural ecosystems. All proposed use of non native species require NEPA documentation, analysis of impacts to plant and animal communities and biological and genetic diversity.
FEMAT: (July 1993) "Maintain and restore the species composition and structural diversity of plant communities in riparian zones and wetlands..."; "Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species".

NFP ROD SEIS: (April 1994) "Another goal of forest management on federal lands is to maintain The biological diversity associated with native species and ecosystems in accordance with laws and regulations."; ACS Objective 9 "Maintain and restore habitat to support well distributed populations of native plant, invertebrate, and vertebrate riparian dependent species."

NFP ROD SEIS Standards and Guidelines: (April 1994) "In general non native species (plant and animal) should not be introduced into LSRs."; "Evaluate the impacts of non native species (plan and animal) currently existing within the reserves, and develop plans for eliminating or controlling non native species that are inconsistent with LSR objectives."

BLM ROD RMP: (June 1995) "A second goal is to maintain biological diversity associated with native species and ecosystems in accordance with laws and regulations."; "Enhance biological resources for human values through the use of native species for ecosystem restoration, species recovery or other actions involving plant, fish, and wildlife introductions on the District."

Interim Management Policy for Lands Under Wilderness Review H-8550-1 (III.C.1.): (July 1995) "Reseeding and planting under emergency conditions will utilize species native to the area and will minimize cross-country use of motorized equipment."

ICBEMP - Eastside Draft Environmental Impact Statement: (May 1997) For Alternatives 3 - 7, Terrestrial Strategies TS-01 Objective: "Maintain and promote healthy, productive, and diverse native plant communities as appropriate to soil type, climate, and land form."; Terrestrial Strategies TS-03 Objective: "Rehabilitate disturbed areas to restore native species, maintain productivity, and prevent soil loss."; Tribal Rights And Interests TI-03 Objective: "Recognize native plant communities as traditional resources that are important to tribes..."

Standards For Rangeland Health And Guidelines For Livestock Grazing Management For Public Lands Administered By The BLM In The States Of Oregon And Washington: (August 12,1997) "...non native vegetation should only be used in those cases where native species are not available in sufficient quantities, where native species are incapable of maintaining or achieving the standards; or where non native species are essential to the functional integrity of the site." (43 CFR 4180.2 (f)(2)(ix))

Draft Southeastern Oregon RMP/EIS: (October 1998) Objective 1 - Rangeland Vegetation "Restore, protect, and enhance the diversity and distribution of desired vegetation communities including perennial native and desirable introduced plant species."; Objective 2 - Water Resources and Riparian /Wetland Areas "Restore, maintain, or improve riparian vegetation, habitat diversity, and associated watershed function to achieve healthy an productive riparian areas and wetlands."

Executive Order 13112: Invasive Species: (February 3,1999) Directs actions to prevent introduction and provide for control of invasive species. Revokes Executive Order 11987.

Findings And Recommendations - Native Species Plant Materials

The findings and recommendations developed by the ID Team on Native Species are as follows:

2. A barrier to the use of natives is the lack of availability of adapted plant materials. Some Districts have initiated re-vegetation work with native species. Coordination with other users (e.g., Districts, State and Federal Agencies) will increase the demand for native plant materials.

   Recommendation 1: Districts should initiate or continue efforts to supply and use native species plant materials. The production of native species plant materials can be scaled up as needs increase. Statewide coordination is not feasible at this time. District and program level coordination to facilitate native species related contracts and project work (collection, propagation, seed increase, etc.) is necessary. Inter-District, intra-state and inter-agency cooperation should be stressed. The goal is to improve the availability of adapted native plant materials. Consolidated seed collection and propagation projects will be more cost effective.

3. Another barrier to the use of natives is the lack of funding and limited staff time authorized to implement the native species program. It would be helpful to have a statewide strategy that includes personnel and funding needs.

   Recommendation 2: Native species program needs are included in the RMPs. As Districts implement these plans, the program needs should be identified and integrated

into the budget process. This policy and a separate document with guidelines (Western Oregon) is intended to be used as guidance for facilitating this process. The timeframe for implementation is flexible. Districts should plan and implement a transition for using native species plant materials.

3. The supply of native species plant materials may be limited or it may be difficult to obtain appropriate plant materials for the project site. It is often easiest to use traditional sources for plant materials.

   Recommendation 3: All Districts should promote the use of native species and reestablishment of native plant communities. Requiring the use of native species in revegetation projects (internal projects, contracts, cooperative projects, etc.) will increase the demand for native plant materials and lead to decreased costs. Seed mixes should include grasses, forbs, and shrubs appropriate to the site. NEPA analysis and interdisciplinary team review will help guide decision making if adapted native species are not available.

4. Guidelines are helpful for implementation of the native species program. A western Oregon ID Team has developed guidelines as part of the process for the BLM Plant Genetics Plan. These could be modified to cover Eastern Oregon conditions.

   Recommendation 4: Western Oregon specialists should work with an eastern Oregon ID team to develop native species guidelines for eastern Oregon.

5. Many sources of information are available regarding native species and the establishment of a native species program. However, specific operational knowledge and techniques must still be developed for many native plant species. Education and information sharing will facilitate development and successful implementation of the native species program.

   Recommendation 5: All District specialists involved with re-vegetation projects should attend training. Districts should conduct inter-agency native species workshops and seminars for education, coordination, and information exchange. To be successful it is important to build a base of operational knowledge of native species. Practices for collection, propagation, and planting of conifer trees are well established and can serve as a model for the development of other native species.

6. Transfer guidelines for native species plant materials will facilitate the collection and utilization of native plant materials. Interagency guidelines are desirable to ensure a standardized region wide identification system. Alternatives to accomplish this include continued individual District and Forest efforts, or development with an interagency approach.

   Recommendation 6: General transfer guidelines for important native species are available in some cases. These existing agency transfer guidelines should be considered when interdisciplinary teams design re-vegetation projects. Interagency transfer guidelines will not be developed at this time. Source information on plant material collections should be documented and used to guide decisions on deployment.

Staff specialists should coordinate recommendations and initiate cooperative genetic studies for important native species. Interim and final transfer guidelines can be developed from the study results.

7. BLM Manual 1745 allows for re-delegation of the authority to approve activity plans for supplementing or augmenting existing populations of non-native or naturalized species of plants and animals.

   Recommendation 7: Re-delegate the authority to approve supplementing or augmenting existing populations of non native species to the Field Manager level. (See BLM Manual 1745.16)

NATIVE PLANT SPECIES PROGRAM GUIDELINES WESTERN OREGON

These guidelines are based on information from the Policy On The Use Of Natives Plant Materials In California, BLM 1996. They were revised and rewritten by a BLM Interdisciplinary Team as part of the BLM Plant Genetics Plan process. The guidelines are not mandatory steps. They are an outline of a process to ensure success with native species plant materials. There are several good handbooks and references available which provide more detailed information on the guidelines in this document.

Coordination

* Conduct a review of all the various re-vegetation projects (type and scope) that the District has planned or is including in watershed analysis and landscape planning. Determine the native species plant material needs for Late-Successional Reserves.

* Consider plant material needs for re-vegetation projects in other land use allocations. Coordinate noxious weed control and fire rehabilitation efforts to incorporate the estimated plant materials needs.

* Estimate the short and long-term needs for native species plant materials based on current and anticipated projects. Refine and update as needed.

* Set measurable goals and determine the overall timeframe for the District to move to the general use of adapted native plant materials.

* Designate a coordinator for the District native plant species program. Coordinators can be a designated position, a program lead, or other qualified person.

* Develop a recommended list of native plant species including grass, forb, shrub, and tree species that would be appropriate for the various types of re-vegetation projects to meet the desired future condition.

* Determine through literature review and personal contacts the techniques for collection, processing, propagation, and establishment.

* Coordinate with knowledgeable individuals in other Federal and State agencies, the private sector (professional societies, native plant societies, Nature Conservancy, Society of Ecological Restoration, etc.), and the academic community.

* Develop standards for collecting, storing, propagating, and establishing native species. Determine which species are considered easy to implement and those which should be addressed with a species specific strategy.

* Develop specifications (sowing rates, germination, purity, acceptable species and sources, etc.) which can be incorporated into contracts where native species plant materials are requested. Develop cost estimates which can be used to project budget needs.

* Determine if plant materials are available from commercial sources. Develop a list of potential growers and sources.

* Test a variety of restoration methods to determine the best overall method. Experience will show which species and methods work best on specific sites.

* Determine research needs associated with the implementation of a native plant species program. Consider challenge cost shares and other cooperative research projects to address the needs.

* Develop evaluation protocols to determine the effectiveness of various species and operational techniques in meeting management objectives. Incorporate new technologies and seed sources when appropriate.

* Sponsor workshops and seminars to share and disseminate information and to build awareness about the utilization of native plant species.

* Organize volunteer work projects with watershed councils, schools, societies, clubs, and other interested parties.

* Conduct genetic studies with important species to define seed transfer limits, answer taxonomic questions, etc. Use the results from the studies to develop seed transfer guidelines. Use off-the-top funding to fund multi-district or inter-agency studies.

Budgeting

* Determine work months and other associated costs to implement the desired native species program and re-vegetation projects. Incorporate these needs into the Annual Work Plan process.

* Investigate a variety of sources for funding - 6310 Timber Management, 6320 Forest Development, 6330 Wildlife/Fish/Botany, 6650 Jobs In the Woods, 5900 Forest Health, 1110 Challenge Cost Shares, 1742 Fire Rehabilitation, 5310 Repair Damaged Lands, 1220 Recreation, 1210 Wilderness, 1010 Soil/Water/Air, 8100 and 1020 Range, and 2823 Fuels Reduction.

* Funding is often limited. Explore the possibility to include the costs of re-vegetation in the individual project costs, rather than as a separate native species item. This approach identifies the need early and integrates the costs into the benefiting activity. The question of augmentation of timber sales may be an issue in some projects. Contact the timber management staff for advice.

Project Planning

* Plan re-vegetation projects early - a minimum of one-to-two years before the project start date is best. Early consideration should be given to seed increase needs, topsoil stockpiling, collection of plant materials, and purchase of materials. Commercial growers need adequate time to build up supplies of plant materials.

* Coordinate re-vegetation planning efforts and project locations. Use interdisciplinary team review and assistance from experienced staff specialists (e.g., botany, engineering, ecology) and growers to ensure that the project is feasible and the appropriate plants and methods are used.
* Define the objectives of the project and set realistic goals. Decide what progress can be made toward establishing the desired plant community and what time scale should be used to measure success.

* Look at typical sites within or adjacent to the project areas to determine the plant associations. Try to find a reference area that is undisturbed and ecologically similar to the project area if this baseline information is not available for the project area. Take measurements of plant composition, density, and cover if the disturbance has not yet occurred. Use soil surveys to determine the soil series.

* Assess the project site to determine if special habitat, site conditions, or soil types exist which would dictate which species or methods should be used (e.g., shade, seasonal wetlands, frost pockets, etc.).

* Consider using natural regeneration with natives if there is an ample seed source and suitable conditions. Existing plants must reach maturity and produce seed for natural regeneration to be successful. Wind-rowing vegetation off the site and moving the vegetation back on to the site can provide a seed source and favorable conditions for seeds to grow.

* Determine if acceptable commercially produced plant materials are available or if collection for some or all species will be needed. If collection is necessary, determine the collection methods (seeds, cutting, etc.). Commercial seed should meet or exceed weed free standards and come from reputable suppliers.

* Consider the existing conditions at the project site and the objectives of the project to determine the level of weed seed contamination which is acceptable in the seed mix. If it can be shown that a certain percent of contamination of a weed species or other crop species does not interfere with plant establishment and is not persistent in the environment then this level can be an acceptable standard for the seed mix.

* Determine the desired plant species, the quantity needed, the propagation methods (seedlings, vegetative propagation, transplants), and the establishment method (seeding or planting) for the project area. A mix of species is often more effective than relying on a single species.

* If gene contamination is a potential concern, select species with low reproductive fitness, short longevity, sterile hybrids, or self pollination to reduce gene contamination and undesirable long-term effects on the ecosystem. Another approach is to use genera that do not occur in the target area as there is less likelihood of genetic exchange between genera than between species within a genus.

* Topsoil can be salvaged and re-spread as native seeds and micro biota can often be preserved if storage length is limited. However, soil can contain noxious weed seeds which would be transferred to the new location if the soil is moved.

* Develop plans for site preparation, seedling protection, and maintenance of the site. Plan periodic visits to the project area to check the survival of plant materials.

* Develop a contingency plan in case the plant materials are unavailable or unanticipated natural events lead to failure or the need for emergency measures.

* Consider postponing the project if acceptable sources of plant materials are not available.

Collection

* Start with an ample list of potential species and set the desired quantities for the collection. Include a fall down factor. If collections are unsuccessful for some species or some locations, there will still be adequate plant materials for the project.

* Maintain records on the source of all plant materials (species, township, range, section, elevation, date of collection, quantity, collector's name is a minimum). Ecological information (soil type, aspect, slope, associated species, etc.) from the collection site can also be useful. Databases are helpful to process information and inventory the plant materials. GIS can be used to display collection areas and project areas on the same map.

* Consider whether the local plant populations can support the impacts of collecting plant materials. Leave a portion of the seed crop each year to ensure long-term community stability. The portion to be left will depend on factors such as annual versus perennial, distribution of the species, longevity of seed in the soil, etc..

* Decide if in-house or contract collection is appropriate.

* Ensure that the collector is knowledgeable and has sufficient resources to complete the job. Base contract payments on the desired final product (for example: pounds of pure live seed).

* Collect from sites which are ecologically similar to the project area. The assumption is plant materials from ecologically similar sites will be adapted to the project site.

* Visit collection sites frequently to check on plant species which disperse their seed quickly at maturity. Use sheets or bags around the parent plant to capture the seed.

* Obtain cuttings at the appropriate time of year and from material that is not too soft. For example: rapidly growing soft tissue is high in nitrogen and will not produce the auxins needed to root as opposed to more mature, woodier tissue that contains higher ratios of stored carbohydrates.

* Consider genetic principles when conducting collection work. Collect from many (the range is 10 to 50 or more) unrelated (widely spaced) plants within the local source in order to ensure good genetic diversity. Collect from healthy source plants and when the seed is mature.

* Disjunct plant populations may be genetically distinct. If the desired plant species is rare, occurs on an unusual soil (e.g., serpentine), is found in an extreme environment (high

temperature, low precipitation, etc.), or has distinct morphological characteristics that may be genetically based. Seeds or cuttings for re-vegetation should be taken from the local populations. A restoration project on serpentine soil would use seeds/cuttings collected on serpentine soil from within the same watershed and elevation band.

* Collect an approximately equal number of seeds/cuttings from each source plant. Document the location of all collections and track the plant materials as a separate lot during processing, storage, and propagation. Decisions on deployment and whether to combine lots can be made after the propagation phase.

* Consider developing and managing production areas in field locations to facilitate collection of plant materials. Protect known collection areas from encroachment of noxious weeds and road building

* Build and maintain a seed bank of the desired species and seed quantities from known sources. Use current seed need projections to determine quantities. Seed banks are a buffer because seed collection may not be possible every year and the bank can be used to fill requests when catastrophic events occur. Seed banks can be regional (for a District or seed zone) or localized (for a watershed). It is expensive to build a seed bank for many small zones. Typically seed banks start at a regional level and then get more localized as collections and grow outs increase the availability of seed.

Propagation

* Determine if propagation can be accomplished through federal (BLM, U.S. Forest Service (USFS)) facilities, state nurseries (ODF), or contracts with private nurseries.

* Develop contract specifications for the propagation of the desired species in the desired quantities. Refer to existing contract specifications and modify as needed (see handbooks for existing contract examples).

* Allow adequate time for seed stratification and seedling growth. Nurseries will require one to three years for propagation, depending on the species.

* Grow plant materials under environmental conditions that are similar to the project area.

- No federally-listed or proposed species shall be used for re-vegetation without coordination with the Fish and Wildlife Service. Re-vegetation with Special Status, Survey and Manage, or Species of Interest should be coordinated with the Oregon State Office or District Botanist.

Seed Increase

* Use BLM seed orchards, USFS J. Herbert Stone Nursery, and other specialized facilities to increase smaller quantities of stock seed to the quantities needed for revegetation projects or commercial grow outs. Use commercial growers when large quantities of stock seed are available.

* Determine if there is adequate seed available to establish seed increase plots. A minimum of one pound of stock seed is best for specialized seed increase, and three to five pounds or more of stock seed is best for commercial grow outs.

* Develop specifications for seed increase contracts. Contract with commercial growers to produce the desired quantities of the desired species.

* Specifications in the contracts should state that the seeds/plants produced for seed increase are government property and cannot be used for commercial purposes or sold to others without the permission of the government.

* Ensure that the seed produced was not grown under conditions that could have allowed hybridization with other species or pollen contamination from other adjacent plots of the same species.

Seed Testing and Storage

* Determine the proper storage conditions based on the timeframe for the use of the seed. Short term storage is less critical than long-term. If the seed will be used shortly after collection, cool dry storage is acceptable. Reduce the moisture content for longer term storage. Storage should be in moisture proof durable containers. Check current literature to determine if refrigerator or freezer temperatures are recommended for the species.

* Label each storage container with standardized information on species, year of collection and lot identification.

* Test seeds for germination percent, purity, and weed content. X-rays and tetrazolium tests are a quick means to determine filled seed percent and estimated germination capacity. Some species require a stratification period before being germination testing.

* Seed tests can be conducted at the OSU Seed Lab or at a commercial seed lab. Test results should be documented on a report format. Retain copies of the test reports until the seedlot is empty or newer tests are completed.

* Check germination periodically if seed is stored long-term to determine if viability is decreasing.

Deployment

* Consider collection location and ecological information from the collection site when making decisions on deployment. Use transfer guidelines when available. Using seeds and plants which are from local sources has the lowest risk of poorly adapted plant materials. "Local" refers to sources within or as close as possible to the project area.

* Use commercial sources of native plants if the source is known and it is appropriate for the project area. Commercial sources with marginal origin information should be used with caution as an interim measure, while adequate supplies of adapted native plant materials are being collected or grown.

* Attempt to match the conditions at the project site with the collection site. As a starting point use the 5th field watershed boundary as the limits for transfer. A conservative guideline for elevation movements within a watershed is to limit transfer to no more than 500 feet up in elevation and 1000 feet down in elevation from the origin.

* Establish transfer guidelines to direct the collection and deployment of native species plant materials. Use interim guidelines and practical experience until information is developed from detailed genetic studies.

Field Operations

* Use site preparation techniques, when necessary, to reduce competition and improve germination and/or survival.

* Use transplanting to holdover plant materials or grow plants to larger size seedlings.

* Maintain good communication with the grower throughout the propagation phase. Obtain an inventory of the estimated quantity of plant materials available for delivery. Order delivery of plant materials in a timely manner to minimize time in storage. Transport plant materials in such as way to minimize stress or damage.

* Clean or sterilize equipment as a preventative measure to control the spread of noxious weeds.

* Conduct planting/seeding operations at the optimal time. Use the appropriate seeding/planting technique for each species. The window of opportunity for planting extends throughout the dormant winter season. The risk of lower survival is greatest at the beginning and end of that period. The optimal time depends on the species and site conditions. A mix of species and stock types is best to ensure successful revegetation.

* Use higher seeding rates when direct seeding. Direct seeding success rates are generally lower than when planting seedlings.

* Use weed free mulches (such as native grass straw, barley straw, rice hulls, and bark, or mulch mats) to reduce competition and achieve erosion control.

* Irrigation is generally impractical but may be appropriate in some situations such as recreation sites or high visibility areas where success is critical.

* Complete protection measures as needed to minimize damage from animals.

* Implement vegetation maintenance treatments as needed to reduce competition around newly established plants.

Evaluation and Monitoring

* Revisit the project area at the end of the first growing season and survey conditions. Determine if project goals were achieved. Evaluate the results and decide if follow up treatments are needed.

* Complete follow up surveys after years 2, 3, or 5 to check conditions and determine if results are acceptable and project goals have been achieved.

* Track the success or failure of all revegetation projects. Periodically report the status of revegetation projects to share information and explain what can be learned as a result of the project. Even failed efforts yield useful information. Use yearly progress reports to record

methodology and results for long-term revegetation projects. Report the progress on achievement of the project goals.

* Monitor selected project areas to document the results of revegetation projects.

APPENDIX C. Geomorphologic Impacts of Culvert Replacement

Culvert Replacement and Removal:
Avoiding Channel Incision

By Janine Castro, Geomorphologist, USFWS, Portland, OR

These guidelines are used by USFWS when implementing culvert replacement and removal projects, and are recommended practices for entities involved in stream crossing activities. These guidelines should serve to assist with any culvert-related endangered species consultation requirements. Compliance with these guidelines should assist in minimizing or avoiding impacts during project construction activities, and are intended to help culvert projects result in long-term benefits to listed species recovery. However, consistency with these guidelines does not negate the need for Endangered Species Act (ESA) consultation on culvert removal and replacement projects, where listed ESA species may be present. For additional information on ESA compliance requirements for culvert replacement and removal projects, please contact the U.S. Fish and Wildlife Service's Oregon State Office (Rollie White) at (503) 231-6179, or any of the following field offices: LaGrande (541- 962-8509), Bend (541-383-7146), Newport (541-867-4558), or Roseburg (541-957-3474).

OVERVIEW

This technical note describes a specific methodology for determining the vertical stability of stream channels in the vicinity of existing road crossings (primarily culverts), although the methodology is applicable along any reach of a stream. Vertical stability refers to the relative constancy over time of streambed elevation through a given stream reach. A streambed that deepens over time is referred to as "incising," while a rising bed elevation is indicative of an "aggrading" stream channel. Streams that are incising or aggrading on a reach scale are considered to be vertically unstable. However, local variations in bed elevation are inherent in streams because of scour and fill processes, and should not be confused with vertically unstable channels.

Vertical stability is of considerable interest at culverts because these structures often provide elevational control for incising stream channels. Provision of elevational control or "grade control" is important because removal of this control may allow channel incision to migrate upstream, potentially affecting habitat and impeding fish passage. Of primary concern to the US Fish and Wildlife Service (Service), and hence the subject of this paper, are culvert removal or replacement projects in vertically unstable streams. Activities associated with these streams can lead to additional channel incision with a resultant loss of habitat and potential fish passage blockage. Changes to the channel profile post-project are collectively referred to as channel "regrade".

BACKGROUND

Culverts are part of our transportation network and as such, are typically planned, designed, installed, and maintained by various departments of transportation at the local, county, state and federal level. Biologists become involved in culvert replacement and removal projects because the structures interface directly with stream systems and thus floodplain, riparian, and stream habitat. Because of this interface, culvert removal and replacement projects require interdisciplinary participation.

Photo Courtesy of Jane Kelly

It is deceptively easy to assume that culvert-related problems in a stream system are site-specific and site-limited. This is not always the case, and may in fact be the exception. Streams are linear systems that move mass and energy along the channel primarily in upstream/downstream directions and through the floodplain in all directions. It is critical that these linkages are well understood and analyzed before any instream action is taken. Improperly installed culverts compromise or eliminate fish and other aquatic species passage and can alter the quantity or quality of stream corridor habitat. Even properly designed and installed culverts can become fish passage barriers if channel incision occurs downstream and migrates upstream to an existing culvert, since culverts are static structures in dynamic systems.

Channel incision, the overall lowering of a streambed over time, is one of the most common channel processes encountered when working in streams in the Pacific Northwest (PNW). Understanding the causal factor and related stream adjustments as they pertain to the channel incision and evolution process is essential so that these processes are addressed when designing instream projects. By overlooking the geomorphology of these streams because of lack of time, money, or expertise, otherwise well-intentioned and well-planned projects may be completely ineffective or detrimental to the stream system and related habitat.

Incision Processes

Channel incision may exist at a site prior to project implementation, which requires special design considerations, or it may occur post-project, potentially altering the effectiveness of the project. Channel incision can be initiated in numerous ways (Table 1). One of the most common initiators is a change in peak discharge due to land management activities and infrastructure.

Table 1: Causes of Channel Incision

A. Decreased Erosional Resistance
- a. Decreased or modified riparian vegetation cover or rooting strength due to increased agricultural activity, urbanization, timber harvest, overgrazing, fires and droughts.
- b. Watershed surface disturbance causing decreased permeability (i.e. urbanization).
- c. Removal of instream structural elements such as large wood or beaver dams.

B. Increased Erosional Forces
- a. Constriction of flow by culverts, dikes, bridges, and fill material.
- b. Concentration of flow by roads, trails, and ditches.
- c. Steepening of gradient and energy slope by channelization and meander cutoffs, base-level lowering by decreased lake or reservoir level.
- d. Increase in duration, frequency, or intensity of sediment-transporting flows due to more

rapid routing of water to the receiving channel, increase in volume of flood peaks, or artificially elevated wet-season base flows.

e. Decrease of sediment load.

Modified from: Schumm, Harvey, & Watson, 1984.

A primary mechanism that changes the volume and timing of peak flows is the road network, which essentially increases the drainage density of channels, intercepts subsurface water, and decreases the time for overland runoff to reach the stream channel. Even though a watershed receives the same amount of precipitation, it is transported through the system much more quickly, thus resulting in higher peak discharges and resultant increases in stream power. This increased stream power can more effectively erode the streambed and banks. Because the total amount of water remains relatively constant, base flows decrease because the rapid runoff reduces the total amount of water that can infiltrate and be stored in the soil.

Lane's (1955) stream balance relationship clarifies this point:

$$Q\,S \propto Q_s\,d_{50}$$

where Q = channel-forming discharge, S = channel gradient, Q_s = bed-material discharge, and d_{50} = median grain size of bed material.

The stream balance equation indicates that if available stream power is augmented by an increase in discharge or the gradient of the stream, there would be an excess amount of stream power relative to the discharge of bed-material sediment whose resistance is a measure of particle diameter. Additional sediment would be eroded from the channel resulting in: (1) an increase in bed-material discharge to an amount commensurate with the heightened stream power, and (2) a decrease in channel gradient and, consequently, stream power as the elevation of the channel bed is lowered.

Assuming, for illustrative purposes, that the streambed and banks are composed of the same material, the streambed will erode first. This is due to the higher shear stresses exerted on the bottom of the stream channel by the flowing water. The streambed will continue to erode until (1) the critical bank height is exceeded resulting in bank failure and channel widening which may restore the sediment/water balance, (2) a control point is encountered such as bedrock, buried wood, pipelines, bridge aprons, fords, or culverts, (3) deposits of coarse sediment armor the channel bed, or (4) there is a significant change in valley type (i.e. alluvial with floodplain to confined with hillslope interaction) and/or gradient (i.e. low gradient to a much steeper gradient). If the channel bed is more resistant to erosion than the banks (i.e. cobble bed with sand banks), then bank erosion will be the likely mode of adjustment.

Since channel incision generally migrates upstream, an existing culvert may be acting as a grade control, halting the upstream progression of the headcut and channel regrade.

Stream Impacts from Undersized Culverts

Culverts in the PNW have always been problematic for migrating anadromous and resident fish species, but have also impacted other aquatic and terrestrial species because they disrupt the longitudinal continuity, or connectedness, of a stream channel. There has been a great amount of interest and subsequent activity to replace culverts in the PNW with larger culverts or bridges which do not constrict flow or disrupt natural stream processes during low to moderate flows in the stream channel.[1] Culverts are often replaced or removed because they are fish passage barriers due to (1) high velocities, (2) shallow flow depths, (3) length of run with no resting areas, or (4) excessive jump height. High quality aquatic habitat or habitat required for a specific species life stage may exist above a culvert providing the impetus for replacement or removal; however, replacing or removing a culvert without a thorough understanding of the stream dynamics may result in the loss of the upstream habitat that was the stimulus for the project.

Culvert design historically focused on passing water, not sediment and large wood, which resulted in small pipes that become pressurized during high flows. This has resulted in significant problems at culverts including (1) plugging due to large wood transport, (2) sediment deposition at the inlet due to the backwater effect, and (3) high velocity flows exiting the culvert resulting in channel scour.

Plugging of a culvert during flood flows can result in overtopping and failure of the road prism. The road fill material is then directly delivered to the stream system, potentially impacting downstream habitat. Bank erosion and plunge pools can develop at the downstream end of a culvert due to flow constriction within the barrel of the culvert and the resultant turbulent jet of water at the outlet. It is the turbulent jet that dislodges particles on the bed and banks of the channel, generally resulting in a deep plunge pool and erosion of the streambanks (Figure 1). A wedge-shaped sediment deposit upstream of a culvert is also expected when a culvert (1) is undersized, (2) is located above the streambed elevation for the provision of stormwater detention, or (3) becomes plugged with debris due to the decreased velocities and backwater effect. The sediment deposit generally occurs directly upstream (mid-channel) of the culvert which can then cause deflection of flow around the deposit and erosion of the streambanks and road fill. This is considered a *localized effect* of an undersized culvert and can be corrected with culvert replacement or removal and sediment excavation. Grade control is generally not necessary. Using the elevation of the culvert and the stream gradient, the upstream extent of incision through the sediment wedge and the total volume of sediment can be calculated.

1 *For specific information on culvert design for fish passage in Oregon refer to the Oregon Department of Fish and Wildlife document "Guidelines and Criteria For Stream-Road Crossings" (1997) and Oregon House Bill 3002. For Washington State, refer to the Revised Code of Washington (RCW), Titles 75 and 77, and the Washington Administrative Code (WAC) Chapters 220-110-010 through 220-110-360.*

Figure 1. Undersized Culvert and Bridge Replacement

Photo Courtesy of Dan Perritt

Stream Impacts from Channel Incision

Culvert replacement or removal may allow channel incision to progress upstream unchecked. Upstream migration of channel incision proceeds in a relatively predictable manner and is *system-wide*. The channel typically deepens due to a change in the proportionality between the amount and size of sediment, the amount of water, and the stream slope. For example, channel incision is very common downstream of dams because the bedload is effectively removed from the stream system, disrupting the balance between sediment input and sediment output from the reach. After channel incision has occurred and the channel bed becomes stable, the "new" channel can contain higher flows before spilling out onto the floodplain. The subsequent pressure of the greater confined flows is then translated to the streambanks where significant erosion can occur. Once the channel has enlarged to such an extent that the near bank shear stress is significantly reduced, the system will start to stabilize. This "Channel Evolution Model" has been well-documented and is discussed later in the Methodology Section of this document (Schumm, Harvey, and Watson, 1984; Simon and Rinaldi, 2000).

If system-wide channel incision has occurred and a culvert is providing grade control, replacement or removal of the culvert may result in the following responses:

1. Headcut migration upstream and subsequent deepening of the stream channel.
2. Relatively higher channel banks that may exceed critical height resulting in mass failure (bank erosion).
3. Addition of sediment to the stream system due to erosion of the channel boundary.
4. Disconnection of floodplains from active stream channels.
5. Prematurely dewatered or disconnected backwater habitat.
6. Locally increased channel slope and loss of pool habitat.
7. Drainage of shallow aquifers which affects riparian vegetation.
8. Meander cut-offs due to knickpoint migration across a meander neck caused by an increased elevation drop between the old floodplain and active channel bed.
9. Deposition of large masses of sediment causing localized channel braiding and instability of the streambanks.

METHODOLOGY FOR DETERMINING VERTICAL CHANNEL STABILITY

The main geomorphic concern with culvert replacement and removal is a rapid, and potentially catastrophic, regrade of the stream channel including channel bed degradation, lateral erosion, and subsequent deposition of eroded sediments. An existing vertically unstable condition indicates that the likelihood for channel regrade following culvert replacement or removal is high. To evaluate the risk for channel regrade, several approaches may be used to determine if a stream is actively incising or has historically incised. Two methodologies (channel evolution and longitudinal profiles) are presented which are widely-used and generally adequate for the purpose of culvert evaluation.

Channel evolution is most obvious in streams with cohesive beds and banks (Figure 2), because headcuts remain fairly vertical as they progress upstream, and are thus readily visible. In gravel-bedded rivers, headcuts may be dispersed out through several thousand feet of channel and may only be detectable with longitudinal surveys. The Channel Evolution Model is a good tool for reconnaissance level work, however, longitudinal profiles are required to quantify the actual extent of incision. While the Channel Evolution Model indicates a trend for channel stability, longitudinal profiles provide some of the data required for the design of grade control structures.

Figure 2. Example of Channel Evolution from South Dakota

Photo courtesy of Lyle Steffen

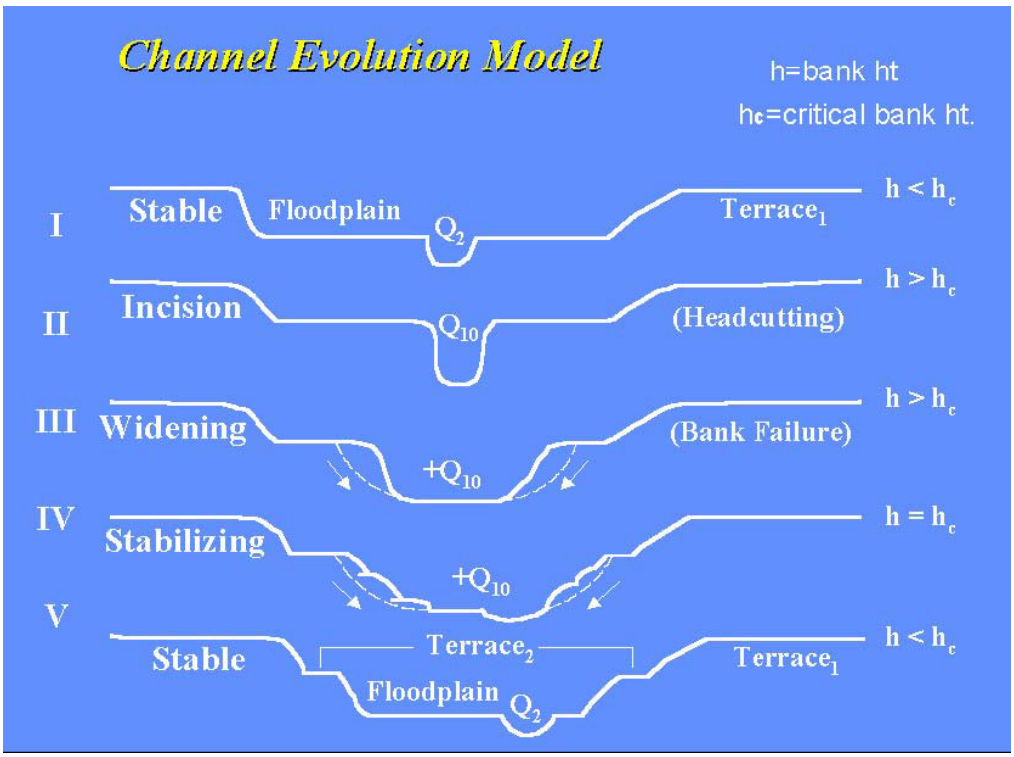
Channel Evolution Model

Channel evolution is the progression from a stable channel, to channel incision, to widening, to stabilization (Figure 3). While the rate and timing of the various stages can vary dramatically,

the general trend is well documented (Schumm et al., 1984; Simon and Rinaldi, 2000). The use of channel evolution models is appropriate for alluvial streams that can vertically and/or laterally adjust.

Determining what stage of channel evolution exists above and below a culvert is instrumental in determining the vertical stability of a stream channel. Since channel incision is typically followed by channel widening and floodplain development in unconstrained alluvial channels, a difference in the stages of channel evolution above and below a culvert (for example, Stage I upstream of a culvert and Stage III below the culvert) can indicate that the culvert is functioning as grade control structure, essentially preventing a headcut from migrating upstream. In this case, it may be prudent to add grade control in addition to culvert replacement or removal so that additional channel incision does not occur above the structure.

Figure 3: Channel Evolution Model



From Schumm, Harvey, and Watson, 1984.

When determining if channel incision is affecting or has affected a particular stream reach, there are numerous channel degradation indicators that can be used for assessment (Table 2).

Table 2. Channel Degradation Indicators

Headcuts – a vertical drop or off-set in the channel bed.
No Sediment Deposits – erosion of the channel bed down to bedrock or other resistant soil layer.
Toe of Bank is Vertical – lack of a sediment facet at the interface between the streambed and banks.
Cultural Features Exposed – exposed bridge footings or aprons, exposed pipelines, or perched culverts.
Historical Reference – individual accounts, historical photos, and old maps or surveys.
Lack of Pools – long reaches of riffle or run, no pool areas.
Dead or Dying Riparian Vegetation – loss of riparian vegetation due to lowering of shallow aquifer.
Dewatering of Aquifers – effluent from banks and evidence from wells and piezometers.
Upland Species Encroaching into Floodplain – change in moisture conditions resulting in plant community changes.

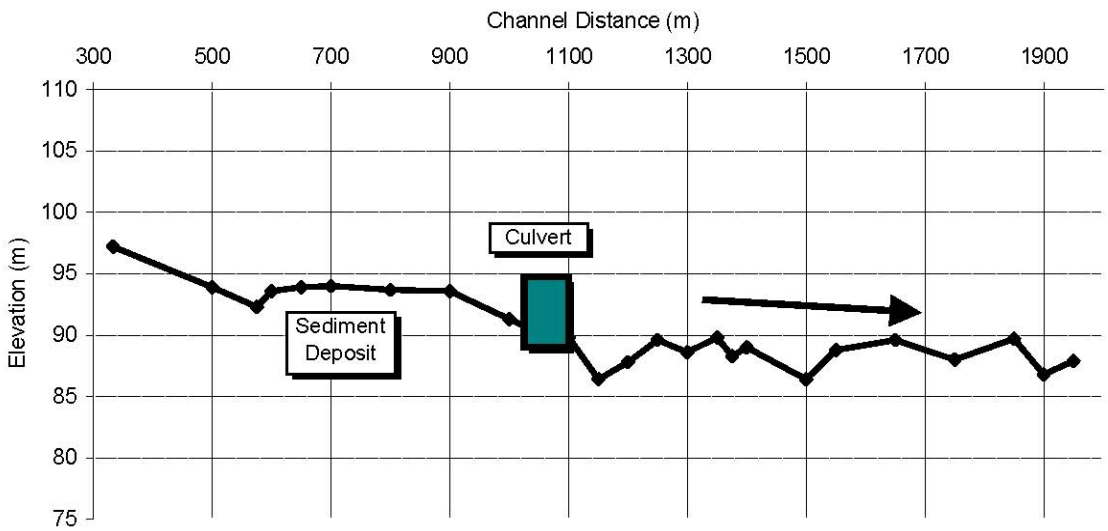
The stage of channel evolution can be determined by investigating the type of erosion that is occurring at a site. If the primary mechanism is erosion of the channel bed, then the channel is at Stage 2. If bank erosion is the primary process, then the channel is at Stage 3. Stage 4 channels exhibit some channel stability and sediment deposition near the banks. It may be difficult to determine whether a stream is at a Stage 1 or 5 if the degree of incision is minimal. It is not uncommon to have a Stage 1 channel above a culvert and a Stage 5 channel below. If the degree of incision is only a few feet, it may be hard to detect, although the impacts of removing the culvert may still occur (see Stream Impacts from Channel Incision, page 5). This situation requires a longitudinal profile to determine the actual degree of channel bed off-set and the stages of channel evolution.

Note: erosion of the outside of meander bends is a natural process and does not necessarily indicate channel incision.

Longitudinal Profile

Longitudinal profiles provide information about overall stream gradient, habitat unit gradient (pool, riffle, run), habitat unit length and spacing, profile breaks or headcuts, residual pools, and bed roughness and variation. A surveyed longitudinal profile for at least 20 channel widths (centered on the road crossing) will be necessary when determining the existence and magnitude of a potential headcut. In addition, it is important to survey beyond the area that is directly influenced by the culvert (i.e. the sediment deposit upstream and area of expansion scour downstream, or beyond areas influenced by other structures such as revetments) (Figure 4).

Figure 4. Culvert with Upstream Sediment Deposit



A longitudinal profile (Figure 5) is a plot of the thalweg elevation of the stream channel which includes all major bed features. A longitudinal profile can also capture the (1) current water elevation, (2) channel forming discharge (bankfull) indicators, (3) floodplain elevations, and (4) terrace elevations. Average channel slope can be calculated from a longitudinal profile if the survey is extensive enough.[2]

Once the profile is surveyed and plotted, it is necessary to determine if there is an off-set of the channel bed at the stream culvert. Examples of longitudinal profiles with and without a bed elevation off-set are provided below (Figures 5 and 6).

2 Refer to "Stream Channel Reference Sites: An Illustrated Guide to Field Techniques" (Harrelson et al. 1994) for specific guidance on surveying a longitudinal profile.

Figure 5: Longitudinal Profile – No Channel Bed Off-Set

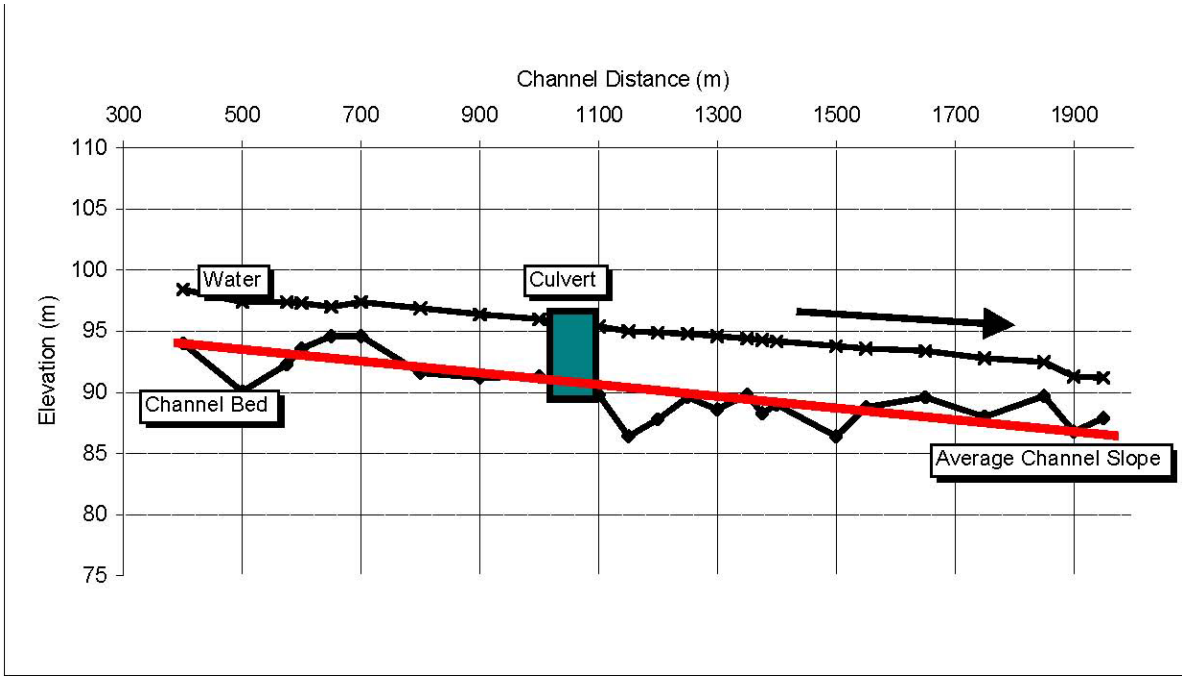
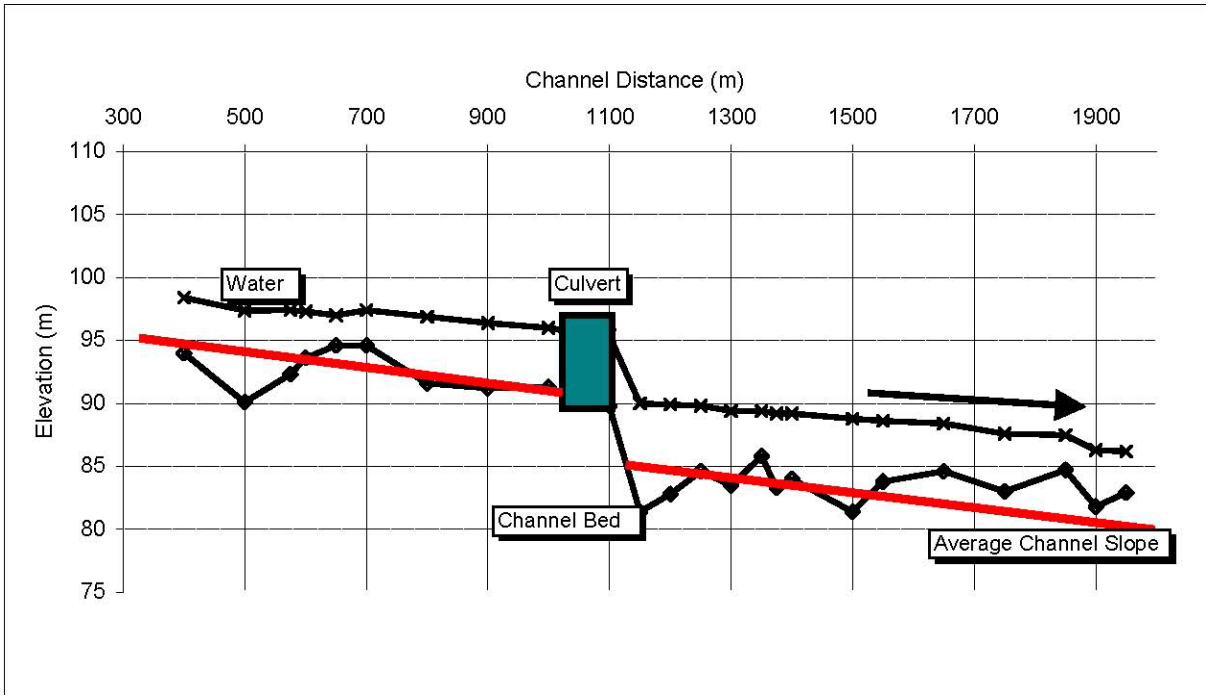


Figure 6: Longitudinal Profile - With Channel Bed Off-Set



Post-Project Monitoring

To evaluate the success and/or failure of culvert replacement and removal, documentation of the design process, changes to the design during construction, and follow-up monitoring is required.

In general, photo points are useful for documenting significant changes to the stream, and should be taken from the road surface looking both upstream and downstream. For monitoring, benchmarks and monumented cross-sections should be used for the longitudinal survey. Benchmarks should be located well outside the area of potential stream influence. The survey should include floodplain and terrace elevations to determine if additional channel incision has occurred.

Refer to published monitoring guidelines for specific information regarding monitoring protocols.

RISK ASSESSMENT

Once field reconnaissance and surveys are complete, a determination regarding vertical channel stability is required. If a channel is vertically unstable, then a risk assessment should be performed to determine the potential for additional channel erosion and habitat degradation.

Determining whether the degree of channel incision is significant requires an integration of field indicators and professional judgment. For example, a one-foot headcut may be inconsequential for a stream that is 100-feet wide with a large floodplain, especially if the bed material is large (gravel to cobble). If the stream is only 10-feet wide and is sand-bedded, a one-foot headcut may pose a significant threat to habitat.

Referring back to the potential stream system response to channel incision (page 5), consider the following:

1. Headcut migration upstream and subsequent deepening of the stream channel.
    - *Will the headcut cause a fish passage barrier in the channel or at an upstream structure?*
        - *i. Determine if barrier will be short-term or long-term.*
        - *ii. Develop a monitoring and contingency plan.*
    - *What is the likelihood that grade control will be encountered and how far is it from the site?*
        - *i. Look for evidence of bedrock, boulders or buried wood.*
        - *ii. Determine distance to grade control and calculate volume of sediment that will be excavated by the stream between the project site and the upstream grade control.*
    - *Is there other infrastructure that will be affected?*
        - *i. Determine if there are any upstream road crossings, pipeline crossings, irrigation diversions, or electric or fiber optic cables.*
    - *How much bank erosion will occur?*
        - *i. Determine average bank heights and potential rates of erosion.*
        - *ii. Evaluate land use and structures in the area.*
        - *iii. Consider easements.*
    - *Is bank stabilization necessary?*
        - *i. Determine if there are existing bank stabilization structures.*
        - *ii. Consider alternatives for non-structural bank protection.*

- *Is the stream water quality limited?*
    - *i. Calculate the volume of fine sediment that will be added to the channel from both the bed and banks due to erosion.*
    - *ii. Calculate the volume of sediment stored upstream of the existing culvert.*
- *What is the caliber of sediment (clay, silt, sand)?*
    - *i. Determine how will this affect downstream habitat (redds, macroinvertebrates).*
    - *ii. Evaluate increases in turbidity.*
- *How often will the old floodplain be inundated -- once every 2, 5, 10, 100-years?*
    - *i. Determine channel cross-sectional area and estimate frequency of floodplain inundation. Inundation less frequent than the 5-year flow indicates a channel that is highly incised and probably unstable.*
- *Will this significantly increase stream power within the main channel (more concentrated flow)?*
    - *i. Calculate stream power and determine if this will cause an increase in sediment transport. If the stream transports more sediment, additional incision is likely.*
- *Will backwater habitat be completely disconnected or will it be functional for much shorter periods during the year?*
    - *i. Survey available backwater habitat and determine how frequently it can be accessed by species of interest.*
    - *ii. Improve connectivity if possible.*
- *Are lack of pools a limiting factor in the stream?*
    - *i. From the longitudinal survey, determine the pool/riffle ratio.*
    - *ii. If pool/pool spacing is greater than 20 channel widths for stream gradients less than 1%, pool habitat is probably lacking.*
- *Is pool quality a limiting factor in the stream?*
    - *i. From the longitudinal profile, determine the residual pool depths (depth of water in a pool assuming zero discharge). The pool should be longer than the channel is wide.*
- *Can the riparian vegetation survive a drop in the water table commensurate with expected incision?*
    - *i. Evaluate the age structure and condition of the riparian plant community.*
    - *ii. Determine if there are any impermeable soil layers that will prevent roots from following the water table.*
- *Many wetland species are very sensitive to changes in moisture regimes. Monitoring of the plant community is recommended.*
- *What is the potential for channel straightening and simplification?*
    - *i. This process is more common in deeply incised channels with somewhat cohesive banks that flood on a five to ten-year basis.*
    - *ii. Determine flood re-entry points that are susceptible to meander cut-offs.*
    - *iii. Determine historical channel patterns and compare to current condition.*
- *Is deposition of coarse sediment en masse likely for the stream in question?*
    - *i. Extensive bar formation is more common in arid streams, streams with high sediment loads, and streams that have "flashy" hydrographs.*
    - *ii. Calculate the amount of sediment that will be eroded from the channel boundary, assume it will be deposited locally, and consider the impact of this sediment to channel form.*

iii. Mid-channel bars may form, causing concentrated flow near both banks.

- *Is local aggradation a concern for fish passage?*

  i. Wide, shallow channels can be fish passage barriers due to the lack of concentrated flow, or due to all flows going subsurface.

2. Relatively high channel banks that may exceed critical height resulting in mass failure (bank erosion).
3. Addition of fine sediment to the stream system due to erosion of the channel boundary.
4. Disconnection of floodplains from active stream channels.
5. Prematurely dewatered or disconnected backwater habitat.
6. Locally increased channel slope and loss of pool habitat.
7. Drainage of shallow aquifers which affects riparian vegetation.
8. Meander cut-offs due to knickpoint migration across a meander neck caused by an increased elevation drop between the old floodplain and active channel bed.
9. Deposition of large masses of sediment causing localized channel braiding and instability of the streambanks.

There are numerous other potential impacts due to headcut migration that are site-specific. It is not necessary to quantify all of these processes, but they should be at least qualitatively evaluated for a risk assessment.

OPTIONS FOR GRADE CONTROL FOR INCISING CHANNELS

It is not possible to describe all of the various scenarios for culvert replacement or removal because each site is unique and requires an individual assessment as discussed above. There are however, general characteristics of each treatment that may be favorable in different stream systems.

Grade control treatment alternatives discussed in this document include, but are not limited to, (1) do nothing, (2) large roughness elements, (3) rock and log weirs, and (4) constructed step-pools and cascades. The choice of treatment may be based on site limitations (i.e. channel slope or bed material type), material availability, economics, land use, design competence or familiarity, and/or regulatory restrictions (i.e. jump heights for fish).

The "Do Nothing" Alternative

If the evaluation of channel evolution and the longitudinal profile indicate a low risk for channel incision (i.e. minimal headcut relative to channel size or evidence of natural grade control such as bedrock, cemented gravel, or buried wood), and downstream riparian and channel conditions are adequate, then a "no-action" alternative is indicated. The culvert would be replaced or removed without the addition of grade control.

Determining the significance of a headcut is site-specific and requires the judgement of a geomorphologist or other trained professional. An evaluation of downstream channel resilience

(i.e. the existence of floodplains, stable banks, well vegetated riparian zones, etc.) is essential because this area will be impacted by the additional sediment generated from channel erosion.

Benefits
1. Least expensive in the near-term (economically).
2. No maintenance.
3. No risk of grade control failure.

Limitations (see Risk Assessment, page 11)
1. Large potential for lost instream and terrestrial habitat.
2. Loss of riparian vegetation.
3. Downstream flooding.
4. Channel widening.
5. Increased turbidity and suspended sediments.
6. Mid-channel bar formation due to increased sediment load.
7. Decreased bank stability.
8. Loss of wetlands.

Large Roughness Elements: Wood and Boulders

In many PNW streams, large wood and boulders provide natural grade control in the form of channel spanning log jams or debris flow deposits. It is often feasible to mimic this natural analog to provide grade stabilization in areas where the risk of headcut migration exists. The goal of using large roughness elements is not to completely halt the incision process, but rather to slow it down and spread the elevation change over a greater length of channel.

Since log jams are porous structures, not all of the sediment will be held in place; however, sediment inputs will be spread out over time rather than introduced to the stream as one large pulse. A log jam is also self-maintaining as long as more large wood is available in the stream system.

To hold existing sediment in place above a culvert, large wood should be buried into the stream bottom and should be relatively channel-spanning. Boulders can be used as anchor points or to increase structure mass to reduce buoyancy. As with any structural approach, risk can be dispersed through several smaller structures rather than relying on a single large structure. Log jams placed downstream of a road crossing should have some sort of natural or artificial anchoring, but do not necessarily need to be buried in the channel bed. The downstream large wood will capture some sediment as it moves through the reach.

Benefits
1. Provides some stability for upstream banks while allowing dynamic stream response.
2. Improves habitat diversity.
3. Self-healing and possibly self-maintaining if there is an upstream source of wood.

Limitations

1. Initially requires large wood source for construction.
2. Lack of readily accessible, specific design guidance.
3. Structures change over time – variable factor of safety.
4. Risk of damage to infrastructure due to wood transport.

Rock and Log Weirs

Rock and log weirs (Figures 7 and 8) have been used for many years to stabilize channel beds. Straight weirs disperse flows and can cause channel widening and thus structure flanking (erosion around the ends of the structure). To minimize this effect, 'V' shaped weirs that are oriented with the apex upstream and are lower in the center were developed. Since water crosses perpendicular to the weir face, the 'V' shape redirects flow back to the center of the channel.

Figure 7: Rock Weir

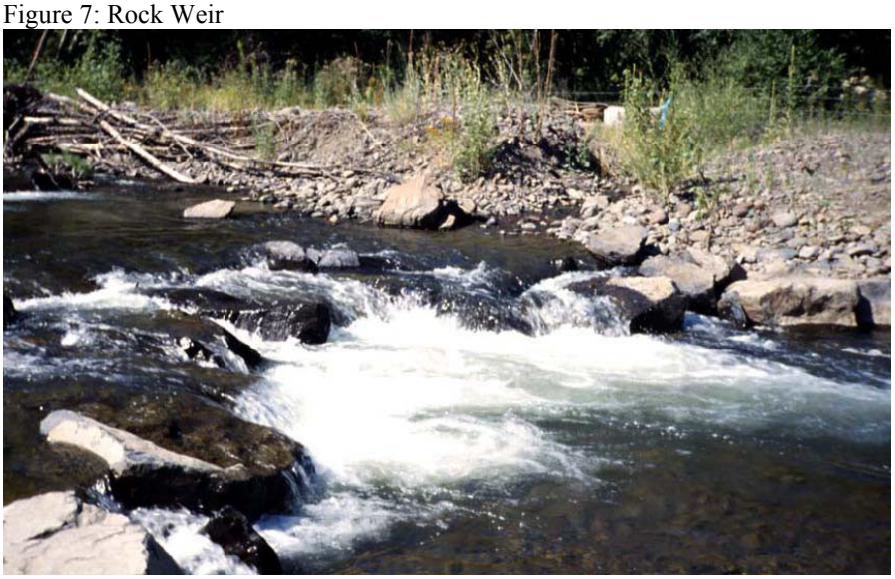


Figure 8: Log Weir

Rock and log weirs may be installed to provide some of the following functions: (1) stabilize stream gradient; (2) create pool habitat; (3) establish and maintain a lower width to depth ratio; (4) provide fish passage by concentrating low flows in flat-bottomed channels into narrower, deeper channels; (5) control flow direction and therefore minimize meandering; (6) raise water surface elevations to provide water to diversions and off-channel habitat; (7) center, and sometimes create, a stream thalweg; (8) provide energy dissipation; (9) protect streambanks by redirecting stream flow; and (10) increase sedimentation along streambanks, and recruit and/or maintain spawning gravel (NRCS, 2000).

Benefits

1. Relatively inexpensive for smaller streams.
2. Easy to design, with available guidance tools (NRCS, 2000).
3. Material is easily obtained.

Limitations

1. Potential for unnatural appearance.
2. Maintenance.
3. Prone to failure by undermining or outflanking.
4. Federal and state requirements for aquatic species passage can result in very low weir heights. This may cause weirs to be impractical in steeper streams or in areas where the right-of-way is limited and there is no access to adjacent property. If weirs must be placed close together, the jet from one weir impinges on the next one, tending to undermine or wash it out, and the weir system becomes a turbulent chute which could become a fish passage barrier.

Constructed Step-Pool and Cascades

One of the newest grade control methods is the construction of artificial cascades or step-pools (Figure 9). Cascades and step-pools are natural stream types which are found in steep channels (greater than 3%). Although these stream types may be out of context for a given project site, they do rely on natural channel processes to pass water, sediment, wood, and aquatic organisms. Step-pools or cascades are most appropriate in stream reaches that are naturally steep or in areas where work area is limited due to rights-of-way or other constraints; they may also be preferable in areas where banks are high and excavation is considerable.

Figure 9: Constructed Step-Pool and Cascade

Photo courtesy of Rob Sampson Photo courtesy of Dan Perritt

Benefits

1. Minimizes work area.
2. Provides energy dissipation.
3. Minimizes the number of structures for large elevation changes or steep stream slopes.
4. Materials are easy to obtain.

Limitations

1. Lack of specific design guidance.
2. Requires careful design and construction.
3. Stabilization of bed material below the grade control structure can be difficult; potential for undermining of the step-pool structure.
4. Risk of low flows going completely subsurface through the structure.
5. Consecutive jumps for fish may limit aquatic species passage.
6. Maintenance.

A “culvert confined cascade” has been designed and implemented in the PNW, which is a variation of the constructed cascade approach. The culvert is placed at a relatively steep angle, connecting the upstream and downstream stable bed elevations. The headcut is basically incorporated into the length of the culvert. This may work in areas with a minimal perch height on relatively low gradient streams. Rock is required within the culvert to provide bed roughness to allow for fish passage. For steeper slopes and higher perches, a culvert confined cascade will likely be a fish passage barrier, especially for juveniles. Rock within the culvert could trap debris and cause chronic maintenance issues or risk of failure. Available information on design and success of this technique is limited at this time.

SUMMARY

A tremendous amount of time, energy, and money is spent replacing or removing fish-impassable culverts. Because of the magnitude of effects, it is critical that a geomorphological evaluation of the site be completed to determine potential impacts both at the site and along the stream channel. Vertical instability can result in a whole suite of negative impacts that range from loss of backwater habitat to increased levels of turbidity. An evaluation of the risks to channel morphology, habitat, and infrastructure should be performed before any decision is made regarding culvert removal or replacement. By utilizing the Channel Evolution Model and longitudinal profiles, the risk can be quantified, or at least described in terms of potential impacts, which is an important tool for managers that oversee stream related projects. These risks will determine whether grade control structures are necessary.

ACKNOWLEDGEMENTS

This manuscript was greatly improved by the input from many individuals including: Paul Bakke, Jane Kelly, Mark Mouser, Skip Haak, Bianca Streif, Janet Oatney, Chad Moore, Chris Hamilton, Alan Wetzel, Diana Hwang, Brendan White, Jon Mann, Dan Perritt, Timmie Mandish, Doug Young, and Jennifer Cannon. Thank you for your time and effort.

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APPENDIX D. Level 2 Policy of March 26, 2004 Regarding Marbled Murrelet Suitable Habitat

Policy for the Management of
Potential Marbled Murrelet Nesting Structure within Younger Stands

Issued by the Level 2 Team for the North Coast Planning Province, Oregon
March 26, 2004

This policy guides the management of *potential marbled murrelet nesting structure within younger stands*, herein referred to as *potential nesting structure.* This policy applies to thinning prescriptions in all land use allocations in the North Coast Province. It supplants the "guidance on the management of potential habitat in younger coniferous forests for marbled murrelets," issued on June 25, 1999 by the Level 2 Team for the North Coast Province.

I. Characteristics of Potential nesting structure

A tree with potential nesting structure has the following characteristics:

It occurs within 50 miles (81 km) of the coast (U.S. Fish & Wildlife Service 1997:32) and below 2,925 ft. (900 m) in elevation (Burger 2002);

It is one of four species: Western hemlock, Douglas-fir, Sitka spruce or western red cedar (Nelson & Wilson 2002:24, 44);

It is ≥ 19.1 in. (49 cm) (dbh) in diameter, > 107 ft. (33 m) in height, has at least one platform ≥ 5.9 in. (15 cm) in diameter, nesting substrate (e.g., moss, epiphytes, duff) on that platform, and an access route through the canopy that a murrelet could use to approach and land on the platform (Burger 2002, Nelson & Wilson 2002:24, 27, 42, 97, 100);

And it has a tree branch or foliage, either on the tree with potential nesting structure or on a surrounding tree, that provides protective cover over the platform (Nelson & Wilson 2002:98 & 99);

Any tree that does not meet all of these characteristics is unlikely to support nesting murrelets. However, we recognize that not all of these characteristics are visible from the ground in all situations. Therefore, the unit wildlife biologist shall make site-specific determinations on the presence of potential nesting structure.

II. Options for the Management and Protection of Potential nesting structure

The administrative units shall follow the steps in Appendix E, Figure 1 to determine which of the following three options is available for any given proposed action, and when additional seasonal or time-of-day restrictions must be applied to avoid adverse affects to the murrelet. Compliance with these steps and restrictions is necessary to ensure that actions implemented under Option 2 or Option 3 would have discountable, insignificant or entirely beneficial effects on the murrelet.

Option 1: Follow current practices as provided by the provisions of USDA & USDI 1994:C-10(3) (Occupied Marbled Murrelet Sites).

Prior to implementing a project in suitable or potential murrelet habitat as defined by protocol, the Standards and Guidelines (USDA & USDI 1994:C-10[3]) require survey to protocol and, if nesting occupancy is determined, the identification of an unmapped LSR and the protection of habitat. This is the only option available to an administrative unit if a proposed action may affect and is likely to adversely affect the murrelet.

Option 2: Exclude potential nesting structure from the project area and apply protection measures to ensure that the proposed action would not adversely affect the murrelet.

To comply with Option 2, the administrative unit must do all of the following:

1. Prohibit the removal or damage of potential nesting structure. This includes the removal or damage of trees with potential nesting structure and the removal or damage of adjacent trees with branches that interlock the branches of any tree with potential nesting structure.

2. Prohibit timber harvest and associated ground disturbances during the murrelet nesting period (April 1 – September 15) unless otherwise authorized by a biological opinion.

3. Maintain a 150-foot un-thinned buffer around all trees with potential nesting structure. That is, within 150 feet of any tree(s) exhibiting potential nesting structure, no trees shall be removed for any reason associated with the timber harvest, including the placement of roads, landings or yarding corridors.

4. Maintain an average canopy closure of at least 60 percent post-treatment (averaged over each 40-acre area) in the zone between 150 feet and 300 feet of all trees exhibiting potential nesting structure.

5. Consider additional, site-specific prescriptive measures to maintain or enhance habitat conditions, as deemed necessary, in the zone between 150- and 300-feet from all trees exhibiting potential nesting structure.

6. Maintain an average canopy closure of at least 40 percent post-treatment (averaged over each 40-acre area) within the proposed thinning unit beyond 300 feet from all trees exhibiting potential nesting structure.

Option 3: Protect potential nesting structure within the project area and apply protection measures to ensure that the proposed action would not adversely affect the murrelet.

To comply with Option 3, the administrative unit must do the following:

1. Design the project in accordance with LSR management standards (USDA & USDI 1994:C-9 – C-20) or REO Working Group direction.

2. Prohibit the removal or damage of potential nesting structure as identified in Section I.

3. Design habitat modifications that occur within a distance equal to one site-potential tree height of potential nesting structure to protect and improve future habitat conditions. Examples include protecting the roots of trees with potential nesting structure, and removing suppressed trees, trees that might damage potential nesting structure during wind storms, and trees that compete with key adjacent trees that are, or will be, providing cover to potential nest platforms. The administrative units must consider management actions that aid limb development and the development of adjacent cover.

4. In accordance with U.S. Fish and Wildlife Service 1997:21, prohibit the creation of any opening *(i.e.*, a gap ≥ 0.25 acre [0.10 ha] in size) within a distance equal to one site-potential tree height of potential nesting structure.

5. Verify that proposed habitat modifications comply with the intent of this policy through normal streamline consultation procedures. The administrative units are encouraged to involve the U.S. Fish and Wildlife Service during prescription development. The Level 1 Team will verify that the proposed habitat modification complies with the intent of this policy. Any issues concerning this policy are to be elevated by the Level 1 Team to Level 2 for clarification.

Additional guidance on LSR prescription thinning is contained in USDA & USDI 1997:42-46 and 1998:86-90 and REO direction.

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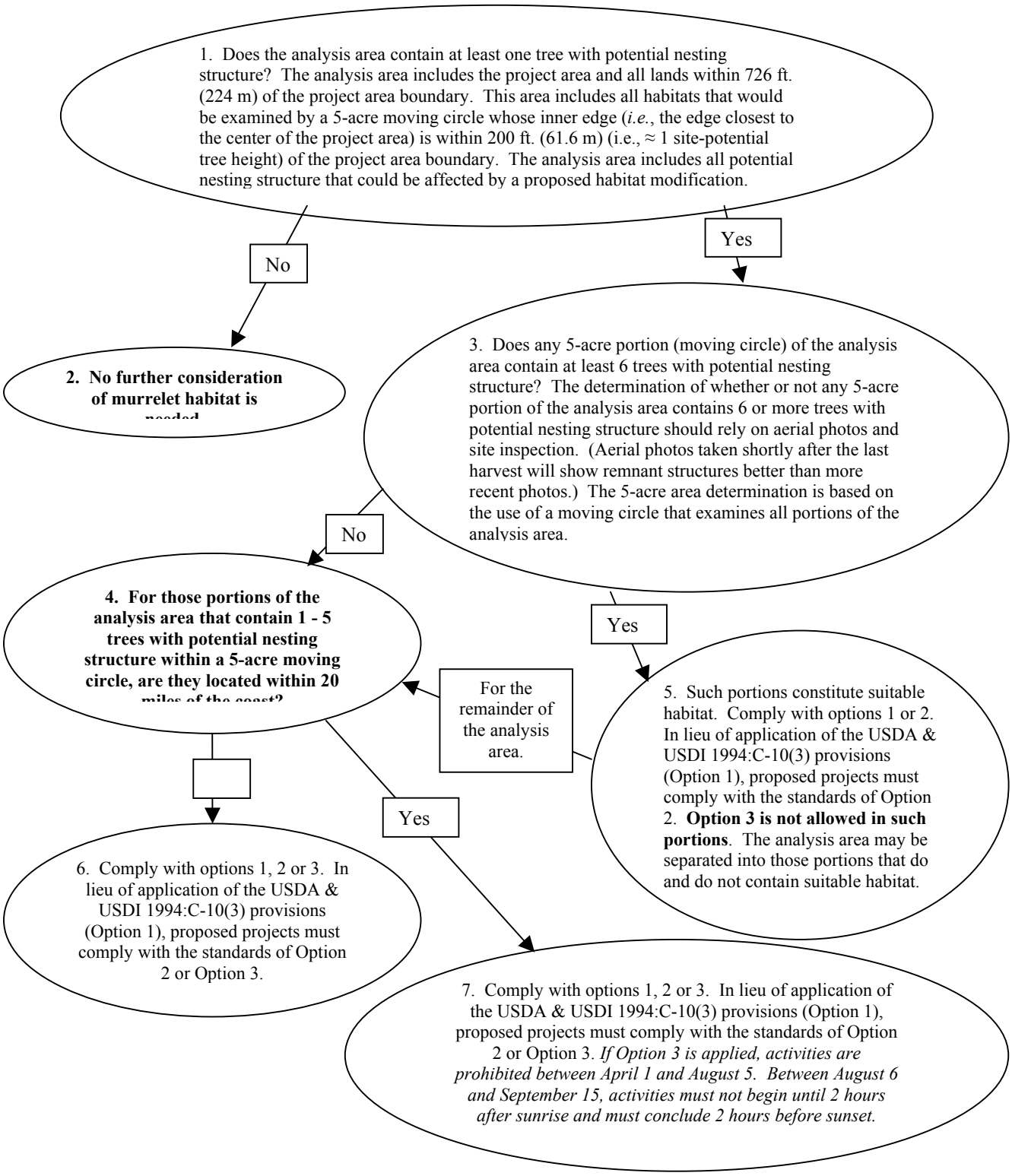
Figure 1 (next page). Steps to determine which options for the management and protection of potential nesting structure are permitted for any given proposed thinning project. Management options are explained in Section II. Step 7 contains additional requirements for the application of Option 3.