Endangered Species Act – Section 7 Consultation Biological and Conference Opinion

for

Oregon Department of Transportation's Statewide Transportation Improvement Program 2014-2018

Action Agency:	Federal Highway Administration
Consultation Conducted By:	U.S. Department of the Interior, Fish and Wildlife Service
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1.0 Consultation History and Background

This concurrence and programmatic biological and conference opinion (PBO) are in response to the October 12, 2011 Federal Highway Administration's (FHWA) request for consultation and ODOT's 2011 Programmatic Biological Assessment (PBA) for their Statewide Transportation Improvement Program 2012 -2015 (Program). For the purposes of this consultation the action agency is referred to as FHWA/ODOT. The PBO is based on information provided in the PBA and supporting reference information; regular meetings and discussions between the Federal regulatory agencies and ODOT personnel and file information and reference material located at the Service's Oregon Fish and Wildlife Office. A complete administrative record of this consultation is on file at the Oregon Fish and Wildlife Office.

Informal consultation for the Program began in spring 2011 with meetings between ODOT, FHWA and Service personnel. On October 12, 2011, FHWA/ODOT requested initiation of formal consultation with its determinations that the proposed STIP Program:

- "may affect, is likely to adversely affect" the marbled murrelet, northern spotted owl, Oregon chub, bull trout (Columbia River DPS and Klamath River DPS), Lost River and short-nosed suckers, Fender's blue butterfly, Bradshaw's lomatium, Kincaid's lupine, Nelson's checkermallow; and
- "may adversely affect" designated or proposed critical habitat for the marbled murrelet, northern spotted owl, bull trout, Oregon chub, Fender's blue butterfly, Bradshaw's lomatium, Kincaid's lupine, and Nelson's checkermallow.

At that time, FHWA/ODOT also requested conferencing on proposed critical habitat for the Lost River and short-nosed suckers, and concurrence from the Service that the STIP "may affect, is not likely to adversely affect" rough popcornflower, Spalding's catchfly, western lily, Willamette Daisy, Applegate's milk-vetch, Cook's lomatium, Gentner's fritillary, Howell's spectacular thelypody, Large-flowered woolly meadowfoam and their designated critical habitat.

The FHWA made these requests in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.) and as outlined in Table 1.

Between October, 2011 and December, 2013, the consultation process occurred sporadically, with several long periods of cessation in response to Service determinations that additional information was required in the PBA, Service and FHWA/ODOT efforts to collaboratively develop additional avoidance, minimization and mitigation measures, and ODOT notification to the Service of alternate consultation priorities. Consultation was formally restarted upon resolution of these efforts, as confirmed via electronic mail form ODOT to the Service on December 09, 2013.

Table 1. Species addressed in this PBO, listing status, and FHWA/ODOT's affects determinations (ODOT 2009).

Species	Scientific name	Federal Status	Determination
Marbled murrelet	*Brachyramphus marmoratus*	T/CH	LAA LAA for CH
Northern spotted owl	*Strix occidentalis caurina*	T/CH	LAA LAA for CH
Oregon chub	*Oregonichthys crameri*	E/CH	LAA LAA CH
Bull trout Columbia River DPS	*Salvelinus confluentus*	T/CH	LAA LAA for CH
Bull trout Klamath River DPS	*Salvelinus confluentus*	T/CH	LAA LAA for CH
Lost River sucker	*Deltistes luxatus*	E/PCH	LAA LAA for PCH
Short-nosed sucker	*Chasmistes brevirostris*	E/PCH	LAA LAA for PCH
Fender's blue butterfly	*Icaricia icarioides fenderi*	E/CH	LAA LAA for CH
Nelson's checkermallow	*Sidalcea nelsoniana*	T	LAA
Kincaid's lupine	*Lupinus sulphureus* ssp. *kincaidii*	T/CH	LAA LAA for CH
Bradshaw's lomatium	*Lomatium bradshawii*	E	LAA
Willamette daisy	*Erigeron decumbens* var. *decumbens*	E/CH	NLAA NLAA for CH
Western lily	*Lilium occidentale*	E	NLAA
Applegate's milkvetch	*Astragalus applegatei*	E	NLAA
Cook's lomatium	*Lomatium cookii*	E/CH	NLAA
Gentner's Fritillary	*Fritillaria gentneri*	E	NLAA
Howell's spectacular thelypody	*Thelypodium howellii spectabilis*	T	NLAA
Large-flowered woolly meadowfoam	*Limnanthes floccosa* ssp. *grandiflora*	E/CH	NLAA
MacFarlane's four-o'clock	*Mirabilis macfarlanei*	T	NLAA
Rough popcornflower	*Plagiobothrys hirtus*	E	NLAA
Spalding's catchfly	*Silene spaldingii*	T	NLAA

(E) – Endangered (T) –Threatened (CH) - designated Critical Habitat (PCH) – proposed Critical Habitat (NLAA) – not likely to adversely affect (LAA) – likely to adversely affect (NLAA for CH) – not likely to adversely affect proposed or designated critical habitat

2.0 Proposed Action

This Programmatic Biological Opinion (PBO) addresses the effects of Oregon's Statewide Transportation Improvement Program (STIP) on species listed as threatened or endangered under the federal Endangered Species Act (ESA) of 1973, as amended. The STIP is Oregon's four-year transportation capital improvement program. The proposed action consists of projects and activities funded by FHWA and included ODOT's 2012-2015 STIP. These activities are anticipated to occur through December, 2017 and this PBO and associated incidental take statement will remain in effect until four years from the date of signature. The proposed action does not cover projects delivered under mechanisms other than the STIP.

Most projects in the STIP fall into two categories: (1) projects that protect the state's investment in the transportation infrastructure by systematically preserving all elements of the existing system, and (2) projects that primarily add new capacity to the system. In addition to these broad categories, the STIP also funds several smaller, specialized programs, including the Transportation Enhancement, Congestion Mitigation and Air Quality, Bicycle and Pedestrian, Railroad Crossing Safety Improvements, Fish Passage and Large Culvert Improvement.

Therefore, the proposed action potentially includes a wide range of "regionally significant" Federally-, state- and locally-funded individual projects on (or associated with) state and federal highways, city and county roads. This PBO does not describe or assess these projects individually, but instead considers the activities conducted to deliver STIP projects and the ecological outcomes that follow, specifically:

- the types of work activities commonly associated with projects of the nature of those included in the STIP;
- the nature of biological effects generally associated with such work activities;
- avoidance, minimization, mitigation and other conservation measures applied to ameliorate those adverse effects or to attain a conservation benefit;
- the likely scale, scope and distribution of work activities and associated conservation measures likely to be implemented via the STIP; and
- based on each of the above factors and to the extent practicable, impacts of a specific quantity, type, and ecological significance.

All of the above, then, collectively serve as the sideboards that determine whether any individual project implemented under STIP is covered by this PBO. Projects that occur outside of these sideboards or are otherwise inconsistent with the assumptions of the PBO are not covered. As individual STIP projects are proposed and implemented, their conformance to the sideboards and expectations of this PBO will be subject to confirmation.

The categories of project types presented in this PBA utilize a naming system developed by ODOT's Geo-Environmental Section for ESA consultation tracking. Project activities are distinct components of work associated with a highway construction project, often related to a particular design element (e.g. stormwater control, or streambank stabilization.) Table 2 presents a summary of the activities and when they tend to occur during different types of projects. Typical work and components of each of these main activities are described below and constitute the Proposed Action for this statewide PBA.

***Table 2.** Proposed activities that typically occur with different types of STIP projects. (Table numbers from the PBA were retained to avoid confusion)*

Sub-Section #	ACTIVITIES (ODOT Specifications)	Project Types[1]												
		Bike/Ped Facilities	Bridge Repair	Bridge Replacement	Culvert Extension/ Repair	Culvert Replacement	Fish Passage Retrofit	Intersection Safety	Modernization	Preservation	Roadside Development	Rockfall/Slide Mitigation	Signals/Signs	Widening/Adding Lanes
1	Geotech Drilling			X		X			X			X	X	
2	Material Source	X		X				X	X	X		X		X
3	General Heavy Construction (Sec 200-500)	X	X	X	X	X	X	X	X	X	X	X		X
4	Mobilization, Staging & Disposal (Sec 210; 225)	X	X	X	X	X			X	X		X		X
5	Erosion & Pollution Control (Sec 280; 290)	X	X	X	X	X	X	X	X	X	X	X		X
6	Temporary Access Roads (Sec 220.40b; SP230[2])			X										
7	Barges (Sec 210)		X											
8	Temporary Bridges & Treated Wood (SP250-252)			X					X					
9	Work Area Isolation (SP 245, SP 290.35(c-2)); Coffer Dams (Sec 510.03)			X	X	X	X		X					
10	Clearing & Earthwork (Sec. 310-330)	X		X		X		X	X	X	X	X		X
11	Weed Removal	X		X		X		X	X	X	X	X		X
12	Tree & Down Timber Removal (Sec 320.40)			X					X					X
13	Blasting (Sec 3303 335)													
14	Slope Stabiliz. (Sec 390-398) & Dewatering (Sec 405.43)											X		
15	Streambank Stabilization & Scour Protection (Sec 390)					X				X				X
16	Culvert Removal (Sec 310), Bridge Removal (Sec. 510)			X		X			X					
17	Bridge Repair & Rehabilitation (Sec 500)		X											X
18	Bridge Installation, Steel (Sec 560); Concrete (Sec 540, 550, 590); Treated Wood (Sec 570)			X					X					
19	Pile Removal (SP 290.34), Drilled Shafts (Sec 512); Pile Driving (Sec 520)			X					X					

[1] X=most common activities for the type of project.
[2] SP indicates existing boiler plate special provision (ODOT 2011a).

20	Culvert Install., Repair, Extension, Retrofit (Sec 440-490, 595), Lining (Sec 410)					X			X	X				
21	Painting/Coating (Sec 593-594)		X											
22	Asphalt & Concrete Paving (Sec 700)	X		X				X	X		X	X		X
23	Other Permanent Roadway Structures (Sec 586, 587, 800, 900, 1050, 1070, 1100)	X	X	X				X	X	X	X		X	X
24	Site Restoration - Perm. Erosion Control (Sec 280); Seeding (Sec 1030); Tree Planting (Sec 1040)	X	X	X	X	X	X	X	X	X	X	X		X
25	Channel Modificaiton & Waterway Enhancements (Sec 1090, SP 1091)						X							
26	Stormwater Management (SP 1092)	X		X				X	X		X			X

2.1 Avoidance and Minimization Measures

The proposed action will occur consistent with ODOT's Standard Specifications, which include measures to minimize disturbance to environmental resources. The PBA describes the Standard Specifications most relevant to this consultation. The Avoidance and Minimization Measures of the Standard Specifications represent best practices and design criteria primarily from SLOPES IV (Transportation NMFS 2008a; Restoration, NMFS 2008b) and the OTIA III PBA (ODOT 2004). The Avoidance and Minimization measures applicable to the various activities listed in Table 2. are also described in detail in Appendix A of this PBO.

2.2 Additional Minimization and Offsetting Measures

While the measures referenced in section 2.1 (and described in detail in Appendix A of the PBO) should substantially reduce the impacts that might otherwise potentially result from the work activities associated with STIP projects, some impacts might still occur. ODOT and FHWA will implement several supplemental measures that 1) increase the effectiveness of section 2.1 measures, and/or 2) minimize the ecological significance of impacts that remain unavoidable despite section 2.1 measures. These supplemental measures are specifically associated with removal of listed plants or butterfly habitat and removal of trees/timber from owl/murrelet habitat areas. If it is determined that the measures described below result in inconsistencies with those in section 2.1 of the PBO, the measures below will be given primacy unless otherwise agreed to by the Service.

ODOT will implement Avoidance and Minimization Measure 1-9 (of section 2.1/Appendix A) through the following activities:

1. Habitat will be replaced by one of the following options:
   a. Establish Agency-owned mitigation sites, banks or projects and use associated credit equivalents;
   b. Purchase of credits in private-sector or Agency-owned conservation sites or mitigation banks already approved by the Services;

2. Regardless of the method used above, the following conditions apply:
   a. Sites should be located where they have the greatest likelihood of benefiting target species and in areas most prioritized for species conservation (e.g.

designated critical habitat; priority habitat areas identified in recovery plans; areas that supplement or expand existing protected areas or that serve to increase the connectivity between such areas; etc.).

b. Selected sites will be mutually agreed-upon by FHWA, ODOT and USFWS.
c. Actions must include assurances of implementation and assurances that mutually agreed-upon target biological conditions will be attained and maintained, as feasible. These include:
(1) Acquisition or permanent conservation easements and ownership of the land and/or easement by a qualified land protection entity;
(2) Planning document or provisions for long-term management to retain target conditions;
(3) Financing necessary to deliver the mitigation and long-term operation/management documented by an appropriate budget or cost-analysis, and sources identified and secured.
(4) Assurances of long-term maintenance of adjacent landscape conditions will be considered if attainment/maintenance of target biological conditions is dependent on adjacent landscape conditions.

3. For northern spotted owl:
   a. Replace lost habitat via the permanent protection of the 86.5-acre "Swanson Property" along the lower Umpqua River;
   b. Place a permanent conservation easement on the above property within six months of the effective date of this PBO;
   c. Upon utilization of the property as described above, it will no longer be available to offset impacts from STIP projects beyond those anticipated in this PBO or from future non-STIP projects[3].

4. For Fender's blue butterfly:
   a. Replacement for loss of host habitat will occur at a ratio of 3:1 (e.g., 3-acres of mitigation for each acre lost) via either preservation of existing/occupied habitat or restoration/enhancement of degraded habitat.
   b. Sites will be consistent with species recovery goals and the recovery plan.
   c. Mitigation areas will be allocated the following value ("credits"): 1 credit will be derived from each 1-acre of host habitat formally protected by and part of the subject bank (or non-bank mitigation project.)

5. For Bradshaw's lomatium, Kincaid's lupine, or Nelson's checkermallow:
   a. Replacement for loss of species will occur at a ratio of 3:1 (e.g., 3 credits of mitigation for each individual plant unit lost) via either preservation of existing habitat or restoration/enhancement of degraded habitat, if the species currently occurs on the mitigation sites. If the species does not currently occur on the sites and does not become naturally established at the sites within 5-yrs, additional mitigation will be required, either in the form of species

[3] The subject property is also being utilized to offset impacts from two previous projects—"County Line Curves" and "Salmonberry." Collectively with the STIP, 25 acres of adversely impacted owl habitat are offset through the permanent protection of the property.

reintroduction measures or in the form of additional habitat up to a total ratio of 6:1 (e.g., 6-credits of mitigation for each individual lost.)

b. Sites will be consistent with species recovery goals and the recovery plan.
c. Mitigation areas will be allocated the following value ("credits"): 1 credit will be derived from each individual plant unit in habitat that is formally protected by and part of the subject bank (or non-bank mitigation project.) An individual plant unit is a reproductive individual plant or, in the case of clonal plants, 0.25 m^2 of foliar cover that has at least 3 reproductive stems.

2.3 Interrelated and Interdependent Actions

Interrelated and Interdependent actions include actions that are part of a larger action and depend on the larger action for justification. Interdependent actions are defined as actions with no independent utility apart from the proposed action. Interrelated actions for this PBA encompass the repair, replacement and realignment of existing structures and roadways and the development of new or expanded transportation corridors described in Section 2.4 of the PBA within the State of Oregon. Interrelated and interdependent activities of transportation construction projects are mainly those conducted by the construction Contractor or a third party but are not part of the Agency's Contract.

2.3.1 Utilities and Disposal

Some of the most common interrelated and interdependent actions associated with transportation projects are utility relocations, aggregate source material, disposal sites for construction debris or excess subsurface material. ODOT typically does not have legal authority to direct these activities except as described in Section 2.3.3. However, ODOT's Standard Specifications require the contractor to comply with all applicable State and Federal laws and regulations, including environmental.

Construction projects often require relocation of utilities, including overhead and underground lines, towers and poles, junction boxes, or other associated features. Except for those owned and operated by ODOT or the local agency (e.g., for traffic cameras, highway illumination, active warning signs, water/sewer), the utility company is responsible for relocating lines in the way of a public transportation improvement project. The Oregon Department of Justice has set limits on how far ODOT can go in directing utility work. In general, ODOT cannot stipulate the exact methods or locations of the utility relocation activities. However, as a condition of their miscellaneous/access permit on public right of way, the utility company is held individually responsible for compliance with applicable environmental laws and obtaining their own permits when needed.

ODOT's Standard Specifications make excess construction material the property of the Contractor, and allow the Contractor to use disposal sites that are outside of the project limits. When Contractors arrange for their disposal sites, they are responsible for obtaining all the required permits and environmental clearances, in particular a Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers when applicable.

2.3.2 Maintenance

General maintenance activities are also interrelated/interdependent actions related to the activities covered under this programmatic action. Maintenance activities vary greatly in size and complexity. In general, highways, bridges and culverts, storm-water conveyances, and related infrastructure require continual maintenance to prolong the lifespan of the structure or roadway. While recently completed projects generally don't require frequent, large-scale maintenance, maintenance actions tend to increase in frequency and complexity with structure age and use. The need for maintenance may also be accelerated if design parameters change during the life of a structure, such as if hydrology patterns or vehicle weights change. In many instances the replacement of a structure is partially based on the continued maintenance costs. Maintenance activities have the potential to adversely affect listed species depending on the type, location and duration of these activities.

Avoidance and Minimization Measures incorporated into this proposed action, (e.g., the fluvial performance standard in Measure 18-2 and avoiding impact pile driving whenever possible per Measure 19-2ii) are anticipated to reduce the need for maintenance actions that historically were of more concern to the Service. Reducing the need for anticipated maintenance benefits all protected resources. In addition to adopting measures that reduce the need for maintenance, maintenance actions tend to be dispersed across the State and temporally, therefore, adverse effects of these actions also tend to be dispersed widely.

2.4 Improvements and Enhancements

ODOT and FHWA anticipate that implementation of the Avoidance and Minimization Measures will result in overall ecological uplift to the environmental baseline (see Program Goal #1, Section 1.5 PBA). For example, culvert and bridge replacements will improve ecological connectivity through compliance with ODFW and NMFS Fish Passage Criteria and floodplain design criteria. Although designed for fish, these standards will help improve connectivity for other organisms (e.g., reptiles, amphibians, small mammals). The weed control and revegetation Avoidance and Minimization Measures in this PBA will improve the condition of supporting habitat for listed and non-listed species and ecological functions.

ODOT and FHWA will track improvements and enhancements through the use of key parameters and metrics captured in data fields in the NRU-ESA Database, Project Notification, Project Completion and Annual monitoring reports (see Section 3.4.2 PBA). For example, the Project Completion Report may identify miles of stream improved for fish access, acres (and type) of habitat disturbed and restored, and numbers of trees removed and planted.

2.5 Modifications

The Program Goals listed in Section 1.5 of the PBA will be achieved if the majority of STIP projects implement the Avoidance and Minimization Measures presented in the Proposed Action section of this document without modifications. These goals can be achieved even if some individual projects are implemented with modifications. Design modifications that can potentially result in impacts that differ from those assumed in this PBO will require review and approval by the Service. Some of the activities most relevant to species and impacts covered in this PBO, and therefore would be most subject to approval by the Service prior to modifications, are summarized on Table 7.

Table 7. Typical situations when design modifications require Services approval.

Activity	Modifications That Require Approval
Terrestrial Resources: [4]	
Removal of listed plants or butterfly habitat	Removal of Fender's blue butterfly habitat, Kincaid's lupine, or Bradshaw's lomatium
High noise producing work within 300 ft. of murrelet habitat	Cannot avoid such activities April 1 – August 5
Removal of trees/timber from owl/murrelet habitat areas	Removal of mature conifer trees (>= 18-in DBH)
Aquatic Resources:	
In-water work timing	Extensions of in-water work period
Fish passage for listed species	Designs that do not meet standards but still improve fish passage
Herbicides near fish habitat	Modifications to herbicide treatment standards
Streambank stabilization or other hard armoring in fish habitat	Any uses of hard armoring below OWH except to replace existing quantity/location
Bridge replacement in/over fish habitat	Does not meet functional floodplain standards
Impact pile driving in fish habitat	Modifications to pile installation impact minimization measures
Channel modification and waterway enhancements	Activities v.-ix. in Section 2.3.25 (fish passage retrofits, channel restoration, set-backs, water control)
Stormwater Management	Projects that cannot fully meet the stormwater management criteria on-site.

[4] Aquatic habitat supporting listed species.

The Service expects that modifications will be developed such that resulting impacts will conform (at a programmatic level) to the amounts, types, and ecological significance (including incidental take) of those assumed in this PBO.

ODOT will coordinate with Service during project development or as early as the need arises. All modifications must be documented in the Project Notification Report (see Section 3.4.2 PBA) or Project Change form if the change is needed after submittal of the Notification (Per the latest ODOT Template on the Geo-Environmental Section, Biology Program website). Any proposed modification must meet the Program Goals (Section 1.5 PBA) and must not exceed the amount of take anticipated and reported in the Project Notification Report.

3.0 Endangered Species Act Informal Consultation and Concurrence

The FHWA/ODOT made a determination of "may affect, is not likely to adversely affect" for seven listed plant species. The species include: Applegate's milkvetch, Cook's lomatium, Gentner's fritillary, Howell's spectacular thelypody, rough popcornflower, Spalding's catchfly, western lily, and Willamette daisy. The Service worked with FHWA/ODOT personnel during the early coordination process to incorporate a Survey and Avoid conservation measure similar to the OTIA III *Species Avoidance - Environmental Performance Standard* (ODOT 2004) that addresses the seven listed plant species. A project site is first evaluated (Project scoping/development, section 2.2 in the PBA) for the potential occurrence of a species based on the presence of suitable habitat or soil types which are known to support listed plants. Project locations will be screened using known habitat or soil types and using existing plant location databases to determine whether a listed plant is potentially in the area. If suitable habitat or soil types are indicated to be present, surveys will be conducted during the appropriate time of year (during the flowering period) to locate the plants. If the plants listed below are present they will be flagged to delineate the site and will be avoided during pre-construction and construction activity (section 2.3.1, 1-9). Pre-construction and construction activities will be monitored to ensure personnel do not alter the hydrology of the site. If plants and their habitat cannot be avoided, FHWA/ODOT will conduct an individual site specific formal consultation for that particular project.

Based on the Survey and Avoid conservation standard, the Service concurs with the FHWA/ODOT determination that the Program "may affect, is not likely to adversely affect" the Applegate's milkvetch, Cook's lomatium, Gentner's fritillary, Howell's spectacular thelypody, Kincaid's lupine, MacFarlane's four-o'clock, Nelson's checkermallow, rough popcornflower, Spalding's catchfly, western lily, and Willamette daisy. If projects cannot avoid impacts to listed plants then it will be addressed in an individual consultation.

3.1 Cook's Lomatium and Willamette daisy Critical Habitat

In the PBA the FHWA/ODOT made a determination that the proposed action "may affect, is not likely to adversely affect" Cook's lomatium and Willamette daisy designated Critical Habitat (CH). Because CH for both species was designated only for known populations (not suitable unoccupied habitat) of these plants and all are mapped and tracked through most plant databases, the Service believes the same rationale as used above for the plants works for CH also because it's occupied and therefore plants would need to be avoided to be covered under this consultation. Based on the Survey and Avoid conservation standard, the Service concurs with the determination of "may affect, is not likely to adversely affect" Cook's lomatium and Willamette daisy designated CH.

4.0 Endangered Species Act Formal Consultation

4.1 Status of the Species: Biological Information and Critical Habitat

This information is contained in Appendix B.

4.2 Environmental Baseline

Regulations implementing section 7 of the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, state, or private actions and other human activities in the action area. The environmental baseline also includes the anticipated impacts of all proposed Federal projects in the action area that have undergone section 7 consultation, and the impacts of state and private actions that are contemporaneous with the consultation in progress. In addition to the statewide and rangewide status of each species described within section 4.1 (Appendix B), a general description of the ecoregional context, habitat types and land management practices that inform the following summary of Environmental Baseline can be found in Appendix C.

4.2.1 Summary of Environmental Baseline

The action area for this consultation is located within the entire state of Oregon—an area too large and variable to describe baseline conditions as a whole. However, based on the summarization and consideration of information in Appendices B and C of this PBO, it is possible to conclude that, generally, not all of the biological requirements of the species and their habitats are being met under the environmental baseline in many of the forests, upland and wet prairies, riparian areas, stream corridors, and watersheds occupied by listed species in Oregon. Improvements in the environmental conditions may be necessary to meet the biological requirements for survival and recovery of many species. Further degradation of these conditions could appreciably reduce the likelihood of survival and recovery of many species.

5.0 Analysis of Effects

The ESA Section 7 implementing regulations (50 CFR 402.02) define "effects of the action" as:

> The direct and indirect effects of an action on the species or critical habitat together with the effects of other activities interrelated or interdependent with that

> action, that will be added to the environmental baseline. The environmental baseline includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 CFR 402.02).

The Service considers the Avoidance, Minimization and Conservation Measures included in Sections 2.1 and 2.2 of this PBO an integral part of the proposed action. By following the proposed action as described in those sections, the vast majority of potential long-term adverse effects to listed species will be avoided, adequately minimized, and offset. Those that cannot be completely avoided will be minimized to the greatest extent practicable or offset by compensatory mitigation actions. The conservation measures will also serve to avoid and minimize potential short-term adverse effects to listed species and maximize potential beneficial effects to listed species. The Service is consulting under the assumption that all pertinent conservation measures will be fully implemented throughout project administration, design, construction, monitoring and reporting from project inception to completion of monitoring and reporting.

5.1 Effects of the Proposed Action

The following analysis addresses the primary pathways through which impacts are likely to be delivered to the species from the work activities associated with STIP projects.

5.1.1 Auditory (Noise) and Visual Harassment

This effects pathway pertains primarily to the listed terrestrial bird species being addressed in this consultation; the marbled murrelet and northern spotted owl. In addition to the information provided in the PBA, this analysis uses information provided in the Service's programmatic Olympic National Forest BO (ONFBO) (USFWS 2003), the Service updated regional guidance on harassment thresholds, and professional interpretation of these information sources. The ONFBO provides a detailed review and summarization of the literature regarding marbled murrelet and northern spotted owl disturbance research.

Bird species and individuals respond to auditory and visual stimuli differently based on life history, behavior, and existing level of exposure, and that there is a gradient of potential outcomes from a stimuli, ranging from not being detected to harassment (i.e., injury) (ONFBO). In this PBO, the Service is using two basic effects definitions for this analysis which are important for quantifying adverse effects to a species: (1) a *disturbance* is any potential auditory or visual stimuli or deviation from ambient/baseline conditions an individual bird, at a given site, is likely to detect and potentially react to; and (2) *harassment*, which is defined [50 CFR §§ 17.3] as "an intentional or negligent act or omission which creates the likelihood of injury by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering." The Service interprets a disturbance response to be something equivalent to showing apparent recognition or avoidance of the sight or sound by hiding, defending itself, moving its wings or body, or postponing a feeding so that the adult still feeds its young the same prey item and is a level less than harassment. In this PBO we are broadening our definition of disturbance somewhat by including what the ONFBO termed the "alert threshold." The Service has interpreted the harassment threshold to be exceeded if an adult is flushed from a nest or aborts a feeding visit such that the young does not receive the prey item or is kept from, or repeatedly flushed from, a nest, winter roost or important foraging area. Ultimately, harassment may lead to reduced productivity or survival due to lower fledging weight, physical injury or death of adult, hatchling or egg, from reduced feeding visits, nest inattentiveness (i.e., exposure or depredation), flushes, and high energy expenditure (ONFBO). Therefore, harassment primarily pertains to the critical nesting period for the spotted owl and marbled murrelet.

Following these definitions, a disturbance is any project generated event that for a wildlife species may rise, at some point (i.e., via peak dBA, frequency, or duration), to the level of harassment. Therefore, this analysis should address the likelihood that potential disturbance associated with project activities will rise to the level of harassment based on the Service's current harassment thresholds and seasonal timing for each species and the ambient/baseline conditions existing along the roadway or adjacent to associated project activities.

A disturbance can be measured in many ways, including, but not limited to: proximity, frequency, duration, and intensity (i.e., peak dBA). Noise and visual stimuli may also be attenuated by topography, vegetation, humidity, and construction methods (i.e., the use of sound dampening or visual screening devices). However, because noise attenuation factors vary greatly (e.g., humidity, topography, and vegetation) and do not work as well for birds nesting high in the canopy, they will not be addressed in detail here. For birds occurring at a specific site, disturbance factors need to be viewed in the context of the existing ambient/baseline conditions. We are not distinguishing between natural and manmade ambient/baseline conditions. An individual nesting near a roadway has likely become habituated to a predictable sight and sound stimulus pattern which are roadway generated as well as natural stimuli. It is likely that because they are predictable, and no harm has come from them in the past, they are not perceived as a threat. An individual nesting in the interior of a forest is often only accustomed to naturally generated stimuli. The introduction of a foreign sight or sound stimulus may elicit a disturbance or harassment response from an individual in this situation because the stimulus was not predictable and thus perceived as a potential threat. The Service also believes that a stimulus, at a site with human activity, which exceeds the baseline proximity, frequency, duration or intensity conditions of that site, may also result in a disturbance or harassment response.

The exception to this general pattern may be for northern spotted owls. Spotted owls are cryptic in appearance and behavior which helps them avoid detection and predation and often display behavior that appears to be naïve to human activity. This is the foundation for much of the research and monitoring used for spotted owls where close approaches by researchers are used to determine nesting and to capture them for banding (Forsman et al. 1984). In fact, often individual spotted owls become more agitated by the visual proximity of researchers shortly after they have been captured and handled (David Leal, USFWS, pers. obs.). The Service does not believe at this time that a visual harassment threshold for spotted owls is warranted.

There have been many observations of habituated individuals of both species nesting in high activity/traffic areas. The FHWA/ODOT proposed action is primarily associated with highways and higher-use roadways. These highways currently experience a wide range of vehicular and non-vehicular traffic levels. Individual birds nesting proximal to these roadways are doing so in the presence of high ambient/baseline noise levels in the 60 dBA to 80 dBA range from vehicles and likely experience other irregular noises such as chain saws, "jake" brakes, and guns exceeding 80 dBA. However, for murrelets the visual harassment threshold is more conservative than the auditory noise thresholds which would typically be applied to construction generated noise, therefore, for this analysis the 300 foot visual threshold will be used for our effects analysis for murrelets.

Based on analyses of available disturbance and harassment data for the marbled murrelet in the ONFBO and internal discussion, the Service has adjusted its position regarding at what distance noise disturbance is likely to rise to the level of harassment. Table 12 gives the distance thresholds for more common types of noise generating activities where the Service believes harassment to nesting murrelets may be likely.

Table 12: Current Service guidance on auditory and visual harassment thresholds for marbled murrelets

Activity	Harassment Threshold Distance
Blasting (greater than 2 lb. charge)	1.0 mi (1.6 km)
Blasting (less than a 2 lb. charge)	360 ft. (110 m)
Effect pile driving, jackhammer, or rock drill	180 ft. (55 m)
Helicopter or single-engine Aircraft	360 ft. (110 m)
Chainsaws	135 ft. (40 m)
Heavy equipment	105 ft. (32 m)
Visual activity	300 ft. (90 m)

All visual and noise producing activities conducted within the above distance threshold of known nest sites or suitable unsurveyed habitat during the critical nesting period of *April 1 to August 5* will be considered to result in adverse effects. Visual and non-blasting noise producing construction activities conducted from *August 6 to September 15* and implementing a daily limited operating period (LOP) of daytime work being conducted from two hours after sunrise to two hours before sunset will be considered to not result in adverse effects.

Based on the information provided in the PBA, approximately seven projects are anticipated to occur within the coastal zone where murrelet nesting occurs (within 40 miles of the coast), and may result in adverse effects. Some of the larger projects may take multiple years to complete but the majority of the Program projects are smaller and many such as paving and bridge restoration projects can be done in one season, and often less than a couple months. Projects in particular where work will be below the Ordinary High Water Mark will be directed to occur during the recommended fisheries In-Water Work Window to avoid impacts to listed fish. This typically falls during the low flow periods which are usually toward the latter part of the critical nesting period (July and early August) or during the late nesting period (August) for murrelets. With the many of the highways and bridges along the coast being along forested habitat and over streams and rivers, it is likely that a small number of projects over the life of this PBO will occur within murrelet habitat. However, the probability of occurrence within the 300 foot visual harassment distance threshold of a nest site or presumed occupied suitable habitat is low based on available nesting abundance and occupancy data[5].

Based on the small number of projects under the Program that will likely have construction activities within the 300-foot visual harassment threshold of suitable nesting habitat, the Service believes that up to five nests (26 acres of habitat) across the range of the murrelet in Oregon will experience harassment from the Program activities over the four years of this consultation.

For spotted owls, table 13 presents the distances at which more common types of noise generating activities are likely to result in harassment to nesting pairs of the species.

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[5] The Service has estimated (USFWS 2006) a total acreage of 1,095,900 acres of suitable murrelet nesting habitat for both inland zones 1 and 2 within the north and south range of Recovery Zone 3, and 4,266 nesting pairs of murrelets (from at sea surveys) in this same region. This is a very general landscape level view which does not address the fact that murrelets may locally nest in higher densities, however, it still illustrates that a very limited number of murrelets are likely to be nesting within the 300 foot radius visual harassment threshold for a given project.

Table 13: Current Service guidance on auditory and visual harassment thresholds for northern spotted owl.

Activity	Harassment Threshold Distance
Blasting (greater than 2 lb. charge)	1.0 mi (1.6 km)
Blasting (less than a 2 lb. charge)	360 ft. (110 m)
Effect pile driving, jackhammer, or rock drill	180 ft. (55 m)
Helicopter or single-engine Aircraft	360 ft. (110 m)
Chainsaws	195 ft. (60 m)
Heavy equipment	105 ft. (32 m)

The majority of STIP projects will be localized and occur in high activity roadway corridors. Construction noise is not expected to be significantly higher (i.e., peak dBA) than existing baseline conditions but visual activity patterns will be different.

The Service does not believe that Program project construction activity will rise to the level of harassment for northern spotted owl based on (1) the high ambient conditions northern spotted owls are typically exposed to along State highways and the owl's tendency to nest away from high activity, (2) the noise level generated by construction equipment with blasting excluded (avoidance and minimization measure, section 2.3.13), (3) the nocturnal behavior of spotted owls, and (4) the relatively narrow harassment distance threshold (roughly 195 feet maximum for construction equipment and chainsaws) presented in table 7.

5.1.2 Vegetation Removal/Alteration

The majority of habitat removal or alteration associated with the Program is related to project area clearing, equipment staging in proximity to construction sites or when creating access for equipment. The temporal and spatial scales of vegetation removal under this proposed action are important factors in evaluating the effects of the action. The temporal nature of vegetation removal is typically related to the age of the vegetation being removed and the time required to restore it (i.e., re-grow the vegetation). Mature trees take longer to be replaced and upland vegetation often takes longer to grow than riparian vegetation. Therefore, while the removal of younger riparian vegetation is considered a relatively temporary effect, the loss of mature conifers suitable for spotted owl or murrelet habitat can functionally be considered a long-term adverse effect equivalent to a loss.

The effects of vegetation removal carried out during site specific STIP Program projects are variable. Mature forests can function as nesting, roosting foraging and dispersal habitat for spotted owls depending on stand size and landscape characteristics, and nesting habitat for murrelets. Removal of suitable habitat may further limit nesting, roosting and foraging opportunities within a territory for owls, and reduce availability nest trees for murrelets (potentially to the point of elimination of nesting due to relative scarcity of suitable nest trees for murrelets across the landscape.) Additionally, removal of younger trees surrounding suitable murrelet nest trees can degrade the quality of nesting stands by eliminating cover for thermoregulation and predation.

In the impacts assessment, FHWA/ODOT have estimated **7** and 22 anticipated Program projects may affect murrelets and spotted owls, respectively, and these project may result in removal of up to 10 acres of spotted owl habitat with no anticipated loss of murrelet habitat. The owl habitat removed will most likely function as foraging, dispersal and potentially roosting habitat since nesting is unlikely along high-activity roadways and highways.

While the amount of habitat likely to be removed is relatively small (across the range of the owl in Oregon), such incremental loss of habitat may result in a reduced ability of areas within and proximal to projects to support occupancy or successful nesting of territorial owls, or to support dispersal or longer-term support of nonterritorial owls. In order to minimize the significance of this unavoidable potential remaining impact, FHWA/ODOT will permanently protect ~87-acres of existing suitable habitat and other forest at a specific site along the lower Umpqua River, as described in section 2.2 of this PBO.

Upland prairie, and to a lesser degree wet prairie habitat may provide nectaring and larval foraging habitat for Fender's blue butterflies. These habitats often grow in roadway Rights-of-Way (ROW) partly due to ODOT management keeping exotic and native woody vegetation mowed, thus eliminating competition and succession that would shade out listed and other desirable nectaring and larval foraging species. New projects or ones in which the net result is highway widening (i.e., widening, modernization or safety) have the potential to remove these habitats.

In addition to removal which might result from construction activities, subsequent restoration efforts can have long-term adverse effects if not done properly. Restoring the site or staging area with exotic grasses, introducing noxious weeds, or top dressing with foreign substrate can lead to long-term habitat loss for native plant species dependent on specific environmental conditions.

The FHWA/ODOT's impact assessment for Fender's blue butterfly, Bradshaw's lomatium, Kincaid's lupine and Nelson's checkermallow habitat loss and impacts is presented in table 16.

Table 16. FHWA/ODOT estimated number of plants to be impacted from projects under the 2012 to 2015 Program (FHWA/ODOT 2011).

Species	Projects	Number of Plants	Impacts to Designated Critical Habitat
Fender's blue butterfly	2	N/A	0.5 acres (includes ~0.2-acres of Kincaid's lupine habitat, below)
Kincaid's lupine	2	125 larval host plants/0.196 acres habitat	0.5 acres (same acreage as above)
Bradshaw's lomatium	2	50	N/A
Nelson's checkermallow	2	50	N/A

FHWA/ODOT estimated two projects each based on the projects currently proposed for the PROGM. Projects on the STIP may change but the currently proposed projects should work as a reasonable indicator of what may occur. Of the habitat that is anticipated to be removed, up to 125 larval host plants including approximately 0.2 acres of adult nectaring habitat (which is contained within 0.5 acres designated as critical habitat) are anticipated to be lost. This impact is expected to occur in critical habitat unit FBB-11 in the Eugene area. This is a large critical habitat unit made up of several patches of nectaring and lupines which function primarily as stepping stone habitat between larger populations of butterflies. The function of the critical habitat unit will not be significantly degraded if 0.5 acres of habitat is removed from the total 244 acres of habitat. In addition FHWA/ODOT will offset any habitat losses as described in section 2.2 of this PBO, which will entail protection or restoration of 1.5-3.0 acres of habitat, and opportunities for such offsets are available within the unit. Again, these estimates of plants impacted are likely overestimates, and minimization and mitigation measures in the proposed action are sufficient to offset these small habitat losses.

Extremely small amounts of habitat for Bradshaw's lomatium and Nelson's checkermallow will be removed or degraded by projects under the STIP. These impacts are assumed to total no more than 0.1 acres of habitat and 50 individuals of each species, and will be offset via habitat protection or restoration measures as described in section 2.2 of this PBO.

For fish, loss of vegetation cover has the potential to adversely affect species by resulting in increased water temperatures, increased susceptibility to erosion, and reduced opportunity for recruitment of large woody debris (LWD). Large woody debris in channels creates complexity and provides refuge habitat for fish, as well as habitat for macroinvertebrates.

In the PBA, FHWA/ODOT conducted an impacts analysis to estimate the number of Program projects that may affect the listed fish in this consultation. Table 14 summarizes the FHWA/ODOT impacts assessment for the proposed Program. These impact acreages were acknowledged to be conservative estimates due partly to an assumption that the projects would all adversely affect listed fish. However, the reality is that these projects will be a mix of "not likely to adversely affect" and "likely to adversely affect" actions. Based on this and the Service's experience with a limited number of prior formal consultations on individual transportation projects that resulted in habitat removal, we believe most of these impact estimates are significant overestimates. They have been revised by the Service as presented in table 15.

Table 14. FHWA/ODOT anticipated impacts from potential Program projects (FHWA/ODOT 2011).

Species	Projects	Habitat (acres)	Trees (n)
Bull trout (Columbia)	35	111.60	2342
Bull trout (Klamath)	4	11	213
Lost River sucker	5	11.69	238
Short-nosed sucker	5	11.69	238
Oregon chub	7	24.51	323

* Contributing Impervious Area is for determining the impacts of stormwater runoff from projects on aquatic species.

Table 15. The Service's refined habitat loss estimates based on the FHWA/ODOT impacts analysis database and projected 2012 to 2015 Program projects.

Species	Number of Projects that Potentially Impact	Habitat Impacted	Total Habitat Impacted (x2 to account for project uncertainty)
Bull trout (Columbia)	11	8 acres	16 acres
Bull trout (Klamath)	1	2 acres	4 acres
Lost River & short-nosed suckers	2	2 acres	4 acres
Oregon chub	3	2 acres	4 acres

The impacts described above for fish, plant, butterflies, northern spotted owls and marbled murrelets will occur over a four year period across Oregon, thus spreading the adverse effects of vegetation removal over that time frame and across watersheds. On the scale of individual projects, vegetation removal is not expected to be a major effect. Some actions may occur in relative proximity to each other for construction efficiency based on ages and type of bridges being repaired or replaced or multiple urgency actions in a given system following a high water event.

5.1.3 Increased Erosion, Turbidity, Sediment Transport, and Chemical Exposure

This effects pathway pertains primarily to listed fish species addressed in this consultation.

The effects of suspended sediments may result in sub-lethal or lethal direct effects, and are generally correlated to the concentration of sediment within the water column. Fish death can be a result of a combination of factors, and thus is difficult to attribute to suspended sediment alone (Waters 1995). Substrate embeddedness has also been shown to affect aquatic macroinvertebrate abundance and species composition, thus altering the availability and suitability of a critical food source. Lastly, soils can act as a delivery mechanism for transferring chemical pollutants from upland sources.

Use of heavy equipment creates a risk that accidental spills of fuel, lubricants, hydraulic fluid, and similar contaminants may occur. Discharge of construction water used for vehicle washing, concrete washout, pumping for work area isolation, and other purposes can carry sediments and a variety of contaminants to the riparian area and stream. Stripping and prep work of existing infrastructure can also lead to contaminant entering waterways, especially lead or other toxic metals. Chemical exposure can alter fecundity, increase disease, shift biotic communities, and reduce the overall health of aquatic species. If contamination levels are high enough, direct lethal effects are possible through the disruption of biological processes. The introduction of chemicals can be acute, occurring as a result of an accidental spill or equipment and containment leaks during construction activities, or chronic, resulting from increased stormwater runoff to waterways. The potential for adverse effects of chemical exposure may be sub-lethal or lethal, and are generally correlated to the concentration of chemical contaminants within the species aquatic or terrestrial environment.

Stormwater is another water quality issue that can affect fish. Stormwater runoff from highway systems can deliver a variety of chemical and sediment pollutants to streams from rain (NMFS 2008).

Research has shown that dissolved copper and other metals found in stormwater runoff from roadways (derived from the copper in vehicle brake pads) can impair salmonid olfactory senses (Brooks 2004). Accordingly, it is likely that bull trout would be adversely impacted by water quality changes due to stormwater runoff, spills, other contaminant events and increased turbidity. However, most of the waterways potentially impacted by STIP projects will occur in migratory habitats in which bull trout spend little time, thus limiting their likely exposure. Most bull trout spawning and rearing habitat occurs higher in the river system than the vast majority of highways and roadways likely to be subject to work activity under the STIP. Less is known about how water quality affects Oregon chub. However, because chub habitat is typically off channel and isolated with much slower rates of water exchange, contaminant and turbidity events would be expected to persist longer and result in more exposure to chub than to bull trout. Water quality in the Klamath Basin for suckers is already a limiting factor for the species, particularly during the summer and, therefore, potential contaminant or turbidity events could substantially impact those species.

However, due to the avoidance and minimization measures for Erosion, Sedimentation, Pollution Control and Stormwater Management that will be employed for STIP projects, the likelihood, frequency and scale of contamination or turbidity events will be substantially constrained. Events that do occur are expected to be very small-scale and short-term in nature. Effects will not flow substantially downstream from event sites. Accordingly, the Service does not expect any lethal effects from increased erosion, turbidity, sediment transport, and chemical exposure to listed aquatic species, and does not expect fish passage to be blocked. However, some adverse effects in the form of delays in migration and possibly degraded fish health due to temporary, localized lower water quality are possible.

The minimal nature and likelihood of adverse effects at any individual project site, and the fact that any such effects that do occur will be distributed across Oregon and over a four year period mean that impacts to local and watershed level fish populations should be discountable and insignificant.

5.1.4 Pile Driving (Hydroacoustics)

The FHWA/ODOT have proposed activities which will require the installation of permanent and temporary piles which will expose fish to high levels of underwater sound during pile driving. (Total suspended sediment can also increase with pile removal; the effects of turbidity, sedimentation and chemical release are discussed above). Although there is limited information regarding the effects on wild fish from underwater sound pressure waves generated during piling installation (Anderson and Reyff 2006, Laughlin 2006), laboratory research on the effects of sound on fish has used a variety of species and sounds (Popper and Clarke 1976, Hastings *et al.* 1996, Scholik and Yan 2002). It is also well established that elevated sound pressure can cause injuries to fish swim bladders and internal organs[6]. However, because those data are not reported in a consistent manner and most studies did not examine the type of sound specifically generated by pile driving, it is difficult to directly apply the results of those studies to pile driving effects on bull trout, Oregon chub, Lost River and short-nosed suckers. And, the degree to which normal behavior patterns are altered is less known or studied.

The degree to which an individual fish exposed to underwater sound will be affected (from startle response to mortality) is dependent on a number of variables such as species of fish, size of the fish, presence of a swimbladder, sound pressure intensity and frequency, shape of the sound wave (rise time), depth of the water around the pile and the

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[6] The Department of the Navy conducted a series of experiments to determine the effects on fish from underwater explosions (Goertner *et al.* 1994, Gaspin 1975) which resulted in significant differences in effects to fish depending on whether or not they had swimbladders. Research indicates it's likely the inflated swimbladder rapidly expanding as the sound pressure wave passes through the fish which causes the injuries to internal organs (Keevin and Hempen 1997). Also CalTrans 2001 and Abbott and Bing-Sawyer 2002.

bottom substrate composition and texture. However, based on available data, it is assumed that the installation and removal of piling with a vibratory or impact hammer has the potential to result in adverse effects to bull trout, Oregon chub, Lost River and short-nosed suckers due to high levels of underwater sound pressure.

FHWA/ODOT propose, per current pile driving best practices, to use a confined bubble curtain on each project to help attenuate sound pressure waves associated with pile driving. The 32-inch (or less) temporary piles will be driven in the wetted channel. Any piles driven in the channel will be within a confined bubble curtain. Air bubbles can reduce sound pressure levels (SPLs) at some frequencies by as much as 30 dB (Gisiner *et al.* 1998) and bubble curtains have been demonstrated to reduce the mortality of caged shiner surfperch (Caltrans 2001). Bubble curtains can also reduce particle velocity levels (MacGillivray and Racca 2005).

Up to 12 STIP projects are expected to require pile driving in waters used by bull trout. Most will occur in migratory and foraging habitat rather than spawning and rearing habitat. Few bull trout are expected to use these lower elevation foraging and migratory habitats in the mid to late summer in-water work period. The likelihood of an adult bull trout being within an area where pile driving is occurring is therefore low. In addition, the use of bubble curtains will reduce the sound pressure to varying degrees depending on stream variables such as water depth and substrate. All of these factors result in a low but unquantifiable likelihood of mortality of bull trout from pile driving under the STIP. It is possibly more likely that there could be delayed migration of a very small number of adult bull trout if fish moving upstream encounter pile driving activities. The length of time a bull trout delays its migration will depend on the amount and daily and overall duration of pile driving activities.

Up to 3 STIP projects are expected to require pile driving in waters potentially used by Oregon chub. These fish are resident in off-channel river habitat, with localized, concentrated populations. Up to 3 STIP projects are also expected to require pile driving in waters potentially used by Lost River and short-nosed suckers, which are resident fish in the Klamath Basin. If pile driving is conducted in occupied habitat (for chub) or in occupied spawning habitat or suitable nearshore lake habitat (for suckers), the risk of mortality and significant impacts to local populations are much greater than for wide-ranging and migratory fish such as bull trout. For each of these 3 species, use of bubble curtains will reduce the sound pressure, and therefore reduce potential for adverse impacts. While the potential for mortality cannot be completely discounted in light of the minimization measures, neither is it quantifiable based on available information.

5.1.5 In-water Work and Fish Capture and Release

Some STIP project work activities will require in-water work. Activities occurring in-water can result in juvenile and resident fish (that may be rearing in the vicinity of the action area) being displaced or killed, migrating adults being delayed, injured or killed, and downstream or upstream passage being temporarily blocked. In addition, use of heavy equipment instream may compact and disturb stream bed gravels. Compaction and disturbance of stream bed gravels may increase the difficulty of redd excavation and the ability of the gravels to be aerated, thereby reducing egg to fry survival.

The potential for these impacts will be minimized by isolation of the work area and limiting in-water activities to the recommended In-Water Work Window (IWWW), as well as other avoidance and minimization measures. One of the most important of these other measures is the requirement to capture and relocate fish that do become contained within in-water work isolation areas. Captured fish will be removed to safer areas not subject to work activities. However, this important impact minimization measure can itself result in sub-lethal and lethal affects to listed fish species. In fact, fish capture and relocation is reasonably certain to result in some take from handling stress and injury, including immediate or delayed mortality. However, the areas where this action will occur will be very localized to the immediate project isolation areas and the action will occur in each area for very short-terms (days/weeks) and, as a result, the number of individual fish likely to actually be subject to this action (and therefore subject to take) is very small. The associated take will likely be minimized relative to the adverse impacts that would potentially occur without fish capture and relocation from the isolated work areas.

As an example of the low potential for individual fish to actually be subject to take from these actions-- no individual bull trout, Oregon chub, short-nosed and Lost River suckers have been captured during in-water work isolation in approximately seven years of bridge replacements and repairs for the OTIA III Statewide Bridge Replacement Program. Since only a small percentage of STIP projects are expected to occur in portions of in rivers and lakes used by rearing or resident fish of these species during the IWWWs, that same pattern of impacts is likely to occur.

However, some fish capture/handling and associated take cannot be ruled-out. Accordingly, handling and lethal take, including delayed mortality from stress and injury, from fish capture and release is assumed to conform to the following:

1. FHWA/ODOT may capture and release up to 5 bull trout, 20 Oregon chub, 20 Lost River sucker and 20 short-nosed sucker. This is a conservative estimate based on the low probability of these species in an area requiring in-water work (and ODOTs estimation of bridge repair and replacement projects over the four year life of the PBO) but provides for the ability to move a small number of fish if necessary.

2. For ESA-listed bull trout, Oregon chub, Lost River and short-nosed suckers, to be captured and handled, 95 percent or more are expected to survive with no long-term effects, and five percent are expected to be injured or killed (including those that die later as a result of injury). This would result in up to 1 bull trout, 2 Oregon chub, 2 Lost River, and 2 short-nosed suckers each to be lethally taken over the four year life of the PBO.

The Service expects any lethal effect from in-water work and fish capture and release to listed aquatic species will be limited to only those individuals for which lethal mortality is unavoidable during work area isolation and fish capture and removal efforts. In addition, the Service anticipates sub-lethal effects, direct or indirect, from in-water work, and fish capture and release to listed species will be low.

5.2 Effects of the Proposed Action on Critical Habitat

The Service designates critical habitat based on physical and biological features that are essential to the listed species. Essential features of fish species designated critical habitat include substrate, water quality, water quantity, water temperature, food, riparian vegetation, access, water velocity, space and safe passage. Critical habitat for listed anadromous ESUs consists of all waterways below naturally-impassable barriers including the project area. The adjacent riparian zone is also included in the designation. This zone is defined as the area that provides the following functions: shade, sediment, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter.

Because regulated terrestrial and aquatic species can vary so widely taxonomically (i.e., butterflies, birds, plants and fish) it is difficult to list similar features of designated critical habitat that apply across taxon. However, the primary constituent elements (PCEs) of each Service regulated species' designated or proposed critical habitat is discussed in section 4.1. More recently published critical habitat designations contain more detailed descriptions of the PCEs and conservation and recovery objectives of the specific elements.

5.2.1 Summary of Effects to Critical Habitat for Aquatic Species

Information presented in the status and baseline sections of this PBO show that conditions for spawning, rearing, and migration are degraded from historical conditions. Within the action area there will be short-term adverse effects including temporary disturbances to water quality and temporary increases in sediment from construction activities. Short-term effects of streambank habitat modification, sedimentation, and water quality impacts are expected to be insignificant at the critical habitat unit scale due to the expected short duration of construction activities, the limited amount of in-water and stream bank work and the use of avoidance, minimization and conservation measures. These effects will occur at a low level for a short duration and therefore will be minimally significant to the conservation function and value of bull trout, Oregon chub designated CH and proposed CH for the Lost River and short-nosed suckers.

5.2.2 Summary of Effects to Terrestrial Species Critical Habitat

As described in the proposed action and reviewed in the effects analysis section, effects from the Program projects will be relatively small and primarily scattered across western Oregon. Because the individual projects are typically small and dispersed across the landscape, the effects of vegetation removal for most species are expected to be minor and not have a significant adverse effect on the function of a given critical habitat unit. One specific project potentially implemented under STIP might impact up to 0.5 acres of designated critical habitat for the Fender's blue butterfly near Eugene. The affected critical habitat unit is a complex of stepping stone habitats totaling approximately 244 acres. The portions of the unit along the highway (those most likely to be affected by the project) are not likely to represent the highest quality habitat and potential impacts will be mitigated on site or at another nearby site within the recovery unit, via 1.5-3.0 acres of habitat per the provisions of section 2.2 of this PBO. The small amount of habitat lost (0.5 acres) is not likely to alter the function of the critical habitat unit as stepping stone habitat between populations, and any biological significance that might be associated with this impact is likely to be further reduced through subsequent mitigation. Based on these facts and previous history of these types of projects and impacts, the Service does not expect the STIP program to appreciably affect the function of critical habitat units on population size and distribution, species dispersal, conservation, or recovery.

5.3 Cumulative Effects

Cumulative effects are defined in 50 CFR 402.02 as "those effects of future State or private activities, not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation." The Service is currently working on a Habitat Conservation Plan with ODOT to address routine road maintenance along Oregon's State highways this HCP will address a small amount of take and adverse effects (plants) to some of the same species addressed in this consultation. Again the amount is small and mitigation within the HCP will more than offset any impacts to conservation and recovery of the species. The Service is not aware of any specific future non-federal activities within the action area that would cause greater effects to listed species than presently occurs. Because this program is statewide, the action area includes significant tracts of private and state lands. Land use on non-federal lands includes urban and rural development, agricultural use, commercial forestry and many other uses. The Service generally does not consider existing rules governing timber harvests, agricultural practices, and rural development on non-federal lands within Oregon to be sufficiently protective of watershed, riparian, prairie and stream habitat functions to support the survival and recovery of listed species. Therefore, habitat functions for listed species are generally at risk as a result of future activities on non-federal lands within the state.

Non-federal activities within the action area are expected to increase due to a projected 34 percent increase in human population by the year 2024 in Oregon (ODAS 1999). Thus, The Service assumes that future private and state actions will continue within the action area, increasing as population density rises, particularly in the Willamette Valley (FHWA/ODOT 2011)

5.4 Summary of Effects and Conclusion

After reviewing the current status of the marbled murrelet, northern spotted owl, bull trout, Oregon chub, Lost River sucker, short-nosed sucker, Fender's blue butterfly, Bradshaw's lomatium, Kincaid's lupine, and Nelson's checkermallow, the environmental baseline for the action area, the effects of the proposed action and cumulative effects, the Service has determined that the Program is may result in the following impacts:

Species	Acres Removed or Degraded	Critical Habitat Acres Removed or Degraded	Individuals Harmed or Harassed	Number of Projects Resulting in Impacts
Northern Spotted Owl	10 acres	0	0	22
Marbled Murrelet	0	0	Birds associated with up to 5 nests associated with 26 acres (not to the level of mortality)	7
Bull Trout	16 acres (Columbia) 4 acres (Klamath)	Per previous column Per previous column	5 (including 1 mortality)	11-22 1-2
Oregon Chub	4 acres	Per previous column	20 (including 2 mortalities)	3-6
Lost River Sucker and Short-nosed Sucker	4 acres	Per previous column	20 of each species, including 2 mortalities of each species)	2-4
Fender's Blue Butterfly	0.2 acres	0.5 acres (inclusive of previous column)	N/A	2
Kinkaid's Lupine	Same as for FBB	Same as for FBB	125	Same as for FBB
Bradshaw's Lomatium	0.1 acre	N/A	50	2
Nelson's Checkermallow	0.1 acre	N/A	50	2

The Service has determined that the nature, scale and scope of the above impacts will not appreciably reduce the size, distribution or productivity of populations of any of the affected species; the project will not jeopardize the continued existence of these species or adversely modify designated or proposed critical habitat. These conclusions were reached for the following reasons:

Marbled Murrelet

1. The anticipated impacts will affect a small handful of murrelet nest sites in dispersed locations over a four year period. The impacts will occur in the form of disturbances which are likely to be of very short duration in any given location, and occur relatively late in the nesting period when individuals of the species should be less vulnerable to such disturbances. This represents a very limited number of potentially affected individuals and locations, and a low likelihood that impacts they experience will significantly impair their function and survival.

Northern spotted owl

1. The anticipated impacts will affect a very small amount of suitable northern spotted owl habitat in dispersed locations. As such, there is not a high likelihood that the amount of habitat available within any given owl territory or occupied location will be reduced to an extent that limits ability to support occupancy. Cumulatively, this amount and distribution represents a minor portion of the existing habitat within each province and across the landscape overall, making it unlikely that landscape level habitat availability or connectivity will be substantially altered.

2. Affected habitat occurs near or within major highway corridors and therefore does not likely support roosting or nesting, and supports minimal foraging. Therefore, the critical life functions of individual owls associated with the affected habitat are not likely to be substantially reduced.

3. The significance of any adverse effects that might nonetheless arise from the loss of small amounts of low quality, geographically dispersed habitat will be minimized via the permanent protection of ~87-acres of existing suitable habitat. This replacement habitat should be more valuable (than the removed habitat) to the species due to its higher quality, contiguous distribution, and larger acreage[7].

Bull trout

1. The amount of habitat affected is relatively small and represents a very minor portion of the existing habitat within the range of the species. It will be dispersed across multiple locations, stream reaches and populations, and temporally such that no individual population center will be subject to losses that alter site-specific productivity or viability.

2. Most of the affected habitat is likely to be already degraded and incapable of supporting critical rearing functions; it will largely consist of more widely available migratory and foraging habitat.

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[7] The proportion of this protection action undertaken specifically for STIP projects will result in an approximately 3.5:1 habitat replacement ratio.

3. Riparian habitats removed during construction will be restored on site.

4. The number of individuals of the species likely to be directly harmed (as a result of work area isolation and fish handling/relocation) is very small, and only 1 individual is expected to be harmed to the point of mortality.

Oregon chub

1. The amount of habitat affected is relatively small and represents a very minor portion of the existing habitat within the range of the species. It will be dispersed across multiple locations, stream reaches and populations, and temporally such that no individual population center will be subject to losses that alter site-specific productivity or viability.

2. Riparian habitats removed during construction will be restored on site.

3. The number of individuals of the species likely to be directly harmed (as a result of work area isolation and fish handling/relocation) is very small, and only 2 individuals are expected to be harmed to the point of mortality.

Lost River and short-nosed suckers

1. The amount of habitat affected is relatively small and represents a very minor portion of the existing habitat within the range of the species. It will be dispersed across multiple locations, stream or lake reaches and populations, and temporally such that no individual population center will be subject to losses that alter site-specific productivity or viability.

2. Riparian habitats removed during construction will be restored on site.

3. The number of individuals of each species likely to be directly harmed (as a result of work area isolation and fish handling/relocation) is very small, and only 2 individuals of each species are expected to be harmed to the point of mortality.

Fender's blue butterfly

1. The amount of habitat affected is relatively small and represents a minor portion of the existing habitat within the range of the species. While much of the impacted habitat will occur in a relatively localized area and single critical habitat unit, it still represents an extremely small percentage of habitat in that local area. Moreover, the affected habitat occurs along the highway and is not likely to represent the highest quality habitat in that area.

2. The amount and distribution of impacts are not such that the size and viability of any population centers, contiguous habitat patches, or connectivity between these

populations and habitat patches are likely to be significantly reduced by the proposed action.

3. The removed habitat will be offset via the protection or restoration of greater amounts of habitat on-site or nearby, thereby potentially replacing any biological functions associated with the above impacts.

Kincaid's lupine

1. The amount of habitat and number of individuals affected are relatively small and represent a minor portion of the existing habitat and plants within the range of the species. While much of the impacted habitat will occur in a relatively localized area and single critical habitat unit, it still represents an extremely small percentage of habitat in that local area. Moreover, the affected habitat occurs along the highway and is not likely to represent the highest quality habitat in that area.

2. The amount and distribution of impacts are not such that the size and viability of any population centers, contiguous habitat patches, or connectivity between these populations and habitat patches are likely to be significantly reduced by the proposed action.

3. The removed habitat will be offset via the protection or restoration of greater amounts of habitat on-site or nearby, thereby potentially replacing any biological functions associated with the above impacts.

Bradshaw's lomatium

1. The amount of habitat and number of individuals affected are relatively small and represents a minor portion of the existing habitat and plants within the range of the species.

2. The amount and distribution of impacts are not such that the size and viability of any population centers, contiguous habitat patches, or connectivity between these populations and habitat patches are likely to be significantly reduced by the proposed action.

3. The removed habitat will be offset via the protection or restoration of greater amounts of habitat on-site or nearby, thereby potentially replacing any biological functions associated with the above impacts.

Nelson's checkermallow

1. The amount of habitat and number of individuals affected are relatively small and represents a minor portion of the existing habitat and plants within the range of the species.

2. The amount and distribution of impacts are not such that the size and viability of any population centers, contiguous habitat patches, or connectivity between these populations and habitat patches are likely to be significantly reduced by the proposed action.

3. The removed habitat will be offset via the protection or restoration of greater amounts of habitat on-site or nearby, thereby potentially replacing any biological functions associated with the above impacts.

6.0 Reinitiation of Consultation

To the extent the FHWA/ODOT retains discretionary involvement or control over this action as described in 50 CFR 402.16, the FHWA/ODOT must reinitiate consultation if: 1) The action is modified in a way that causes an effect on the listed species that was not previously considered in this PBO; 2) new information or project monitoring reveals effects of the action that may affect the listed species in a way not previously considered; 3) a new species is listed or critical habitat is designated that may be affected by the action; or 4) if the amount or extent of incidental take is exceeded (50 CFR 402.16).

If FHWA/ODOT's, or any agent's thereof, exercise of the Program is likely to result in or has resulted in effects on listed species and critical habitat that are not consistent with those described in this PBO, if FHWA/ODOT does not ensure the proposed action (Section 2) is administered as proposed, or if FHWA/ODOT does not provide the information described in the Incidental Take Statement (Section 7) by the dates specified in the proposed action and terms and conditions of this PBO, or if incidental take is exceeded, the Services may consider any of those circumstances to be a modification of the action that causes an effect on listed species not previously considered, potentially resulting in the need to reinitiate consultation.

7.0 Incidental Take Statement

The ESA section 9 [16 USC 1538] prohibits take of endangered species. The prohibition of take is extended to threatened species by section 4(d) rule [50 CFR 223.203]. Take is defined by the statute as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." [16 USC 1532(19)] Harm is further defined by regulation as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavior patterns, including, breeding, spawning, rearing, migrating, feeding or sheltering." [50 CFR 222.102] Harass is defined as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering." [50 CFR 17.3] Incidental take is defined as "takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant." [50 CFR 402.02] The ESA at Section 7(o) (2) removes the prohibition from any incidental taking that is in compliance with the terms and conditions specified in a Section 7(b)(4) incidental take statement [16 USC 1536].

7.1 Amount and Extent of the Take

The Services anticipate that activities associated with the proposed action are reasonably certain to result in incidental take of marbled murrelet, northern spotted owl, Oregon chub, bull trout (Columbia River DPS and Klamath Basin DPS), and Fender's blue butterfly due to the effects described in section 5.0 of this PBO. The proposed avoidance, minimization and conservation measures as detailed in Section 2.0 will minimize these potential effects. The Service regards these avoidance, minimization and conservation measures as integral components of this take statement and consider them to be part of the action. The Service assumes avoidance, minimization and conservation measures will be applied to all projects administered under the STIP, both by FHWA/ODOT and by all contractors and other third-parties responsible for project delivery.

The Service anticipates incidental take to occur through harassment, harm, and lethal mortality as specified in section 5.4 of the PBO. In that section of the PBO, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species or adverse modification of designated critical habitat. The amount, nature, and sources of take are limited to those described in the PBO.

8.0 Reasonable and Prudent Measures

The Services believe that the following reasonable and prudent measures are necessary and appropriate to avoid or minimize take of listed species resulting from the action covered by this Opinion. In order to monitor the impacts of incidental take, the Federal agency or any applicant must report the progress of the action and its impact on the species to the Services as specified in the incidental take statement. The reporting requirements are established in accordance with 50 CFR 13.45 and 18.27 for USFWS and 50 CFR 220.45 and 228.5 for NOAA Fisheries.

The FHWA/ODOT shall:

1. Ensure completion of a comprehensive monitoring and reporting program regarding all actions authorized or completed using the Program PBO.

2. Implement STIP projects as described in section 2.0 of the PBO.

3. Survey for Oregon chub in suitable habitat and avoid hydroacoustic effects.

4. Avoid pile driving in Lost River and short-nosed sucker spawning habitat when adults, eggs and fry are present. Follow standard hydroacoustic minimization measures at other times.

8.1 Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the FHWA/ODOT and/or their contractors must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. To implement reasonable and prudent measure #1 (ensure completion of a comprehensive monitoring and reporting program), the FHWA/ODOT shall ensure that:

   The FHWA/ODOT will submit a monitoring report to the Service annually that describes the FHWA/ODOT's efforts to carry out this PBO. The report will include an assessment of overall program activity including projects being monitored from previous years Program projects, a map showing the location and type of each action authorized and carried out under this PBO, a summary of habitat impacts within each project area reported in acres, the associated restoration or mitigation, numbers of fish salvaged during the previous year, and any other data or analyses the FHWA/ODOT deems necessary or helpful to assess habitat trends as a result of actions authorized under this PBO. Monitoring reports will be submitted to:

   Oregon Fish and Wildlife Office
   2600 SE 98th Ave, Suite 100
   Portland, OR 97266

   If a dead, injured, or sick listed species is located, initial notification must be made to the nearest Service Law Enforcement Office, located at 9025 SW Hillman Court, Suite 3134, Wilsonville, OR 97070; phone: 503-682-6131. Care should be taken in handling sick or injured specimens to ensure effective treatment or the handling of dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered and threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

2. To implement reasonable and prudent measure #2 (implement STIP projects as described in section 2.0 of the PBO), the FHWA/ODOT shall ensure that measures described in sections 2.1 and 2.2 of the PBO are applied to all projects, as applicable.

3. To implement reasonable and prudent measure #3 (Survey for Oregon chub in suitable habitat and avoid hydroacoustic effects), the FHWA/ODOT shall ensure that:

   a. Projects needing pile driving for detour or work bridges that are in and around suitable off channel chub habitat will first conduct surveys to determine chub presence or absence.

b. If a local chub population is known or located, piles will not be driven with an impact hammer. Piles driven with vibratory hammer or other method of pile placement that does not cause hydroacoustic impacts may be used.

4. To implement reasonable and prudent measure #4 (Avoid pile driving in Lost River and short-nosed sucker spawning habitat when adults, eggs and fry are present), the FHWA/ODOT shall ensure that:

    a. Projects needing pile driving for detour or work bridges that are in and around suitable Lost River or short-nosed sucker spawning habitat will avoid pile driving from 15 February to July 15.

9.0 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purpose of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service has no conservation recommendations.

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APPENDIX A: AVOIDANCE AND MINIMIZATION MEASURES (section 2.1 of PBO)

(Numbering below references sections of the PBA.)

2.3.1 General Heavy Construction

Most transportation projects require the use of heavy equipment, (e.g., bull dozers, cranes, front-end loader, flatbed and large pick-up trucks). The equipment is typically much larger, heavier, and louder than standard traffic. Although a fairly minor construction activity, guardrail replacement is included in this section because posts may need to be installed with impact pile drivers.

While more specific activities involving heavy equipment are described in their corresponding sections, this section addresses general habitat disturbance and increased noise and activity levels at construction sites. ODOT's scoping process and standard specifications are well developed for minimizing water, air, and noise pollution for human receptors, but Environmental staff may need to increase coordination during project development to minimize physical and noise disturbance to listed species, particularly plants and birds.

Avoidance and Minimization Measures:
The following measures will be implemented on all projects performed under this Programmatic, during design or in Contract Special Provisions:

1-1. Conduct periodic environmental inspections, as needed to observe construction activities that "May Affect" listed species and critical habitat.

1-2. Select and operate heavy equipment as necessary to minimize adverse effects on the environment (e.g., minimally-sized, low pressure tires, minimal hard turn paths for tracked vehicles, temporary mats or plates within wet areas or sensitive soil, etc.).

1-3. Complete all work within the active channel of aquatic habitat supporting listed species in accordance with the Oregon Guidelines for timing of in-water work to protect fish and wildlife resources (ODFW 2008) except:
   - i Do not conduct in-water work from the mouth of the Willamette River to Willamette Falls during the winter in-water work period (December 1 to January 31).
   - ii Hydraulic, topographic measurements and encased geotechnical drilling may be completed at any time, if a fish biologist determines that the affected area is not occupied by adult fish congregating for spawning or in an area where redds are occupied by eggs or pre-emergent alevins.
   - iii Other exceptions/modifications require regulatory approval (see Section 2.6; 3.2 PBA).

1-4. Except as allowed temporarily during in-water work area isolation (see Section 2.3.9, Measure 9-4), provide safe passage around or through the isolated work area for adult and juvenile migratory fish unless passage did not previously exist.

1-5. For all projects that affect fish passage (listed species), design structures to provide adult and juvenile passage that meets both ODFW fish passage standards (ODFW 2011) and NMFS' fish passage criteria (NMFS 2008c), or most up to date versions, for the life of the structure. This may be modified as long as it meets Program Goals as per Section 1.5, and provides access for spawning and migration of listed species; requires regulatory approval (see Section 2.6; 3.2 PBA).

1-6. If a project cannot provide fish passage as per 1-5, offset the functional equivalent, (see PBA Glossary, Appendix A) of the fish passage, following the ODFW fish passage exemption or waiver process, with NMFS or USFWS review/approval. Generally, the standard is removal of a similar fish passage barrier in the same subbasin, although alternatives may be proposed/negotiated (see Administration, Section 2.5; 3.2 PBA).

1-7. Do not allow equipment to cross directly through aquatic habitat supporting listed species for temporary construction access, unless shown on project plans or approved by the Construction Manager, and only under the following conditions:

i. A fisheries biologist must survey the proposed crossing for presence of sensitive aquatic resources.
ii. ODOT will allow stream crossings if proposed crossing will not interfere with spawning behavior, eggs, or pre-emergent juveniles in an occupied redd, or native submerged aquatic vegetation as confirmed by a fish biologist.
iii. If the crossing is a ford, it must be located and designed to provide for foreseeable risks, such as flooding and associated bed load and debris, to prevent the diversion of stream flow out of the channel down the road if the crossing fails.
iv. If vehicles and machinery must cross riparian areas and streams, utilize the shortest crossing possible.
v. If warranted and feasible, use temporary mats or plates.
vi. When a crossing is no longer needed, block the area from future incidental access, obliterate the route, and restore the soils and vegetation (see Site Restoration, Section 2.3.24).

1-8. If water is required for construction, divert streamflow only if water from developed sources (e.g., municipal supplies, ponds, reservoirs, or tank trucks) is unavailable or inadequate, the diversion will not exceed 10 percent of the available flow at any given time. For streams with less than 5 cubic feet per second (cfs), drafting will not exceed 0.03 cfs (18,000 gallons per day). In-takes will be screened and maintained as follows:

i. Clean and repair water intake screening to maintain adequate flow and protection of aquatic life.
ii. Provide ditch screens with a bypass system to transport fish safely and rapidly back to the stream.
iii. When drawing or pumping water from any stream, protect fish by equipping intakes with screens having a minimum 27 percent open area and meeting the following requirements:
   - Perforated plate openings shall be 3/32 inch or smaller.
   - Mesh or woven wire screen openings shall be 3/32 inch or smaller in the narrowest direction.
   - Profile bar screen or wedge wire openings shall be 1/16 inch or smaller in the narrow direction.
   - Choose size and position of screens to meet the criteria in Table 2.

Table 3. Fish screen criteria (FHWA/ODOT 2011).

Type	Approach Velocity[8] (Ft./Sec.)	Sweeping Velocity[9] (Ft./Sec.)	Wetted Area of Screen (Sq. Ft.)	Comments
Ditch Screen	0.4	Shall exceed approach velocity	Divide max. water flow rate (cfs) by 0.4 ft/sec	If screen is longer than 4 feet, angle 45° or less to stream flow
Screen with proven self-cleaning system	0.4	–	Divide max. water flow rate (cfs) by 0.4 ft/sec	–
Screen with no cleaning system other than manual	0.2	–	Divide max. water flow rate (cfs) by 0.2 ft/sec	Pump rate 1 cfs or less

1-9. Identify No Work Zones in Plans and Special Provisions, as needed to restrict access to locations with protected resources. If listed plants or butterfly habitat (as covered by this PBA) are disturbed by construction activities, replace the functional equivalent of the species or critical habitat, on-site when property is available or off-site when suitable protected lands are available. Generally, the standard is conservation or restoration efforts that replace three times the amount of resource lost in the same recovery zone (i.e., 3:1), although alternatives may be proposed/negotiated with USFWS (see Section 2.6; 3.2 PBA).

[8] Velocity perpendicular to screen face at a distance of approximately 3 inches.
[9] Velocity parallel to screen

1-10. The following noise and visual activity restrictions apply to projects within 300 feet of occupied or unsurveyed suitable nesting habitat for marbled murrelet[10] (this distance may be modified based on site conditions if visual activity is screen and justified in the Project Notification, see Section 2.6; 3.2 PBA).

i. Conduct activities outside the typical April 1 through August 5 critical nesting period, if practicable.

ii. Enforce the following mandatory dawn and dusk daily no work periods if activities will occur from April 1 through September 15 (see illustration):

(a) Daytime work may occur between two hours after sunrise to two hours before sunset.

(b) If night work is required, in addition to daytime work restrictions, work may occur between one hour after sunset to one hour before sunrise (requires USFWS approval).

Dawn and Dusk No-Work Periods for Marbled Murrelet:

<table>
<tr><td rowspan="2">(b) Night-time Work</td><td>1 hr</td><td>2 hrs</td><td rowspan="2">(a) Datytime Work</td><td>2 hrs</td><td>1 hr</td><td rowspan="2">(b) Night-time Work</td></tr>
<tr><td colspan="2">sunrise</td><td colspan="2">sunset</td></tr>
</table>

iii. To minimize adverse effect due to harassment and ensure Contractor is complying with timing restrictions, conduct weekly inspections during the no-work periods (section 2.6; 3.2 and 3.4.3 PBA).

1-10. The following noise and visual activity restrictions apply for projects within 300 feet of occupied or unsurveyed suitable nesting habitat for marbled murrelet when the work involves high-noise producing activities (> 90 dBA at 50 feet; typical of many types of construction equipment and activities). Modifications require review/approval from USFWS (see Section 3.2).

i. Conduct activities outside the typical April 1 through August 5 critical nesting period, if practicable.

ii. If activities will occur from April 1 through September 15, do not allow night time work between two hours before sunset and two hours after sunrise:

iii. To minimize adverse effect due to harassment and ensure Contractor is complying with timing restrictions, conduct weekly inspections when high noise producing work may occur during the seasonal restriction period. See Administration Section 3.4.3.

2.3.2 Geotechnical Drilling

Geotechnical drilling (including Drill Pad Preparation; Drilling and Sampling Operations, Mobilization, and Setup; Auger Drilling; Water or Mud Rotary Drilling; and In-water

[10] For noise restrictions associated with northern spotted owl, see Section 2.3.13 (Measure 13-2).

Drilling) is typically needed for identifying aggregate material sources, or for projects that involve construction of new or changes in weight-bearing foundations (e.g., bridge abutments), or for slope stabilization. Geotechnical drilling site investigations are conducted to determine construction design conditions or constraints. It includes drilling to remove rock and soil samples, along with drilling to evaluate soil stability and other soil characteristics. Drilling may be required to confirm soil and rock conditions including vertical and horizontal extent for temporary or permanent structures.

Avoidance and Minimization Measures:
The following measures will be implemented for all drilling work performed under this PBA during design or in Contract Special Provisions:

2-1. For drilling/boring/jacking within 150 feet of aquatic habitat supporting listed species or No Work Zones (this distance may be modified based on site conditions and justified in the Project Notification; see Section 3.4.2 PBA):
   i Design, build, and maintain facilities to collect and treat all construction and drilling discharge water using the best available technology applicable to site conditions. Provide treatment to remove debris, nutrients, sediment, petroleum hydrocarbons, metals, and other pollutants likely to be present. An alternate to treatment is collection and proper disposal offsite.
   ii Isolate drilling operations from wetted stream to prevent drilling fluids and waste from contacting aquatic habitat supporting listed species.

2-2. If drilling fluid or waste is released to any aquatic habitat supporting listed species or No Work Zones, contact appropriate regulatory agencies (including NMFS or USFWS, depending on resources) within 48 hours.

2.3.3 Material Sources

Although it is not always feasible or practical to do so, ODOT attempts to proactively manage and make available all the earthen materials needed for construction projects by providing fully permitted (including environmental permits and clearances) ODOT owned and/or controlled material sources located near the project. This strategy is aimed at reducing traffic congestion, haul costs, and consumption of fuels on ODOT projects. Via Contract requirement, the Agency has the ability to offer Agency-furnished sources of fill material and/or aggregate material either as prospective[11] or mandatory[12]. Agency-furnished material sources are typically located outside the project limits, although

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[11] Per Standard Specification 00160.00(a) (ODOT 2008a): Prospective Source – Agency-furnished Materials source, use of which by the Contractor is optional. The Agency makes no guarantee or representation, by implication or otherwise, of the land use status, quantity, quality, or acceptability of Materials available from it, except as may be stated in the Special Provisions.

[12] Per Standard Specification 00160.00(b): Mandatory Source – Agency-furnished Materials source, use of which by the Contractor is required.

occasionally are within the project limits. Most sites require additional operational development (grading, extraction, processing, etc.), and associated operational specifications are included in the Contract Special Provisions.

Most Agency-furnished material sources that are located outside the project limits are developed independently, including environmental permits and clearances. They may be used to provide borrow for fill material and/or aggregate on multiple projects. Independent development of Agency-furnished material sources may be completed internally or via Contracts. Regardless of the mechanism for development, if completed using FHWA STIP funds, the Agency may utilize this PBA for ESA consultation if the work can be completed within the scope of the PBA. Individual ESA consultation may be necessary if Agency-furnished sites are not developed with FHWA-STIP funds or if use/development is outside of the scope of this PBA.

If ODOT does not furnish material sources, the Contractor is responsible for furnishing or acquiring such sites and obtaining all the required permits and environmental clearances. Some Contractors own or control aggregate sources, while others use available commercial, private, or some public sites.

Avoidance and Minimization Measures:
No distinct Avoidance and Minimization Measures. Use of ODOT-furnished material source sites within scope of this PBA will follow applicable Avoidance and Minimization Measures.

2.3.4 Mobilization, Staging and Disposal

Construction mobilization consists of site preparation in advance of primary construction activities, and includes preparation and installation of environmental controls, preparation of equipment and material storage areas, and relocation of utilities. If utilities are owned by ODOT, the work is part of the contracted project. If not, ODOT or the contractor will coordinate with utility companies or owners of the utility during project development. Relocation work will take place either prior to or during mobilization if possible. When an independent utility company must perform the relocation, the company is required to comply with environmental regulations (see Interrelated and Interdependent Activities, Section 2.4; 3.1 PBA).

Construction staging or equipment storage areas are secured, cleared, and developed, as needed. Staging area development may include grading and storage of soil overburden from within the necessary area, and laying crushed rock or gravel as needed for dust and erosion control, or as a stable foundation for construction trailers, mobile fabrication or paint sheds, debris bins, etc. Environmental controls may include establishment of clearing limits, installation of temporary erosion controls, and preparation of site-specific pollution and erosion control plans.

Contractors may use storage areas and staging sites that are outside of the project limits, as per Standard Specifications, which state that "staging and disposal sites to be located in previously improved or disturbed sites, including existing roadways, pullouts, turnouts, parking lots, and storage yards that have been compacted, graveled and paved, unless otherwise approved in writing by the Engineer" (see Appendix B, PBA, Section 00290.10). For locations of disposal, Contractors may dispose of clean fill at Agency-furnished sites, and any other construction waste at public facilities (Agency property, municipal recycling or landfills) or private property. When the Contractor utilizes private sites, they are responsible for obtaining all the required permits and environmental clearances. However, the Agency may reduce the risk of potential regulatory violations by clearing and designating sites that are to be used for the Contract. ODOT recently completed guidance for project teams and Construction Project Managers to help determine when it is appropriate to designate an Agency-furnished site, whether the site should be prospective or mandatory, and which party is responsible for environmental clearances and permitting (ODOT 2008b).

Avoidance and Minimization Measures:
The following measures will be implemented on all projects performed under this Programmatic, during design or in Contract Special Provisions:

4-1. For projects with high environmental sensitivity, plan and designate staging areas and disposal sites as per ODOT Technical Services Bulletin GE08-04(B) (ODOT 2008c).

4-2. For Contractor-designated sites within project limits, approve equipment storage, staging areas, and disposal sites on undeveloped or undisturbed areas only when undeveloped land is the only reasonable alternative. In such cases, locate sites at least 150 feet from aquatic habitat supporting listed species or No Work Zones (this distance may be modified based on site conditions and justified in the Project Notification, see Section 3.4.2 PBA).

2.3.5 Erosion, Sedimentation and Pollution Control

Although ODOT will develop an Erosion and Sediment Control Plan as part of contract documents, the Contractor is required by Standard Specifications to modify or update the Plan as needed for construction practices and site conditions. ODOT's Standard Specifications also require the Contractor to install the controls before any other ground-disturbing activities (see Appendix B PBA, Section 00280.02).

ODOT will use erosion and sediment control measures to ensure compliance with applicable NPDES and local permits governing sediment discharge from construction areas. Generally, ODOT will install silt fences near the toe of the road embankment fill slopes in areas where sediment-laden water has a potential of entering aquatic habitat supporting listed species or leaving the work area. Straw wattles or other devices may be used in areas that are sensitive or need extra protection. Rock check dams may be constructed at regular intervals throughout the roadside ditch system to slow the flow of water. These are just a few of the more common types of controls; some other typical methods are provided in Appendix B of the PBA. The Contractor may propose other methods (requires approval by ODOT).

Avoidance and Minimization Measures:
Erosion and pollution Avoidance and Minimization Measures are provided in Appendix B (ODOT Standard Specification Sections 00280 and 00290), and as Standard Specifications, are required of all ODOT contracts. The following additional measures will be implemented on all projects performed under this Programmatic, during design or in Contract Special Provisions:

5-1. Do not discharge contaminated or sediment-laden water, or water contained within a work isolation area, directly into any aquatic habitat supporting listed species or No Work zone until it has been satisfactorily treated to turbidity requirement in Measure 5-2.

5-2. Do not exceed turbidity standards in aquatic habitat supporting species covered by this PBA Consultation. The turbidity standard is no more than 10 percent above background reading (up to 100-feet upstream of the project) as measured 100-feet downstream of the project.

5-3. The following minimum pollution control measures are required of all construction vehicles and other heavy equipment to prevent leaks and spills from entering protected areas (see Appendix B PBA, Section 00290.30a). Distances may be modified based on site conditions and justified in the Project Notification (see Section 3.4.2 PBA).

   i. Inspect and clean all equipment prior to operating within 150 feet of any aquatic habitat supporting listed species, No Work zone, or storm inlet. Check for fluid leaks and remove all external oil, grease, weed seed, and dirt.
   ii. Locate areas for parking, refueling and servicing mobile equipment and vehicles at least 150 feet away from any aquatic habitat supporting listed species, No Work Zone, or storm inlet.
   iii. Maintain and protect as necessary any generators, cranes and any other stationary equipment operated within 150 feet of any aquatic habitat supporting listed species or No Work Zones.
   iv. Inspect heavy equipment, storage containers, staging areas and other potential sources of hazardous substances daily to identify and prevent potential releases.

5-4. Treat all discharge water created by construction (e.g., concrete washout, pumping for work area isolation, vehicle wash water, drilling fluids) must be treated using the best available technology applicable to site conditions to remove debris, nutrients, sediment, petroleum products, metals and other pollutants likely to be present.

5-5. Implement containment measures adequate to prevent pollutants or construction and demolition materials, such as waste spoils, fuel or petroleum products, concrete cured less than 24 hours, concrete cure water, silt, welding slag and grindings, concrete saw cutting by-products and sandblasting abrasives, from entering contact any aquatic habitat supporting listed species or No Work Zones.

2.3.6 Temporary Access Roads

ODOT may need temporary access roads for geotechnical drilling, staging or access to portions of the project that cannot otherwise be accessed. Access roads may be design features of the project or left to the contractor to design. Construction of access roads typically involves clearing and grading to create an improved surface and slope suitable for construction equipment. Crushed rock or gravel may be used for stability, dust and erosion control, and to facilitate site reclamation.

<u>Avoidance and Minimization Measures:</u>
The following measures will be implemented for all projects performed under this PBA that have temporary access roads, either during design or in Contract Special Provisions:

6-1. Unless no reasonable alternatives are available, do not design or allow new temporary access roads within 150 feet of any habitat supporting listed species or No Work Zones (this distance may be modified based on site conditions and justified in the Project Notification, see Section 3.4.2 PBA).

6-2. When new roads are needed:
  i. Do not design or allow temporary access routes on steep slopes, where grade, soil, or other features suggest a likelihood of excessive erosion (e.g., rills or gullies) or failure;
  ii. Design site restoration with the goal of obliterating all temporary access routes, stabilizing the soil and restoring the natural vegetation (see Section 2.3.24).

6-3. Follow Avoidance and Minimization Measure 1-7 if temporary stream crossings are needed.

2.3.7 Barges

Barges may be used for bridge replacement or repair work, or as needed to access structures near large bodies of water. The use of barges may be necessary if a navigation channel must remain open to commercial and recreational uses, thereby precluding the contractor from constructing a work bridge across the channel. Barges may be used to set sheet pile cofferdams, drill shafts for new bridge piles, deliver materials to the site, set new prefabricated bridge elements into place, transport existing bridge off-site, or contain demolition materials,. Anchoring of the barge typically is accomplished by lowering spuds to the bed of the waterway and allowing them to sink in solely by their weight. Spuds sometimes are augmented by a system of anchors. All of the equipment on the barge will have its own containment, including containment pans or absorbent booms to contain minor spills.

Avoidance and Minimization Measures:
The following measures will be implemented for all projects performed under this PBA with relevant work in aquatic habitat supporting listed species, during design or in Contract Special Provisions:

7-1. Rather than leaving it up to the discretion of the Contractor, specify if barges are allowed or disallowed.

7-2. If a barge is allowed, include the following additional Special Provisions for the Contractor:
   i. Barges will be of sufficient size and within the safe load capacity to remain stable under adverse conditions such as severe weather and large waves.
   ii. Move the barge if there is a possibility of grounding at low tide.
   iii. Prior to bringing a barge to the project site, ensure the barge and ballast are free of invasive species.
   iv. Load, secure, contain, stabilize and maintain the barge, as well as equipment and materials on the barge, to meet Pollution Control measures (see Appendix B PBA, Sections 00290.20 and 00290.30).
   v. Dock the barge in a safe location if weather forecasts suggest that unsafe conditions for the barge may occur. Unsafe conditions include loss of balance or stability, loss of anchorage, and any condition that reduces safe load capacity below actual loading.

2.3.8 Temporary Bridges and Treated Materials

Bridge replacements typically require some kind of temporary bridge, either as a containment and work platform, or for staged construction and traffic detours. The design for a temporary bridge depends on the scope of its intended use and load bearing capacity. When project team determines that the scope of a temporary structure merits up-front design/bid items, ODOT will design and specify temporary work or detour bridges. Contractors sometimes utilize the same temporary bridge for containment of demolition material as well as construction access. ODOT has boiler plate special provisions for the construction of temporary work bridges, which may be updated as needed to comply with current regulatory guidance.

Wood and steel materials are used in many aspects of highway construction - as support for temporary or permanent bridges, pedestrian bridges, fences and barriers, various types of containment systems, shoring for roadwork or culvert replacement, and concrete falsework. Untreated wood or steel may decay, and depending on the duration of its use, treated wood or other more stable materials may be necessary. Non-treated materials may be specified, but require planning and coordination, and may not always be economically feasible.

Avoidance and Minimization Measures:
The following measures will be implemented for all projects performed under this PBA that may involve temporary bridges or treated wood near aquatic habitat

supporting listed species, during design or in Contract Special Provisions (other Avoidance and Minimization Measures throughout this consultation may apply):

8-1. Unless no reasonable alternatives are available, do not design or allow the use of construction materials treated or preserved with pesticidal compounds; and offer cleaner alternatives.

8-2. If treated materials are used over-water or in-water structure, all surfaces exposed to leaching by precipitation, overtopping waves, or submersion with a water-proof seal or barrier to be maintained for the life of the project.

8-3. Any treated structures located below the ordinary high water elevation (OHWE), including pilings, must have design features to avoid or minimize impacts and abrasion that would deposit treated wood debris and dust in riparian or aquatic habitat.

8-4. The following conditions are required for use of treated materials below OHWE:

- i. Store pesticide-treated wood in appropriate dry storage areas, at least 150 feet away from aquatic habitat supporting listed species or where it will not drain into such habitat. This distance may be modified based on site conditions and justified in the Project Notification (see Section 3.4.2 PBA).
- ii. Avoid contact with standing water and wet soil.
- iii. Ensure pesticide-treated wood is free of residue, bleeding of preservative, preservative-saturated sawdust, contaminated soil, or other pollutants.
- iv. Use prefabrication whenever practicable to minimize onsite cutting, drilling, and field preservative treatment.
- v. Do not discharge of sawdust, drill shavings, excess preservative and other debris into riparian or aquatic habitat.

8-5. For removal of treated wood over aquatic habitat supporting listed species, require that the Contractor develop a work containment plan (WCP) for the design and implementation of a work containment system (WCS) to avoid or minimize disturbance and potential release of construction debris, material, or other contaminants to riparian and aquatic habitat. Minimum design standards are:

- i. Not constructed of treated timber, unless implemented as per Measures 8-2 and 8-3.
- ii. Provides full containment of, and spill prevention for, hazardous liquids procedures (already a requirement in ODOT Standard Specifications).
- iii. As applicable, is fire retardant or resistant to fire from welding slag, torch operation, or any sparks from work.
- iv. Able to withstand dead load, live load, and wind load.

8-6. Remove temporary bridges or trestles when no longer needed, obliterate the route, and restore the soils and vegetation (see Avoidance and Minimization Measures in Section 2.3.24).

2.3.9 Work Area Isolation

Work area isolation may be required for work in an actively flowing stream, pond or lake. Although the Contractor has the responsibility to determine which method or combination of methods best matches the project objectives, ODOT can require measures to avoid and minimize impacts to protected resources. ODOT's Standard Specifications limit the timing of work performed within Regulated Work Areas to only within the regulated in-water work periods, that are described in project Special Provisions (unless modified by Special Provision). Standard Specifications do not allow equipment to enter any waters of the State or U.S. or the Regulated Work Area except as allowed in permits issued for the Project (see Appendix B PBA, Section 00290.34). ODOT has boiler plate Special Provisions for temporary water management, water intake screens, and surface water diversion (currently in SP00245 and SP00290; ODOT 2011a), which are updated as needed to comply with current regulatory guidance.

ODOT will coordinate with the Contractor to schedule fish salvage by qualified Biologists. Fish salvage normally takes place just prior to stream diversion. When water levels are too high, the diversion process takes place when water levels have been lowered enough to permit proper salvage. Pumping or temporary gravity-fed piping are used to divert stream flow around the work area. Whenever pumping is used for conveying water, the system must be monitored on a continuous basis, and a fully-operational backup pump must be available at the site. The pump system is fitted with screens to exclude any fish, following NMFS guidelines (see Avoidance and Minimization Measure 1-9). Consequently, while pumping occurs, both up and downstream fish migration may be blocked. Contract specifications will not permit the stream to be de-watered below the project site at any point during the construction process. A continuous use, gravity fed, by-pass pipe installed around the work area may require excavation, temporary shoring, and traffic impacts during installation. Continuous pumping may require round the clock monitoring costs and logistical problems with mechanical failure.

The three most common methods used by ODOT for work area isolation are sandbag dams with stream diversion, coffer dams, and floating silt curtains (although other methods may be used). Culvert replacements and smaller bridge replacements (e.g., reinforced concrete box culvert [RCBC]) typically use sandbag dams and dewatering to completely isolate the in-stream work area from stream flow during construction. Stream flow is diverted during the ODFW defined in-water work period. Isolating the stream flow from the work area may reduce the potential for negative impacts to water quality and aquatic species (e.g., direct take) during in-water work activities. For temporary water management, water may be diverted by sandbag dams installed upstream of the work area and then conveyed around the work area either by pumping or gravity flow through a temporary pipe. In either case, the water is returned to the stream channel downstream of another sandbag dam. Silt curtains, sediment mats, or similar materials

may be installed downstream prior to flow reintroduction to capture as much displaced sediment as possible and comply with turbidity limitations. ODOT Standard Specifications require the Contractor to submit a dewatering plan to ODOT for review and approval.
Coffer dams are temporary barriers constructed to exclude water from an area that is normally submerged, such as a bridge pier. Usually, they are welded steel structures, with components consisting of sheet piles, wales, and cross braces. Fish salvage takes place within the isolated coffer dam, water is then pumped out or air is pumped into the space to displace the water and allow a dry work environment below the surface.

Floating silt curtains are barriers to contain and control the dispersion of turbidity and silt in a body of water. They are used when water levels are too deep for complete work area isolation with a coffer dam, and often for bank stabilization and removal and construction of bridge bents near the edge of a stream. ODOT typically uses hanging style curtains that are intended to capture as much sediment as possible during construction activities. The sediment is removed with removal of the floating silt curtain upon completion of the work. Sediment entering the static water area is isolated and settles out of suspension within the area of the floating silt curtain. Fish salvage typically will be attempted within the water body isolated by the silt curtain.

Avoidance and Minimization Measures:
The following measures will be implemented for all projects performed under this PBA with in-water work in aquatic habitat supporting listed species, during design or in Contract Special Provisions:

9-1. Comply with in-water timing requirements during installation and removal of work area isolation (see Avoidance and Minimization Measure 2.3).

9-2. Ensure that fish capture and removal is completed in work areas isolated from the active channel, except where infeasible in deep water situations or as recommended by the biologist.
   i. Biologists with current ODFW fish salvage permit must remove fish and aquatic life from the isolation work areas.
   ii. Require that the Contractor allow fish biologists access into the isolation work areas as necessary.
   iii. Any fish trapped within the isolated work area must be captured and released using a trap, seine, electrofishing, or other methods as prudent to minimize the risk of injury, before being released at a safe release site.
   iv. If electrofishing is used to capture fish, NMFS electrofishing guidelines must be followed (NMFS 2000).

9-3. Develop a Temporary Water Management Plan and require that the Contractor update the plan as necessary for their construction methods. The Plan must meet pollution and erosion control requirements in this PBA and include at least the following information:
   i. The sequence and schedule for dewatering and re-watering.

ii. Methods to isolate the work area from the active stream flow.
iii. As applicable, methods to route and convey stream flow around or through the isolated work area.
iv. As applicable, methods to de-water the isolated work area.
v. As applicable, methods to pump and treat water before it is discharged downstream.
vi. Specifications for on-site backup materials and equipment.
vii. Calculations of water withdraw pumps capacity.

9-4. Operate temporary water management as follows:
i. Maintain a downstream water flow rate of at least 50 percent of the upstream water flow rate at all times.
ii. Provide safe passage around or through the isolated work area for adult and juvenile migratory fish unless passage did not previously exist.

9-5. If pumps are used:
i. Operate the pumps as needed up to 24 hours a day during the diversion to prevent de-watering of the stream downstream of the diversion.
ii. Monitor pumps continuously when in operation.
iii. Keep a back up pump available in the event of failure of the primary pump.
iv. As feasible, maintain a negative pressure inside the isolated work area to contain turbidity.
v. After completion of the work, if significant sediment has accumulated within the isolated work area, pump out the sediment and filter through existing vegetation.

9-6. Install, operate, and maintain all water intake screens including pumps used to isolate the in-water work area according to Avoidance and Minimization Measure 1-8.

2.3.10 Clearing, Grubbing and Earthwork

Clearing and grubbing is performed to remove and dispose of vegetation and buried matter within the work area. Within excavation and embankment limits, contractors will remove tree stumps, roots, and other vegetation and dispose of this matter and debris on- or off- site by chipping, burying, or other proper methods of disposal. Standard Specifications limit vegetation clearing and grubbing to areas shown on plans or 10 feet from relevant highway features (see Appendix B PBA, Section 00320). As needed to protect sensitive resources, project Plans and Special Provisions will designate avoidance within No Work Zones (see Section 2.2).

Earthwork consists of excavation, ditching, backfilling, embankment construction, grading, leveling, and other earth-moving work required in the construction of the project. Earthwork normally requires the use of mechanical equipment such as tracked excavators, backhoes, bulldozers, and grading equipment. ODOT Standard Specifications require that all earthwork conform to the lines, grades and cross sections established in contract plans. The plans will specify whether fill material is furnished by ODOT or if it is the responsibility of the Contractor.

Avoidance and Minimization Measures:
The following measures will be implemented for all projects performed under this PBA with clearing, grubbing, and earthwork, during design or in Contract Special Provisions (see Avoidance and Minimization Measure 1-9 to avoid and minimize impacts to listed plants and butterfly habitat):

10-1. Minimize vegetation disturbance to the greatest extent practicable as follows:
  i. Leave native materials where they are found when possible.
  ii. Clip vegetation at ground level in areas to be cleared to retain root mass and encourage reestablishment of native vegetation.
  iii. If use of large wood, native top soil, or native channel material is required for the site restoration according to the Roadside Development Plans, stockpile all large wood, native vegetation, weed-free topsoil, and native channel material displaced by construction during site preparation.

2.3.11 Weed Removal

Manual and chemical control of noxious and invasive weeds is often required by construction specifications, prior to site grading, prior to landscaping, and during plant establishment and post-construction site maintenance. The purpose of weed control prior to site grading is to prevent the spread of weeds during construction. Mowing or manual removal is often the most effective method. Grubbing or herbicide treatment may be specified in temporarily disturbed areas. Re-growth of weeds may be treated with manual removal or herbicide.

Avoidance and Minimization Measures:
Weed control measures are provided in Appendix B PBA (Section 001030). The following additional measures are based on a NMFS Biological Opinion with the U.S. Forest Service (USFS 2005). These will be implemented on all projects performed under this PBA that may require weed control in (or within buffer distances listed below) habitats supporting listed aquatic species, during design or in Contract Special Provisions (alternative treatments may be approved on a case-by-case basis, as long as the effects are within scope of this programmatic, as approved by NMFS or USFWS, see Section 3.2 PBA):

11-1. Specify Weed Management Areas in project plans and special provisions.

11-2. Do not allow herbicide treatment in the buffer areas shown on Table 4. For combination herbicides, use the most conservative buffer. Buffer widths are measured perpendicular to the bankfull elevation for streams, the upland boundary for wetlands, or the upper bank for roadside ditches.

11-3. Liquid or granular forms of herbicides must be applied as follows:

i. Broadcast spraying – hand held nozzles attached to back pack tanks or vehicles, or vehicle mounted booms. Do not apply Triclopyr by broadcast spray.
ii. Spot spraying – hand held nozzles attached to back pack tanks or vehicles, hand-pumped spray, or squirt bottles to spray herbicide directly onto small patches or individual plants.
iii. Hand/selective – wicking and wiping, basal bark, fill ("hack and squirt"), stem injection, cut-stump.

11-4. Limit herbicide treatment in habitat supporting listed aquatic species to not more than 2 acres above OHWE, and 0.25 acre below OHWE, per project, once per year.

11-5. Minimize disturbance to native vegetation and aquatic habitat as follows:

i. Utilizing hand clearing or other low-impact methods whenever practicable.
ii. Utilizing spot spraying for herbicide treatment whenever practicable.
iii. Avoiding boom or broadcast spraying when wind speeds exceed 5 miles per hour.
iv. Keeping boom or spray as low as possible to reduce wind effects.

11-6. The only herbicides allowed under this PBA/PBO are (some common trade names are shown in parentheses):

i. aquatic imazapyr (e.g., Habitat)
ii. aquatic glyphosate (e.g., AquaMaster, AquaPro)
iii. aquatic triclopyr-TEA (e.g., Renovate 3)
iv. chlorsulfuron (e.g., Telar, Glean, Corsair)
v. clopyralid (e.g., Transline)
vi. glyphosate (e.g., Rodeo)
vii. imazapic (e.g., Plateau)
viii. imazapyr (e.g., Arsenal, Chopper)
ix. metsulfuron-methyl (e.g., Escort)
x. picloram (e.g., Tordon)
xi. sethoxydim (e.g., Poast, Vantage)
xii. sulfometuron-methyl (e.g., Oust, Oust XP)
xiii. triclopyr (e.g., Garlon 3A, Tahoe 3A)

11-7. The only adjuvants allowed under this PBA are shown on Table 5. Do not use polyethoxylated tallow amine (POEA) surfactant and herbicides that contain POEA (e.g., Roundup or Roundup Pro).

11-8. Limit herbicide carriers (solvents) to water or specifically-labeled vegetable oil.

11-9. Apply herbicides at the lowest effective label rates, including the typical and maximum rates given below (Table 6). For broadcast spraying, do not exceed the typical label rates for application of herbicides or surfactant.

11-10. Restrict herbicide application from locations with listed plants or butterfly habitat or designated No Work Zones. However, spot spraying may be permitted at times when protected resources are dormant/inactive, and directly coordinated with the ODOT biologist[13] or USFWS.

Table 4. Herbicide application buffer distances, based on herbicide formula, stream type, and application method.

	Buffer Distance (in feet)					
	Perennial Streams, Wetlands, or Intermittent Streams and Roadside Ditches with flowing or standing			**Dry Intermittent Streams and Wetlands, Dry Roadside Ditches**		
Herbicide Active Ingredient	**Broadcast Spraying**	**Spot Spraying**	**Hand Selective**	**Broadcast Spraying**	**Spot Spraying**	**Hand Selective**
Labeled for Aquatic Use						
Aquatic Glyphosate	100	waterline	waterline	50	none	none
Aquatic Imazapyr	100	15	waterline	50	none	none
Aquatic Triclopyr-TEA	**Not Allowed**	15	waterline	**Not Allowed**	none	none
Low Risk to Aquatic Organisms						
Imazapic	100	15	OHWE	50	None	none
Clopyralid	100	15	OHWE	50	None	none
Metsulfuron-Methyl	100	15	OHWE	50	None	none
Moderate Risk To Aquatic Organisms						
Imazapyr	100	50	OHWE	50	15	OHWE
Sulfometuron-Methyl	100	50	5	50	15	OHWE
Chlorsulfuron	100	50	OHWE	50	15	OHWE
High Risk To Aquatic Organisms						
Triclopyr	**Not Allowed**	150	150	**Not Allowed**	150	150
Picloram	100	50	50	100	50	50
Sethoxydim	100	50	50	100	50	50
Glyphosate	100	50	50	100	50	50

Table 5. Herbicide adjuvants, trade names, mixing rates, and application rates.

Adjuvant Type	**Trade Name**	**Mixing Rate** [14]	**Application Areas**
Surfactants	Activator 90	0.16 - 0.64	Upland
	Agri-Dee	0.16 - 0.48	Riparian

[13] See footnote 11, Section 2.2.

[14] Fluid ounces adjuvant per gallon of herbicide.

	Hasten	0.16 - 0.48	Riparian
	LI 700	0.16 - 0.48	Riparian
	R 11	0.16 - 1.28	Riparian
	Super Spread MSO®	0.16 - 0.32	Riparian
	Syl-Tae	0.16 - 0.48	Upland
Drift Retardants	41-A	0.03 - 0.06	Riparian
	Vale	0.16	Upland

Table 6. Typical and maximum rates for herbicide applications.

Herbicide	Typical Rate[15]	Maximum Rate
Imazapic	0.1	0.1875
Clopyralid	0.35	0.5
Metsulfuron-methyl	0.03	0.15
Imazapyr	0.45	1.5
Sulfometuron-methyl	0.045	0.38
Chlorsulfuron	0.056	0.25
Triclopyr	1.0	10.0
Picloram	0.35	1.0
Sethoxydim	0.3	0.45
Glyphosate	2.0	8.0

2.3.12 Tree and Down Timber Removal

Removal of trees and down timber (also referred to as logs, large woody material or large woody debris) may be part of clearing and grubbing operations. ODOT's Standard Specifications require that the Contractor remove vegetation and debris within the project footprint, including removal of sod, weeds, dead vegetation, down timber, brush, other vegetation,, sticks and branches with diameters greater than 1/2 inch, stumps, and specified trimmings (see Appendix B PBA, Section 00320). Trees and down timber are valuable to most terrestrial and aquatic species, as a vital resource for many species' life cycles, for air and water quality, stream temperature control, and maintaining natural water cycles. If vegetation and debris, including trees or down timber are to be preserved, it must be specified in Contract Plans and Special Provisions.

Avoidance and Minimization Measures:

The following measures will be implemented for all projects performed under this PBA that involve tree and down timber removal in the habitat areas specified below, during design or in Contract Special Provisions:

12-1. When feasible, plan and design to avoid removal of native coniferous trees[16] and down timber from habitat areas described in Measures 12-2 and 12-3.

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[15] Typical and maximum rates are in pounds of active ingredient per acre.

[16] A native tree is indigenous to Oregon and provides necessary functions for listed species, including watershed functions for listed fish or foraging habitat for listed birds.

12-2. For projects that have tree/timber removal within the riparian zone of listed aquatic species, ensure that:
   i. Native coniferous trees or timber greater than 18 inches diameter at breast height (DBH) are salvaged and used for aquatic habitat enhancement when applicable and feasible.[17] Coordinate with a NMFS or USFWS hydraulic designer (depending on species) for appropriate size requirements of trees salvaged for aquatic habitat.
   ii. Remove or replace the functional equivalent (see Glossary, Appendix A) of the number and sizes of trees or down timber either on-site when property is available, or off-site when suitable protected lands are available (see Section 2.3.25).

12-3. When mature trees (generally greater than 18 inches DBH) are removed from suitable nesting habitat for marbled murrelet or nesting/roosting/foraging habitat for northern spotted owl, ODOT will ensure that impacts are offset through the protection of similar or higher quality habitat and utilization of ratios that, collectively, yield a meaningful net benefit for the species.

2.3.13 Blasting

Blasting is a form of earthwork, required as needed to remove bedrock. ODOT typically performs exploratory drilling during project development, and specifies blasting only when necessary. In appropriate situations, exploratory drilling is preferred by ODOT to avoid potential delays and cost overruns. However, in the event that rock is encountered when not anticipated, ODOT allows blasting, following standard specifications. The Contractor is required to develop a Blasting Plan for ODOT review and approval.

Avoidance and Minimization Measures:
The following measures will be implemented for all projects performed under this PBA that may involve blasting work, during design or in Contract Special Provisions:

13-1. Blasting is not allowed in aquatic habitat supporting listed species below the OHWE.

13-2. The following seasonal noise restrictions are required if occupied or suitable unsurveyed nesting habitat for marbled murrelet or northern spotted owl occurs within one mile of the blasting activities:
   i For marbled murrelet habitat: Avoid blasting activities from April 1 to September 15th.
   ii For northern spotted owl: Avoid blasting activities during the

[17] Salvage of trees or down timber is considered feasible when suitable on-site uses are available and part of project plans (e.g., bank stabilization, waterway enhancements, site restoration, roadside development), or when off-site storage is readily available and salvaged materials have been designated for specific uses either by Agency or others. If use is by others, ODOT will be responsible for transportation costs up to 60 miles from the project.

following critical nesting periods:

- March 1 to July 7 for the North Coast Province.
- March 1 to June 30 for the Rogue/Siskiyou National Forest (NF) and Medford District of U.S. Bureau of Land Management (BLM) in the Southwest Province.
- March 1 to July 15 for the Umpqua NF in the Southwest Province.
- March 1 to July 15 for the Willamette Province.
- March 1 to September 30 for the Deschutes NF, Fremont NF, and Winema NF, and unlisted areas.

2.3.14 Slope Stabilization and Drainage

This activity includes various forms of rock slope stabilization and reinforcement, typically involved in rockfall/slide mitigation work to stabilize or prevent slopes above roadways from eroding and harming drivers and pedestrians. ODOT will design the stabilization as needed to meet site conditions based on geotechnical investigations. Slope drainage (also referred to as dewatering) is often a component of slope stabilization, and drainage systems will be designed to meet site conditions. As described in Section 2.1, ESA consultation for emergency repair work may be covered by this PBO if the work is federalized by FHWA Emergency funds; and the work is completed within scope and following the Avoidance and Minimization Measures in the PBA/PBO.

Avoidance and Minimization Measure:
No new Avoidance and Minimization Measures are proposed for this activity. Appropriate sediment and erosion controls will be designed and implemented at all times, including dewatering drainage systems, to meet ODOT Standard Specifications (see Appendix B PBA, Sections 00280 and 00290) and applicable NPDES and local permits.

2.3.15 Streambank Stabilization and Scour Protection

This Section applies to bank stabilization and scour protection of roadbeds located along streambanks, stormwater outfalls, bridge abutments, or the ends of culverts. Riprap or rock armoring is used where water velocities or safety considerations prevent the use of natural vegetation or seeding. ODOT Standard Specifications (Section 00390) define riprap as erosion resistant cover material for protecting slopes and basins. Common types of riprap may include filter blankets, backing, lose, keyed-in or grouted-in materials. Riprap is the most common method for stream bank stabilization at bridge end bents and culvert ends to prevent scour damage, or for repairing streambank scour as needed to protect the roadway. Retaining walls provide another form of streambank protection. These are typically formed concrete and/or mechanically-stabilized earth.

Streambank stabilization also may be achieved with "bioengineering" techniques that utilize live vegetation material to provide stability. Additionally, habitat elements, such as root wads and logs, may be incorporated into streambank protection designs (see Channel Modification and Waterway Enhancements, Section 2.3.25).

Avoidance and Minimization Measures:
The following measures will be implemented for all projects performed under this PBA that involve streambank stabilization in aquatic habitat supporting listed species, either during design or in Contract Special Provisions:

15-1. Except as designed to replace existing quantity/location of hard armoring, any uses of hard armoring below OHWE (listed habitat areas) requires approval from NMFS or USFWS and documented in the Project Notification (see Sections 2.6; 3.2 and 3.4.2 PBA). The Notification must include design justification, as well as type, size, quantity, location, and description of relevant Avoidance and Minimization Measures.

15-2. Design the amount of hard armoring to the minimum necessary to protect the integrity of a structure from erosion or scour.

15-3. Whenever practicable, incorporate the following types of natural material into stream bank stabilization or scour protection designs:

i. Vegetated riprap with large wood.
ii. Partially spanning porous weir.
iii. Woody plantings.
iv. Herbaceous cover, in areas where the native vegetation does not include trees or shrubs; bank reshaping and slope grading.
v. Coir logs.
vi. Deformable soil reinforcement.
vii. Engineered log jams.
viii. Floodplain flow spreaders.
ix. Floodplain roughness.

15-4. Design and install vegetated riprap with large wood meeting the following minimum standards:

i. When practicable, use natural hard points, such as large, stable trees or rock outcrops, to begin or end the toe of the revetment.
ii. Develop an irregular toe and bank line to increase roughness and habitat value.
iii. Place larger sizes of rock at the toe of the slope and smaller sizes higher in the bank where the shear stress is generally lower.
iv. Except where bridge cover would shade out plant growth, incorporate soil and plantings above critical scour elevations to provide a better growing medium for plants. To facilitate and improve success, install soil and plantings during construction of riprap slopes.
v. To improve plant growth, avoid using geotextile fabrics as filter behind the riprap whenever practicable.
vi. Include large wood as an integral component to create roughness, pools and cover whenever practicable (see Channel Modification and Waterway Enhancements, Section 2.3.25).
vii. Terrace slopes wherever practicable.

15-5. Visually inspect natural bank stabilization and vegetated riprap each year following installation during the monitoring period (see Administration, Section 3.4.5 PBA), during low flows, to examine transitions between undisturbed and treated banks to ensure that native soils above and behind the riprap are not collapsing, sinking, or showing other evidence of piping loss or movement of rock materials. To access the overall integrity of the riprap treatment, evaluate the following:

i. Loss of rock materials.
ii. Survival rate of vegetation (see Section 2.3.24).
iii. Anchoring success of large woody debris placed in the treatment.
iv. Any channel changes since construction.

15-6. If hard armoring is required below the OHWE (which exceeds replacement of existing armoring) that does not incorporate natural material (per Measure 15-3) or vegetated riprap (per Measure 15-4), Replace the functional equivalent of the area of new hard armoring (excluding that which replaces existing quantity/location) on-site when property is available, or off-site when suitable protected lands are available. Generally, the standard is removal of the same quantity of hard armoring in the same subbasin, although alternatives may be proposed/negotiated with NMFS or USFWS, depending on species (see Section 2.6; 3.2 PBA).

2.3.16 Culvert and Bridge Removal

Deficient culverts and bridges that need replacing are typically removed during the clearing and grubbing phase of a project, or when specified during the in-water work period (e.g., for stream conveyances). Although ODOT cannot prescribe the exact methods for structure demolition and removal, Contract Special Provisions can be developed to minimize impacts to protected resources. Standard Specifications require that the Contractor properly recycle and dispose of waste materials while preventing construction debris or pollutants from entering any waters of the State or the U.S. (see Appendix B PBA, Section 00290.20[c-3]).

For culvert removal, a crane, large excavator, or similar equipment is typically used to remove a culvert in one piece or in sections. It may be necessary to break up the concrete or sawcut it to lift it out. Concrete, if present, would be broken up using a concrete saw, jack hammers, or a stinger on a backhoe.

For bridge removal, the bridge is often cut or broken into pieces and the pieces removed with a crane or with helicopter lifts. A demolition platform is often constructed under the existing bridge prior to its removal, and may be required by special provisions when needed to prevent debris and/or containments from entering the stream or floodway. Containment systems are extremely diverse, depending on site conditions and project scope, and may be comprised of work platforms, retaining walls, coffer dams, etc. In sensitive areas, ODOT can direct the Contractor to develop and install a project-specific Containment Work System and prepare and submit a Containment Work Plan following specified design constraints (see Avoidance and Minimization Measures below). ODOT has review/approval authority over the Contractor's design and methods.

When bridges are removed, and when applicable, concrete bridge decks may be sawed into pieces and lifted out of the work area via a crane parked on the road surface. Once the bridge deck is gone, the girders, truss and bents are then dismantled either by sawing or breaking them down into pieces.

Avoidance and Minimization Measures:
The following measures will be implemented for all projects performed under this PBA with removal of bridges, culverts, piles or associated facilities in/over aquatic habitat supporting listed species, during design or in Contract Special Provisions:

16-1. For culvert and bridge removal and repair activities in or over aquatic habitat supporting listed species, require that the Contractor develop a WCP for a WCS, as per Avoidance and Minimization Measure 8-5.

2.3.17 Bridge Repair and Rehabilitation

Bridge repair may range from replacing damaged components like bridge rails, to repainting or seismic retrofits. Bridge preservation and rehabilitation projects generally include the types of activities listed below. Appendix C of the PBA provides a more detailed description of each of these activities (taken from the ODOT-FHWA Programmatic ESA Biological Assessment for Bridge Preservation and Rehabilitation Projects; ODOT-FHWA 2010).

- Preparation and Coating of Steel and Reinforced Concrete Bridge Components
- Concrete Patching
- Cathodic Protection
- Pack Rust Removal on Steel Bridges
- Cap Replacement, Crossbeam Repairs, Replacement of Timber Components, and External Post-Tensioning
- Structural Steel Repairs
- Installation, Upgrading, and Removal of Access Hardware
- Mechanical, Electrical, and Architectural Rehabilitation
- Historic Rail Retrofit
- Deck Replacement
- Pavement Removal and/or Resurfacing, Concrete Sealer Application, Bridge Deck Overlays, and Bridge Deck Concrete Repairs up to Full Depth
- Fiber-reinforced Polymer Strengthening and Crack Injection
- Seismic Retrofit, Bearing Retrofit, and Bridge Deck Joint Repair/Retrofit
- Bridge Lane Widening
- Vertical Clearance Improvement

The purpose of bridge preservation/rehabilitation projects is to extend the useful life of existing bridges. In some cases, preservation/rehabilitation activities are required to conserve historic resources. In other cases, preservation/rehabilitation activities are warranted for economic reasons, i.e., bridge replacement is often more costly than preservation/rehabilitation and much more disruptive to local communities and traffic flow. On the environmental side, if a current bridge is not restricting water flow, the floodplain, or fish or wildlife passage, activities associated with bridge preservation/rehabilitation will likely have fewer short-term impacts to the environment than full bridge replacement.

Just as in culvert or bridge removal (Section 2.3.16), containment for bridge repair and rehabilitation varies considerably depending on the scope of the project and site conditions. Standard Specifications Section 00594.05 describe different types of containment required for field painting and coating activities often associated with bridge repair and rehabilitation (see Appendix C).

Avoidance and Minimization Measures:
No distinct Avoidance and Minimization Measures are proposed for this activity. Refer to related Avoidance and Minimization Measures, including Sections 2.3.1 (General Construction), 2.3.4 through 9 (Mobilization, Staging and Disposal through Work Area Isolation), 2.3.15 (Streambank and Scour Protection), 2.3.16 (Culvert and Bridge Removal), and 2.3.21 (Painting and Coating).

2.3.18 Bridge Construction

Bridges are a major structural component of a roadway, and involve many different components. The length of the bridge is typically a compromise between cost and accommodating landscape feature below the bridge. Longer bridges not only require longer superstructures, but typically they require more foundation work.

Bridge design varies considerably depending on site conditions. However, many bridges have cast-in-place concrete decks, supported by pre-cast concrete beams and/or steel truss and girders that are fabricated on-site. When constructed on-site, concrete forms are constructed, reinforcing steel is placed and concrete is formed. After the deck is cured, cast-in-place concrete curbs are typically constructed on each side of the bridge. Bridge rails may be steel or concrete, either pre-fabricated barriers or cast-in place, and the components and design vary considerably depending on site conditions and other requirements (e.g., local codes and scenic requirements).

Foundations (i.e., end bents, piers, piling) may be drilled shafts, concrete spread footings, or driven steel or wood piles. Drilled shafts are reinforced concrete sections, cast-in-place against in situ soil, rock, or a casing. Concrete spread footings may be necessary when drilled shafts or pile driving are not feasible such as when there is shallow bedrock. ODOT Standard Specifications require that concrete work be performed under dry conditions to ensure that uncured or green concrete do not enter a stream. Dewatering, containment, and stream diversion may be necessary (see Work Area Isolation, Section 2.3.9). The removal of old abutments, piers, and pilings, and installation drilled pilings are separated from other bridge installation activities due to the effects to aquatic species (see Pile Removal and Pile Driving, Section 2.3.19).

Avoidance and Minimization Measures:
The following measures will be implemented for all projects performed under this PBA that have new and replacement bridges and cross streams with listed aquatic species, either during design or in Contract Special Provisions. These measures may be modified as long as project meets Program Goals as per Section 1.5; modifications require NMFS or USFWS approval, depending on species, see Section 2.6; 3.2 PBA.

18-1. Only new crossings that reconnect stream channels with floodplains and do not represent part of a new road network are covered by this PBA (see Section 2.3.25).

18-2. For any replacement permanent stream crossing, describe in the Project Notification how the bridge will not impair the physical and biological processes associated with a fully functional floodplain, and will restore any physical or biological process that was degraded by the previous crossing (see Administration, Section 3.4.2 PBA).

18-3. Design stream crossings to maintain or restore floodplain function by meeting the following conditions:

i. Meet NMFS fish passage criteria (NMFS 2008c, or latest version).
ii. For single span structures, structural fill that is at least as wide as 1.5 times the active channel width.
iii. For multiple span structures, structural fill that is at least as wide as 2.2 times the active channel width.
iv. Provide the basic goals of a functional floodplain (see Glossary, Appendix A PBA), including:
    - Maintain the general scour prism, as a clear, unobstructed opening (i.e., free of any fill, embankment, scour countermeasure, or structural material).
    - Avoid local bank scour or stream bottom downcutting.
    - Allow the fluvial transport of large wood, up to one site potential tree height in size, through the project area without becoming stranded on the bridge structure.
    - Allow for natural channel migration patterns within the functional floodplain for the design life of the bridge.

18-4. Ensure the removal of all other artificial constrictions within the functional floodplain within the project limits that are not otherwise a component of the final project design.

18-5. If a replacement or new bridge cannot provide basic goals of a functional floodplain, offset the functional equivalent of the area of floodplain fill, either on-site when property is available, or off-site when suitable protected lands are available. Generally, the standard is removal of the same quantity of floodplain fill in the same subbasin, although alternatives may be proposed/negotiated with NMFS or USFWS, depending on species (see Section 2.6; 3.2 PBA).

2.3.19 Pile Removal and Pile Driving

Driven piles are often used to support temporary structures such as detour bridges and work bridges. They may also be used to provide additional support to permanent spread footings (see Section 2.3.18). The size and type of piles depends on site conditions, substrate, and load generated by the bridge and expected introduced load from traffic, and other design considerations. The best placement of piles sometimes requires exploratory pile driving. For replacement bridges, old piles are typically removed during other bridge demolition activities.

Pile driving may be accomplished by vibratory or impact hammer (air steam, open-end diesel, closed-end diesel, gravity, or hydraulic hammers), supported on the temporary work bridge or land. Typically, harder substrates require the use of impact hammers, and bearing capacity can only be determined with impact hammers. Pile driving equipment must be approved by ODOT. Additional work components for steel pile driving include pile cushions to protect the heads of concrete piles, metal helmets to protect impact hammers, hammer cushions to prevent damage to the hammers or piles (ODOT Standard Specifications disallow the use of wood, wire rope, or asbestos hammer cushions), a follower to transmit energy, and leads to support the piles in line. In some cases, piles are installed by pre-drilling and setting the piles.

Permanent steel piles may be epoxy-coated to provide corrosion protection, and have a cast-in-place concrete pile cap or an outer sealant to prevent coal/tar from leaching into aquatic habitats. After the piles are driven, concrete pile caps are typically formed, reinforced steel placed, and the concrete poured.

ODOT Standard Specifications require that concrete work be performed under dry conditions (uncured or green concrete is not allowed to enter a stream). Dewatering, containment, and stream diversion may be necessary (see Section 2.3.9).

Avoidance and Minimization Measures:
The following measures will be implemented for all projects performed under this PBA that involve removal or installation of bridge piles below the bankfull elevation (see Glossary, Appendix A PBA) of streams with protected aquatic species, either during design or in Contract Special Provisions:

19-1. During removal of bridge piles below the OHWE, in addition to standard pollution and erosion control measures (see Section 2.3.5) implement the following measures to minimize creosote release, sediment disturbance and total suspended solids:

i. Install floating surface booms or other measures to capture floating surface debris.
ii. Utilize methods to dislodge piles that minimize sediment disturbance.
iii. Fill the holes left by each removed pile with clean, native sediments

immediately upon removal.

iv. For broken or intractable piling:

- Do not excavate broken or intractable piles.
- If a pile in uncontaminated sediment is intractable or breaks above or below the water surface, when feasible, cut off the pile or stump at least three feet below the surface of the sediment; cap with clean, native substrates that match surrounding streambed materials.
- If a pile in contaminated sediment is intractable or breaks above the surface, when feasible, cut off the pile or stump at the sediment line.
- If a pile breaks below the surface in contaminated sediment, make no further effort to remove it and cover the hole with a cap of clean substrate appropriate for the site.
- If dredging is likely where broken piles are buried, use a GPS device to record the location of all broken piles for future use in site debris characterization.

19-2. Implement the following hydro-acoustic impact minimization measures for pile driving below bankfull elevation. These may be modified as long as project meets Program Goals as per Section 1.5; modifications require NMFS or USFWS approval, depending on species (see Section 2.6; 3.2 PBA).

i. Design or specify pile made of untreated wood, hollow steel, H-pile made of concrete, steel round pile or H-pile less than 36 inches in diameter in which both pile size and numbers of driven piles are minimized.

ii. When practicable, use drilled shafts or a vibratory hammer for installing piles (i.e., avoid impact pile driving).

iii. If concrete or steel pile must be installed by impact hammer, require that the Contractor prepare and implement a Noise Attenuation Plan (NAP) for review and approval by NMFS and/or USFWS.

iv. The NAP must include a confined bubble curtain system, design details, performance testing, schedule, and a plan for monitoring and maintenance to achieve proper function.

v. Only allow pile driving with an impact hammer between one hour after sunrise and one hour before sunset, regardless of the material type. This is to ensure that pile driving does not occur at dawn or dusk, the peak movement period for juvenile and adult ESA-listed fish.

vi. In the event of an observance of any dead, injured, or distressed fish, collect the specimens if possible and immediately notify NMFS or USFWS, depending on species.

19-3. Avoid pile driving in Oregon chub, Lost River and short-nosed sucker spawning habitat when spawning adults, eggs and fry are present. Refer to Measure 19-2 for hydroacoustic minimization measures at other times.

2.3.20 Culvert Extension, Repair and Installation

Culverts are used to convey various forms of flowing water underneath the roadway, from stream crossings to storm drains. ODOT must design replacement culverts in fish bearing streams to meet ODFW fish passage standards (ODFW 2011). To meet these standards, culverts are typically countersunk below the overall longitudinal flowline profile and backfilled with a rock substrate mix to provide a simulated streambed throughout the culvert. The rock substrate mix may be imported or suitable in-situ material may be obtained from construction excavation, and range from very large, angular boulders to fine sands and silts. Larger boulders help hold the reconstructed channel in place during the design flood, preventing channel head cutting and formation of new fish passage barriers. Finer materials may be specified to help fill interstitial spaces between the larger rocks, keeping the stream from flowing subsurface. The substrate material may be field-blended with high pressure water to ensure a mixture of size classes and fill interstitial spaces and voids between the larger materials to simulate "water compaction" and reduce sub-surface flows.

Culverts and drain pipes may be lined as opposed to replaced when trenching and replacing the pipe are cost prohibitive. Pipe lining work typically takes less time than more invasive types of culvert replacement work. Pipe lining consists of rehabilitating existing pipes by furnishing and installing pipe liners by pipe bursting and lining, slip lining, or cured-in-place lining. Resin is typically used for the rehabilitation process, as well as general purpose or enhanced strength unsaturated, thermosetting, polyester, vinylester, or epoxy resin and a catalyst system compatible with the installation process. Prior to lining operations, the pipe is flushed and cleaned to remove all debris and obstructions. Cleaning methods may include washing with high-pressure water, mechanical removal, sandblasting of the walls, entry with hand tools, or other methods as approved by ODOT.

<u>Avoidance and Minimization Measures:</u>
The following measures will be implemented for all projects performed under this PBA with culverts or drain pipes installed or repaired in streams with protected aquatic species, during design or in Contract Special Provisions:

20-1. Ensure structures meet stormwater management standards (Section 2.3.26).

20-2. ODOT will ensure that fish passage, work area isolation and containment are implemented as needed to protect aquatic and riparian habitat during culvert replacement and repair activities.

2.3.21 Painting and Coating

Several highway components require painting and coatings for protection from the elements, and for aesthetics. Most projects entail removing old/deteriorated paint, coating, or markings, and replacing them with newer materials. Components subject to repainting or recoating will be cleaned of all existing coating and corrosion down to clean, bare steel, typically by sand blasting or high pressure water jetting.

Painting and coating activities may occur off-site at a factory, at Contractor's offices, in staging areas, or in-place. Powder coating involves preparing and powder coating new and existing metal structures and features, including steel, galvanized, aluminum, and other specified surfaces. ODOT's Standard Specifications (Section 00594.05) have detailed containment requirements for field preparation and painting/coating, and hazardous waste pollution control (see Appendix B). Re-coating materials will not contain lead.

Waste material becomes the property of the Contractor at the point of origin. This includes all grindings and all removed marking material. Disposal must follow standard pollution control measures (see Appendix B PBA, Section 00290.20).

Avoidance and Minimization Measures:
The following measures will be implemented for all projects performed under this PBA with painting and coating, or similar types of chemical applications, near habitat supporting listed aquatic species, during design or in Contract Special Provisions:

21-1. Whenever practicable, ensure that painting, coating or other similar chemical applications are conducted at an approved off-site facility or within a designated staging area (see Section 2.3.4).

21-2. Ensure that work area isolation and containment is implemented, as needed to protect aquatic and riparian habitat during painting, coating, or other activities that may have similar water quality effects.

2.3.22 Asphalt and Concrete Paving

Typical paving construction activities include: (1) grind/inlay of various existing asphalt; (2) construction or reconstruction of new and existing subgrade (the in-situ material underneath a constructed roadbed) and shoulders; (3) reconstruction of various interchanges; and (4) installation of precast and cast-in-place concrete features. Paving projects may be preservation of the existing roadway without any upgrades, or may entail safety improvements to correct steep slopes or roadway grades (e.g., due to subsidence, pull-outs, drainage, stream bank scour, guardrail end treatments. Even with strict preservation projects, guardrail, culverts or drainage systems are often replaced. Shoulder widening may take place as needed to improve safety and to provide anchoring support needed for guardrail, especially in areas with steep irrecoverable slopes and unprotected culvert ends. Additional lanes may be added to Intersection or Safety projects such as the addition of turning or passing lanes or chain-up areas, or to Modernization projects when additional capacity is needed.

Avoidance and Minimization Measures:
No distinct Avoidance and Minimization Measures are proposed for this activity. Refer to related Avoidance and Minimization Measures, including Sections 2.3.1 (General Construction), through 2.3.5 (Erosion, Sedimentation and Pollution Control).

2.3.23 Other Permanent Roadway Structures

Transportation facilities involve many permanent roadway structures not described in other sections of this PBA. These may include, but are not limited to (per ODOT Standard Specifications; ODOT 2008a): retaining and sound walls (Sections 00596-00597), various forms of safety barriers (cable barrier, bollards, concrete barrier, impact attenuators; Section 00800), various forms of signs (Sections 00905-00941), fences (Section 01050), electrical systems (Section 00950-00965), roadway illumination (Section 00970), signals (Section 00990), and irrigation systems (Section 01100). These seemingly disparate activities are grouped in this section because each may involve ground disturbing work. With the exception of situations where the features cross riparian areas and streams (some electrical lines may require stream crossings), the majority of the work is on upland habitat beyond the road shoulder or median. The work may involve clearing, grubbing and earthwork (see Section 2.3.10) and possibly trenching similar to that described under Culvert Extension, Repair and Installation (see Section 2.3.20).

<u>Avoidance and Minimization Measures:</u>
The following measures will be implemented for all projects performed under this PBA that have other permanent roadway structures in areas described below, either during design or in Contract Special Provisions:

23-1. If any listed plants or habitat for Fender's blue butterfly (see Covered Species, Section 1.4) occur within the construction footprint of these permanent roadway features (based on pre-construction surveys as per Section 2.2), design the project to avoid damaging plants or removing habitat. See Avoidance and Minimization Measure 1-9 if avoidance is not feasible.

23-2. If night lighting is added to bridges over streams with listed fish or within 300 feet of suitable nesting habitat for northern spotted owl or marbled murrelet (this distance may be modified based on site conditions and justified in the Project Notification, see Section 3.4.2):

i. Design permanent lighting such that it is directed on the roadway facilities, not into habitat areas; and
ii. Include contract specifications that restrict use of temporary construction lighting directed into habitat areas.

23-3. Design Agency owned utility lines to avoid trenching through streams or floodways that support listed aquatic species whenever practicable. This can be achieved by designing aerial lines or directional drilling, boring and jacking that span the floodway. If trenching through streams or floodways that support listed aquatic species is necessary:

i. Backfill trenches with native material and cap portions within streams with clean gravel suitable for fish use in the project area.
ii. Align each crossing as perpendicular to the watercourse as possible, and for drilled, bored or jacked crossings, ensure that the utility line is

below the total scour prism.

iii. Return any large wood displaced by trenching or plowing to its original position (as nearly as possible), or otherwise replace as per Avoidance and Minimization Measure 12-2.

iv. Restore habitat functions (see Section 2.3.24).

2.3.24 Site Restoration and Enhancement Plantings

Standard specifications require seeding for temporary and permanent erosion control (see Appendix B PBA, Section 00280). The Contractor must temporarily stabilize exposed soils every 14 days or more frequently if needed or directed by ODOT. Permanent seeding must be completed within certain time frames depending on geographic and climatic conditions. ODOT will provide a seed mix and fertilizer requirements in project Special Provisions. Application methods may entail direct seeding (by hand, drill, blower or spreader) or hydroseeding (with or without hydromulch and tackifier). Special Provisions may specify the method. Unlike woody plantings, seeding requires an establishment period only as long as needed to meet soil coverage requirements.

Woody plantings will be a design feature, included in Roadside Development Plans. Standard Specifications describe approved methods and acceptance criteria for plantings (see Appendix B PBA, Section 01040). Project Plans and Specifications will describe planting locations, preparation, species and plant sizes, soil amendments, and requirements for herbicide or pesticides. The Contractor is responsible for maintaining plantings during the specified plant establishment period (typically one year after installation). For full payment, the Contractor must replace dead plantings.

ODOT and FHWA avoid extending plant establishment beyond the one year establishment period to limit the time Construction Contracts are left open, for legal requirements and to reduce Contract management costs. The allowance for replacement plantings at the end of the one-year establishment period means the Contractor will no longer be responsible for subsequent plant care. To solve the problem of poor maintenance and survival of mitigation plantings, ODOT has dedicated funding for post-construction restoration site management. Success of restoration plantings has dramatically improved since this program became available.

Another option that ODOT has for improving success of restoration plantings is to set aside funds from the Contract to independently hire a landscaping Contractor. This may be conducted when ODOT wants to be more directly involved with the planting work or utilize the same Contractor for design, planting and longer establishment periods.

<u>Avoidance and Minimization Measures:</u>
The following measures will be implemented for all projects performed under the PBA/PBO with temporary ground disturbances within the following areas: (1) the functional floodplain and riparian zone of listed aquatic species (see Glossary, Appendix A), and (2) the range of and potential habitat for northern spotted owl or marbled murrelet, Fender's Blue butterfly and listed plants in this Programmatic, during design or in Contract Special Provisions:

24-1. Do not install trees or shrubs within the 20 feet of roadway clear zone (the area adjacent to the roadway needed for sight distance and safety), bridges, culverts, behind guardrail or adjacent to other permanent roadways structures[18].

24-2. Develop a Site Restoration Plan for submittal with the Project Notification (see Administration, Section 3.4.2 PBA).

24-3. The goals of site restoration are:

i. Human and livestock disturbance, if any, are confined to small areas necessary for access or other special management situations.
ii. Areas with signs of significant past erosion are completely stabilized and healed, bare soil spaces are small and well-dispersed.
iii. Soil movement, such as active rills and soil deposition around plants or in small basins, is absent or slight and local.
iv. Native woody and herbaceous vegetation, and germination micro-sites, are present and well distributed across the site.
v. Plants have normal, vigorous growth form, and a high probability of remaining vigorous, healthy and dominant over undesired competing vegetation.
vi. Vegetation structure has rooting throughout the available soil profile.
vii. Plant litter is well distributed and effective in protecting the soil with little or no litter accumulated against vegetation as a result of active sheet erosion ("litter dams").
viii. A continuous corridor of shrubs and trees appropriate to the site are present to provide shade and other habitat functions for the entire streambank.
ix. Streambanks are stable, well vegetated, and protected at margins by roots that extend below baseflow elevation, or by coarse-grained alluvial debris.

24-4. Base species on pre-construction data or reference sites[19], differentiated among revegetation units as appropriate for slope and aspect, hydrology, and soils, and will include a range of successional stages (early, mid, and late) (following guidance in FHWA 2007). Locate reference site within the same watershed, ecoregion, or recovery zone (depending on species).

24-5. Install revegetation seeding and plantings at the appropriate planting season (see Appendix B PBA, Section 01040).

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[18] This is an ODOT standard to minimize potential conflicts with routine maintenance and safety needs.
[19] Reference sites should have similar site characteristics as the corresponding revegetation unit.

24-6. Exclude livestock from restoration areas on Agency-owned lands using wildlife-friendly fencing, unless otherwise justified and presented in the Project Notification (see Section 3.4.2 PBA).

24-7. Measure revegetation success separately in each revegetation unit. Base success criteria on the average percent cover of each stratum in the pre-construction or reference site revegetation unit, minus 20 percent, or as otherwise described in the site restoration plan. (Example calculation: reference site revegetation unit has 30 percent average herbaceous cover and 70 percent average tree and shrub canopy cover; success will then be measured as at least 10 percent herbaceous cover and 50 percent tree and shrub canopy cover.)

24-8. Perform annual monitoring of Site Restoration areas until site restoration goals (Measure 24-3) and success criteria (Measure 24-7) have been met, following ODOT Biology Mitigation Monitoring standards (http://www.oregon.gov/ODOT/HWY/GEOENVIRONMENTAL/biology/mon.shtml) (see Section 3.4.5 PBA).

2.3.25 Channel Modification and Waterway Enhancements

Waterway enhancements encompass the range of in-stream and riparian habitat improvements for fish passage or stream restoration. ODOT has boiler plate Special Provisions (currently in SP01091; ODOT 2011a) for constructing waterway enhancements using fish rocks, logs, boulders, gravels, and other types of waterway habitat elements, that may be updated as needed to comply with current regulatory guidance. The following types of channel modifications and waterway enhancements in streams with ESA-listed species or critical habitat are covered by this PBA (from SLOPES IV for Restoration, NMFS 2008b). Channel modifications or waterway enhancements in non-ESA fish bearing streams or critical habitat are also covered as long as the action has no adverse effect to downstream ESA-listed resources.

Main Types of Channel Modifications/Enhancements:

i. Boulder Placement to increase habitat diversity and complexity, improve flow heterogeneity, provide substrate for aquatic vertebrates, moderate flow disturbances, and provide refuge for fish during high flows by placing large boulders in stream beds where similar natural rock has been removed.

ii. Large Wood Restoration to increase coarse sediment storage, habitat diversity and complexity, retain gravel for spawning habitat, improve flow heterogeneity, provide long-term nutrient storage and substrate for aquatic macro invertebrates, moderate flow disturbances, increase retention of leaf litter, and provide refuge for fish during high flows by placing large wood in areas where natural wood accumulations have been removed.

iii. Spawning Gravel Restoration to improve spawning substrate by compensating for an identified loss of a natural gravel supply.

iv. Piling Removal to improve water quality by eliminating chronic sources of toxic contamination.

v. Streambank Restoration to restore eroding streambanks by (a) bank shaping and installation of coir logs or other soil reinforcements as necessary to support riparian vegetation; (b) planting or installing large wood, trees, shrubs, and herbaceous cover as necessary to restore ecological function in riparian and floodplain habitats; or (c) a combination of the above methods.

vi. Fish Passage Restoration to improve fish passage by installing or improving step weirs, fish ladders, or lamprey ramps at an existing facility, or replacing or improving culverts.

vii. Off- and Side-Channel Habitat Restoration to reconnect stream channels with floodplains, increase habitat diversity and complexity, improve flow heterogeneity, provide long-term nutrient storage and substrate for aquatic macro invertebrates, moderate flow disturbances, increase retention of leaf litter, and provide refuge for fish during high flows by restoring or modifying hydrologic and other essential habitat features of historical river floodplain swales, abandoned side channels, and floodplain channels.

viii. Set-back Existing Berms, Dikes, and Levees to reconnect stream channels with floodplains, increase habitat diversity and complexity, moderate flow disturbances, and provide refuge for fish during high flows by increasing the distance that existing berms, dikes or levees are set back from active streams or wetlands.

ix. Water Control Structure Removal to reconnect stream corridors, reestablish wetlands, improve fish passage, and restore more natural channel and flow conditions, by removing earthen embankments, subsurface drainage features, spillway systems, tide gates, outfalls, pipes, instream flow redirection structures (e.g., drop structure, gabion, groin), or similar devices used to control, discharge, or maintain water levels.

<u>Avoidance and Minimization Measures:</u>
The following measures will be implemented for all projects performed under this PBA that construct waterway enhancements in streams with listed aquatic species, during design or in Contract Special Provisions. Standards may be modified as long as the project meets Program Goals as per Section 1.5; modifications require NMFS or USFWS approval, depending on species (see Section 2.6; 3.2 PBA):

25-1. Obtain review/approval from NMFS and/or USFWS for the design and specifications of Activities v.-ix. above (Streambank Restoration, Fish Passage Restoration, Off- and Side-Channel Habitat Restoration, Set-back Existing Berms/Dikes/Levees, Water Control Structure Removal).

25-2. The following standards are required for design and implementation of boulder placement:

i. Stream reaches must have the following features:
   - An intact, well-vegetated riparian area, including trees and shrubs where those species would naturally occur, or that are part of riparian area restoration action.

- A stream bed that consists predominantly of coarse gravel or larger sediments.

ii. The cross-sectional area of boulders may not exceed 25 percent of the cross-sectional area of the low flow channel, or be installed to shift the stream flow to a single flow pattern in the middle or to the side of the stream.
iii. Boulders will be machine-placed (no end dumping allowed).
iv. Permanent anchoring, including rebar or cabling may not be used.

25-3. Step weir, fish ladder, and culvert replacement must be consistent with NMFS fish passage criteria (NMFS 2008c, or most recent version).

25-4. Include large wood in each streambank restoration action to the maximum extent feasible.

25-5. The following standards are required for the design and implementation of large woody material.

i. Stabilizing or key pieces of large wood that will be relied on to provide streambank stability or redirect flows must be intact, hard, and undecayed to partly decaying, and should have untrimmed root wads to provide functional refugia habitat for fish.
ii. Do not use decayed or fragmented wood found lying on the ground or partially sunken.
iii. Wood that is already within the stream or suspended over the stream may be repositioned to allow for greater interaction with the stream.

2.3.26 Stormwater Management

Information in this section is based on the most updated version of ODOT's Stormwater Management EPS. The purpose of this EPS is to ensure that road and highway projects are designed and implemented in a manner that manages project runoff to protect receiving waters and support their beneficial uses (ODOT 2011b). This section can actually be interpreted as both an activity and also Avoidance and Minimization Measures for related triggering activities described above.

Water quality treatment will be provided for projects that have one or more of the following triggering actions:

i. Produce new impervious surface area.
ii. Change the total Contributing Impervious Area (CIA; see Glossary, Appendix A PBA).
iii. Change the type, location, direction, length or endpoint of the pre-project stormwater conveyance system, including the addition of curbing.
iv. Replace or widen a stream crossing structure.
v. Require a Clean Water Act Section 404 permit and actively involve modification of impervious surfaces.
vi. Reconstructing the highway from the subgrade (in-situ material underneath a constructed roadbed).

Flow control of highway runoff will be provided when uncontrolled stormwater discharges to receiving streams increase by 0.5 cfs or more during the 10-year, 24-hour storm event when compared to pre-project conditions.

ODOT's stormwater management criteria are:

1. Treat all of the runoff generated by the Water Quality Design Storm (see Glossary, Appendix A) from the CIA using best management practices that are recognized as effective at treating highway runoff pollutants and incorporate infiltration, media filtration and filtration through vegetation (see ODOT Stormwater Management Program website, ODOT 2011c).
2. Avoid an increase in sediment transporting flows from pre-project to post-project (i.e., match the existing hydrology) by managing runoff between the following design storms:
    - 42 percent of the 2-year, 24-hour event in western Oregon or 50 percent of the 2-year, 24-hour event in Eastern Oregon.
    - Either the channel over-topping event for streams with an entrenchment ratio that is greater than or equal to 2.2 (i.e., slightly incised) or the 10-year, 24-hour event for streams with an entrenchment ratio that is less than 2.2 (i.e., moderately to severely incised).

Exceptions:

Certain individual minor actions do not automatically trigger the requirement to meet the Stormwater EPS. Actions that are not required to treat stormwater runoff involve impervious surfaces that are not intended for use by motor vehicles or for other pollutant generating activities, sheet flow to pervious surfaces, or are limited in area so generate relatively little stormwater runoff. The following actions are excluded from the water quality portion of the Stormwater EPS:

- Sidewalk and bicycle/pedestrian paths that do not result in substantial alteration of the highway drainage system.
- Small, localized increases in impervious area for non-driving purposes.
- Small, localized excavation into the subgrade and repaving for maintenance actions or as part of 1R projects (single-lift, non-structural overlay or inlay as described in ODOT Technical Services Bulletin TSB09-01(B); ODOT 2009a).
- Repair or replacement in-kind of existing stormwater drainage facilities.

Projects whose triggering actions consist solely of an individual turn lane or the replacement of a stream culvert are not required to treat the whole contributing impervious area. These types of projects are required to provide "opportunistic" water quality treatment for the runoff only for the impervious surface that was modified by the action (removed and replaced or increased). An example would be directing runoff to a vegetated ditch instead of directly discharging to a waterbody.

Projects are exempt from the flow control portion of the Stormwater EPS if the project:

i. Discharges directly into large water bodies. Large water bodies include main stem rivers, lakes, reservoirs and estuaries.
ii. Discharges into other waterbodies where it can be demonstrated that hydrological

changes will not have adverse morphological or ecological effects. This may include waterbodies with tidally controlled or influenced hydrology, streams with lakes or reservoirs a short distance downstream of the project discharge point, and those wetlands, or other waterbodies where hydrologic/hydraulic analysis shows non-substantial effects.

Minimization Measure

The following measure will be implemented for all projects performed under this PBA that trigger stormwater management and contribute stormwater runoff to streams with listed aquatic species, except where exempted above:

26-1. If the stormwater management criteria above cannot be fully met on-site, offset the functional equivalent of the CIA off-site when suitable protected lands are available, although alternatives may be proposed/negotiated with NMFS or USFWS, depending on species. Generally, the standard is treatment within the same watershed for stormwater from a comparable CIA with similar traffic volumes (average Annual Daily Traffic, ADT).

APPENDIX B: STATUS OF THE SPECIES—BIOLOGICAL INFORMATION AND CRITICAL HABITAT (section 4.1 of PBO)

4.1.1 Marbled Murrelet (Brachramphus marmoratus)

Detailed accounts of murrelet taxonomy, ecology, and reproductive characteristics are available in the 1988 Status Review (Marshall 1988), the final rule designating the species as threatened (USFWS 1992, page 45328), the final rule designating critical habitat for the species (USFWS 1996, page 26256), the Service's BO for Alternative 9 (USFWS 1994) of the Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Spotted Owl (USDA and USDI 1994a), the Recovery Plan for the Threatened Marbled Murrelet (USFWS 1997), the 2004 Evaluation Report prepared by EDAW, Inc. for the murrelet 5-year review (McShane et al. 2004), and the status review of the Marbled Murrelet (*Brachyramphus marmoratus*) in Alaska and British Columbia (Piatt et al. 2006).

The murrelet was federally listed as a threatened species in Washington, Oregon, and northern California on September 28, 1992 (USFWS 1992). The final rule designating critical habitat for the murrelet (USFWS 1996) became effective on June 24, 1996. The Service proposed to revise the final critical habitat designation on September 12, 2006 (USFWS 2006), but this revision was not adopted (USFWS 2008). The species' decline is largely due to the extensive removal of late-successional and old-growth coastal forests which provide nesting habitat for murrelets.

The Service recently determined that the California, Oregon, and Washington distinct population segment of the murrelet does not meet the criteria outlined in the Service's 1996 Distinct Population Segment policy (USFWS 2004). However, the murrelet retains its listing and protected status as a threatened species under the ESA until the original 1992 listing decision is revised through formal rule-making procedures, involving public notice and comment.

The Marbled Murrelet Recovery Plan (USFWS 1997) identified the primary threats to the species: 1) predation; 2) loss of nesting habitat; 3) by-catch in gill-nets, and; 4) oil pollution due to both chronic and major spills. McShane et al. (2004) concluded that all threats are still present, although nesting habitat loss, particularly on Federal lands, has declined and the threat of by-catch in gill-nets has been reduced by regulations in California and Washington. Oil pollution continues to be an unpredictable threat, and its effects are variable. New information indicates that predation is a higher threat than before due to limited murrelet nest success (Marzluff and Restani 1999, Luginbuhl et al. 2001, Hebert and Golightly 2003). It is uncertain whether predation is considered an increased threat due to a better understanding of its magnitude or an actual increase in predation since listing (McShane et al. 2004).

The current 5 year review (USFWS 2009), continued to document threats listed above. Additional new information regarding the condition of the marine environment in the

3-state area includes harmful algal blooms, dead zones, prey availability and quality, and the
potential exacerbation of these conditions from climate change (USFWS 2009). This new information suggests there is an increase in the level of threats in the marine environment (USFWS 2009, page 46). Three new threats were identified, derelict fishing gear, energy development and production, and exposure to elevated underwater sound levels (USFWS 2009).

The Service also believes climate change is likely to further exacerbate some existing threats such as the projected potential for increased habitat loss from drought related fire, mortality, insects and disease, and increases in extreme flooding, landslides and windthrow events in the short-term (10 to 30 years). However, while it appears likely that the murrelet will be adversely affected, we lack adequate information to quantify the magnitude of effects to the species from the climate change projections described above (USFWS 2009).

The species' recovery plan refers to the NWFP as the backbone of the murrelet recovery effort (USFWS 1997). However, the plan strategically builds off the NWFP and considers non-Federal lands' recovery role. The NWFP contributes to murrelet recovery and conservation by providing large blocks of protected habitat in LSR land allocations within murrelet conservation zones along the Washington, Oregon, and California coasts. Furthermore, murrelet habitat is protected on Federal land under the NWFP. No new timber sales are planned in forested stands known to be occupied by murrelets regardless of whether these stands occur in LSRs, AMAs, or Matrix areas (USDA and USDI 1994b). Protocol surveys (Evans et al. 2003) are required in suitable habitat to determine occupancy prior to actions that result in habitat loss. In addition, the LSR system not only protects currently suitable murrelet habitat, but also develops future habitat in larger blocks.

Nesting Biology

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

Nest Tree Characteristics

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

Nest Stand Characteristics

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

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

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

Landscape Characteristics

Studies have determined the characteristics of murrelet nesting habitat at a landscape-scale using a variety of methods, including predictive models, radio telemetry, audio-visual surveys, and radar. McShane et al. (2004, pg. 4-103) reported, "At the landscape level, areas with evidence of occupancy tended to have higher proportions of large, old-growth forest, larger stands and greater habitat complexity, but distance to the ocean (up to about 37 miles [60 km]) did not seem important." Elevation had a negative association in some studies with murrelet habitat occupancy (Burger 2002). Nelson and Hamer (1995) sampled 45 nest trees in British Columbia, Washington, Oregon, and California and found the mean elevation to be 1,089 feet (332 m).

Multiple radar studies (e.g., Burger 2001, Raphael et al. 2002) in British Columbia and Washington have shown that radar counts of murrelets are positively associated with total watershed area, increasing amounts of late-seral forests, and with increasing age and height class of associated forests. Murrelet radar counts are also negatively associated with increasing forest edge and areas of logged and immature forests (McShane et al. 2004). Several studies have concluded that murrelets do not pack into higher densities within remaining habitat when nesting habitat is removed (Burger 2001, Cullen 2002).

There is a relationship between proximity of human-modified habitat and increased avian predator abundance. However, increased numbers of avian predators does not always result in increased predation on murrelet nests. For example, Luginbuhl et al. (2001, pg. 565) report, in a study using simulated murrelet nests, that "Corvid numbers were poorly correlated with the rate of predation within each forested plot". Luginbuhl et al. (2001, pg. 569), conclude, "that using measurements of corvid abundance to assess nest predation risk is not possible at the typical scale of homogenous plots (0.5-1.0 km^2 in our study). Rather this approach should be considered useful only at a broader, landscape scale on the order of 5-50 km^2 (based on the scale of our fragmentation and human-use measures)."

Artificial murrelet nest depredation rates were highest in western conifer forests where stand edges were close to human development (De Santo and Willson 2001, Luginbuhl et al. 2001), and Bradley (2002) found increased corvid densities within 3 miles of an urban interface, probably due to supplemental feeding opportunities from anthropogenic activities. Golightly et al. (2002) found extremely low reproductive success for murrelets nesting in large old-growth blocks of redwoods in the California Redwoods National and State Parks. Artificially high corvid densities from adjacent urbanization and park campgrounds are suspected to be a direct cause of the high nesting failure rates for murrelets in the redwoods parks.

If the surrounding landscape has been permanently modified to change the predators' numbers or densities through, for example, agriculture, urbanization, or recreation, and predators are causing unnaturally high nest failures, murrelet reproductive success may remain depressed. Because corvids account for the majority of depredations on murrelet nests and corvid density can increase with human development, corvid predation on murrelet habitat is a primary impact consideration. The threat of predation on murrelet populations (both nests and adults) appears to be greater than previously anticipated (McShane et al. 2004).

Available Nesting Habitat

At the conservation zone scale, murrelet abundance is positively correlated with the estimated amount of inland habitat (McShane et al. 2004). The precise number of acres of suitable habitat in Washington, Oregon, and California is not known. Based on agency estimates and the Service's internal section 7 files, there is roughly 2,223,048 acres of suitable murrelet habitat on Federal lands. Of this, 154,838 acres (7 percent) are classified as remnant habitat within the listed range of this species (McShane et al. 2004). McShane et al. (2004) reported that approximately 93 percent of the suitable habitat occurs on Federal lands. Further, they state Washington contains roughly 48 percent of suitable habitat in the listed range, while Oregon has 35 percent and California has 17 percent (McShane et al. 2004). Based on BioMapper data, Huff et al. (2006) estimated that 41 percent of highly suitable habitat occurs on non-Federal lands. While Huff et al. (2006) appears to document a larger amount of habitat on non-Federal land than McShane et al. (2004), their 41 percent only refers to highly suitable habitat, a subset of suitable habitat.

On Federal lands under the NWFP surveys are required for all timber sales that remove murrelet habitat. If habitat outside of mapped Late-Successional Reserves (LSRs) is found to be used by murrelets, then the habitat and recruitment habitat (trees at least 0.5 site potential tree height) within a 0.5-mile radius of the occupied behavior is designated as a new LSR. Timber harvest within LSRs is designed to benefit the development of late-successional conditions, which should improve future conditions of murrelet nesting habitat. Designated LSRs not only protect habitat currently suitable to murrelets (whether occupied or not), but will also develop future suitable habitat in large blocks.

Suitable inland nesting habitat and the number of breeding sites have declined throughout the listed range since 1992 (McShane et al. 2004). Although the rate of habitat loss on Federal lands has slowed, the status of the species continues to be suffering from the effects of historic habitat loss (McShane et al. 2004). The reduction of habitat amount and quality in combination with high predation levels may be the greatest threat to murrelet population viability (McShane et al. 2004).

Demography and Vital Rates

The present population estimate for the murrelet within the coterminous United States is about 17,354 (95 percent confidence interval of 12,800-21,909) (Falxa 2008). This is based on 2007 survey data for zones 1-5. Spiech and Wahl (1995) concluded murrelet populations in Puget Sound are lower now than they were at the beginning of this century, and the current total estimate for Washington is 9,510 murrelets (Falxa et al. 2008). Oregon has an estimated 6,290 murrelets (Crescent Coast Research 2008).

California populations are estimated to be at 1,554 murrelets (Crescent Coast Research 2008, Flaxa 2008).

Beissinger (1995) constructed a demographic model of the murrelet and concluded that the population may be declining at rates of 4-6 percent per year, but this estimate is hampered by the possibility that the age-ratio data used in the model are reflective of a relatively temporary decline due to unusual ocean conditions (Ralph and Miller 1995). Boulanger et al. (1999) found change in adult survivorship is the single most important factor when projecting demographic trends for murrelets. Similarly, Strong suggests there may have been a 50 percent decline from 1992 to 1999 in the Oregon population, which generally appears to have stabilized since (Strong 2003a and 2003b). Other sources (e.g., Bessinger and Peery 2003) document continued declines in Oregon. Ralph and Miller (1995) summarized some of the reasons for variability in population estimates among researchers, including differences in methodology, assumptions, spatial coverage, and survey and model errors. Lank et al. (2003) state, "Regardless of the approaches taken to estimate [(sic) vital rate] parameter values, the output from the Leslie matrix models representing survivorship and fecundity values for all populations in Washington, Oregon and California (Beissinger and Nur 1997) suggest negative population growth rates." Present at-sea surveys for effectiveness monitoring have a 95 percent chance of detecting annual population changes of ±20 percent or greater.

Recovery and Conservation Planning

The murrelet recovery plan divides their range into six conservation zones to help meet its objective of maintaining a well-dispersed population. Zone delineation was based on current population and habitat distributions, threats, and geopolitical boundaries. Zone delineations will assist in the design of management actions and evaluation of impacts at several scales. They are also the functional equivalent of recovery units as defined by Service policy. McShane et al. (2004) produced a demographic model of murrelet populations in Washington, Oregon, and California by each of the six conservation zones. Similar to previous studies, they found that populations in all conservation zones are declining, with mean annual decline rates between 2.1 and 6.2 percent. The highest rates of decline were in zone 6 at the southern extent of the range. Furthermore, they concluded it is likely that populations in zone 5 and 6 could become non-viable in the near future.

The six recovery zones include the following: Puget Sound (conservation zone 1), Western Washington Coast Range (conservation zone 2), Oregon Coast Range (conservation zone 3), Siskiyou Coast Range (conservation zone 4), Mendocino (conservation zone 5), and Santa Cruz Mountains (conservation zone 6). As specified in the murrelet's recovery plan, pursuant to the ESA, jeopardy/non-jeopardy conclusions for the murrelet will be made for each affected conservation zone rather than exclusively at the species' listed range. However, our overall jeopardy/non-jeopardy determination will include consideration of the long-term viability of the overall population and metapopulations in all conservation zones. Accordingly, the following discussion and analysis for this action will focus on conservation zones 3 and 4.

Conservation Zone 3 (Oregon Coast Range Zone)

This zone extends from the Columbia River, south to North Bend, Coos County, Oregon. Conservation zone 3 includes waters within 2 km (1.2 miles) of the Pacific Ocean shoreline and extends inland a distance of up to 56 km (35 miles) from the Pacific Ocean shoreline and coincides with the zone 1 boundary line. This zone contains the majority of murrelet sites in Oregon. Murrelet sites along the western portion of the Tillamook State Forest are especially important to maintaining well-distributed murrelet populations. Maintaining suitable and occupied murrelet habitat on the Elliot State Forest, Tillamook State Forest, Siuslaw NF, and BLM-administered forests is an essential component for the stabilization and recovery of murrelets (USFWS 1997). Beissinger and Peery (2003) estimated a 2.8 to 13.4 percent population decline for this zone. In 2006, this population was 6,375 (4,569-7,429) birds (Crescent Coast Research 2008). In 2007, the population declined to 3,996 (2,500-6,253) birds, the lowest estimates since population and productivity monitoring started in 2000 (Crescent Coast Research 2008).

Consulted on effects within this Zone, since October 1, 2003 trough December 17, 2009, has included 850 acres of habitat removed. Federal NWFP lands effects include the removal of 234 acres of suitable habitat and 30 acres of potential nesting structure in younger stands. Tribal lands effects include the removal of 276 acres of suitable habitat. Non-Federal lands effects include the removal of 190 acres of suitable habitat and 120 acres of potential nesting structure in younger stands.

Conservation Zone 4 (Siskiyou Coast Range Zone)

The Siskiyou Coast Range zone extends from North Bend, Coos County, Oregon south to the southern end of Humboldt County, California. It includes waters within 1.2 miles of the Pacific Ocean shoreline (including Humboldt and Arcata bays) and, generally extends inland a distance of 56 km (35 miles) from the Pacific shoreline. This zone contains populations in Redwood National Park and several state parks. It contains nesting habitat on private lands in southern Humboldt County and at lower elevations in the western portions of Smith River National Recreation Area (USFWS 1997). Beissinger and Peery (2003) estimated a 2.5 to 13.2 percent population decline for this zone. Currently, this population has 3,791 (2,687-7,342) birds (Falxa 2008). Since 2003, population estimates declined about 15 percent over the past four years.

Consulted on effects within this Zone, since October 1, 2003 trough December 17, 2009, has included 4,742 acres of habitat removed. Federal NWFP lands effects include the removal of 3,770 acres of suitable habitat. Tribal lands effects include the removal of 972 acres of suitable habitat.

4.1.2 Marbled Murrelet Critical Habitat

Critical habitat consists of geographical areas essential to the conservation of a listed species. Under the Act, conservation means to use and the use of all methods and procedures which are necessary to bring an endangered species or threatened species to the point at which the measures provided pursuant to the Act are no longer necessary.

Critical habitat is provided protection under section 7 of the Act by ensuring that activities funded, authorized, or carried out by federal agencies do not adversely modify such habitat to the point that it no longer remains functional (or retains its current ability for primary constituent elements to be functionally established) to serve the intended conservation role for the species.

On May 24, 1996, the Service designated critical habitat for the marbled murrelet within 104 critical habitat Units (CHUs) encompassing approximately 3.9 million acres across Washington (1.6 million), Oregon (1.5 million), and California (0.7 million). The final rule became effective June 24, 1996. The final rule intended the scope of the section 7(a)(2) analysis to evaluate impacts of an action on critical habitat at the conservation zone(s) or even a major part of a conservation zone (USFWS 1996, page 26271).

On July 31, 2008, the Service proposed reducing critical habitat in Northern California and Oregon. New information indicates that these areas do not meet the definition of critical habitat (USFWS 2008b, page 44678). This proposed rule has not been finalized and consultation is on the 1996 critical habitat.

Primary Constituent Elements

Primary constituent elements (PCEs) are physical and biological features the Service determines are essential to a species' conservation (i.e., recovery). The primary constituent elements for the marbled murrelet are: (1) individual trees with potential nesting platforms; and (2) forested lands of at least one half site potential tree height regardless of contiguity within 0.8 kilometers (0.5 miles) of individual trees with potential nesting platforms, and that are used or potentially used by murrelets for nesting or roosting (USFWS 1996, page 26264). The site-potential tree height is the average maximum height for trees given the local growing conditions, and is based on species-specific site index tables. These primary constituent elements are intended to support suitable nesting habitat for successful reproduction of the marbled murrelet.

Critical Habitat Objectives

The Service's primary objective in designating critical habitat was to identify existing terrestrial murrelet habitat that supports nesting, roosting, and other normal behaviors that require special management considerations and to highlight specific areas where management should be given highest priority. The Service designated critical habitat to protect murrelets and their habitat in a well-distributed manner throughout the three states. Critical habitat is primarily based on the LSRs identified in the Northwest Forest Plan (approximately 3 million acres of critical habitat are located within the 3.9 million acre LSR boundary designation). These LSRs were designed to respond to the problems of fragmentation of suitable murrelet habitat, potential increases in predation due to fragmentation, and reduced reproductive success of murrelets in fragmented habitat. The

LSR system identifies large, contiguous blocks of late-successional forest that are to be managed for the conservation and development of the older forest features required by the murrelet, and as such, serve as an ideal basis for murrelet critical habitat. Where Federal lands were not sufficient to provide habitat considered critical for the survival and recovery of the murrelet, other lands were identified, including state, county, city and private lands (USFWS 1996).

Current Condition

The majority (77 percent) of designated critical habitat occurs on Federal lands in LSRs as identified in the Northwest Forest Plan. Because of this high degree of overlap with LSRs and LSR management guidelines, the condition of most of the range-wide network of murrelet critical habitat has experienced little modification of habitat since designation. Consultation data indicates 217 acres of critical habitat removed in Oregon, of which 137 acres was associated with Tribal activities in the Siskiyou Coast Range Zone and 80 acres associated with Federal activities in the Oregon Coast Range Zone (October 1, 2003 - December 17, 2009).

4.1.3 Northern Spotted owl (Strix occidentalis caurina)

Detailed accounts of the taxonomy, ecology, and reproductive characteristics of the spotted owl are found in the 1987 and 1990 USFWS Status Reviews (USFWS 1987, USFWS 1990a), the 1989 Status Review Supplement (USFWS 1989), the Interagency Scientific Committee (ISC) Report (Thomas et al. 1990), the Forest Ecosystem Management Assessment Team (FEMAT) Report (Thomas and Raphael 1993), and the final rule designating the spotted owl as a threatened species (55 FR 26114) and final rule designating critical habitat (57 FR 1796). The spotted owl is one of three subspecies of spotted owls currently recognized by the American Ornithologists' Union is typically associated with old-growth forested habitats throughout the Pacific Northwest. The taxonomic separation of these three subspecies is supported by genetic (Barrowclough and Gutierrez 1990), morphological (Gutierrez et al. 1995) and biogeographic information (Barrowclough and Gutierrez 1990).

Current and Historical Range

The current range and distribution of the spotted owls extends from southern British Columbia through western Washington, Oregon, and California, as far south as Marin County (USFWS 1990a). The southeastern boundary of its range is the Pit River area of Shasta County, California. The range of the spotted owl is partitioned into 12 physiographic provinces (provinces), based upon recognized landscape subdivisions exhibiting different physical and environmental features (Thomas et al. 1993). These provinces are distributed across the range as follows: 4 provinces in Washington (Washington Cascades East, Olympic Peninsula, Washington Cascades West, Western Lowlands), 5 provinces in Oregon (Oregon Coast Range, Willamette Valley, Oregon Cascades West, Oregon Cascades East, Klamath Mountains), and 3 provinces in California (California Coast, California Klamath, California Cascades). Although the current range of the spotted owl is similar to its historical range where forested habitat still exists (the distribution is relatively contiguous, but influenced by the natural insularity of habitat patches within geographic province, and by natural and man-caused fragmentation of vegetation), the owl is extirpated or uncommon in certain areas (e.g., southwestern Washington).

Habitat Relationships

Home Range

Spotted owl home range size varies by province. Home range generally increases from south to north, which is likely in response to decreasing habitat quality (USFWS 1990a). Home range size was linked to type, availability, and abundance of prey (Zabel et al. 1995).

Based on available radio-telemetry data (Thomas et al. 1990), the Service estimated median annual home range size for the spotted owl by province throughout the range of the owl. Because the actual configuration of the home range is rarely known, the estimated home range of an owl pair is represented by a circle centered upon an owl activity center, with an area approximating the provincial median annual home range. For example, estimated home range area varies from 3,340 acres (i.e., 1.3-mile radius area) in California to 9,731 acres (i.e., 2.2-mile radius circle) in Washington. The Service uses a 0.7 mile radius circle (i.e., 984 acres) to delineate the area most heavily used (i.e., core area) by spotted owls during the nesting season. Spotted owls in northern California focused their activities in core areas that ranged from about 167 to 454 acres, with a mean of about 409 acres; approximately half the area of the 0.7-mile radius circle (Bingham and Noon 1997). Spotted owls maintain smaller home ranges during the breeding season and often dramatically increase their home range size during fall and winter (Forsman et al. 1984).

Although differences exist in natural stand characteristics that influence provincial home range size, habitat loss and forest fragmentation caused by timber harvest effectively reduce habitat quality in the home range. A reduction in the amount of suitable habitat reduces spotted owl abundance and nesting success (Bart and Forsman 1992, Bart 1995).

Habitat Use

Forsman et al. (1984) report that spotted owls have been observed in the following forest types (Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), grand fir (*Abies grandis*), white fir (*A. concolor*), ponderosa pine (*Pinus ponderosa*), Shasta red fir (*A. magnifica shastensis*), mixed evergreen, mixed conifer hardwood (Klamath montane) and redwood (*Sequoia sempervirens*). Use by these types coincides with appropriate forest structure (see below). In parts of the Oregon Coast Range, owls have been recorded in pure hardwood stands. In California spotted owls are found from near sea level in coastal forests to approximately 2130 m in the Cascades (Gutierrez et al.1995). The upper elevational limits at which spotted owls occur decrease gradually with increasing latitude in Oregon and Washington. In all areas, the upper elevation limits at which owls occur correspond to the transition to subalpine forest, which is characterized by relatively simple structure and severe winter weather (Gutierrez et al.1995).

Roost sites selected by spotted owls have more complex vegetation structure than forest generally available to them (Barrows and Barrows 1978, Forsman et al. 1984, Solis and Gutierrez 1990). These habitats are usually multi-layered forests having high canopy closure and large diameter trees in the overstory.

Spotted owls nest almost exclusively in trees. Like roosts, nest sites are found in forests having complex structure dominated by large diameter trees (Forsman et al. 1984, Hershey1995). Even in forests that have been previously logged, owls select forests having a structure (i.e., larger trees, greater canopy closure) different than forests generally available to them (Folliard 1993, Buchanan et al. 1995, Hershey. 1995).

Foraging habitat is the most variable of all habitats used by territorial owls (Thomas et al. 1990). Descriptions of foraging habitat have ranged from complex structure (Solis and Gutierrez 1990) to owls that will forage in forests with lower canopy closure and smaller trees than forests containing nests or roosts (Gutierrez 1996).

Habitat Selection

Spotted owls generally rely on older forested habitats because they contain the structures and characteristics required for nesting, roosting, foraging, and dispersal. These characteristics of older forests include the following: a multi-layered, multi-species canopy dominated by large overstory trees; moderate to high canopy closure; a high incidence of trees with large cavities and other types of deformities; numerous large snags; an abundance of large, dead wood on the ground; and open space within and below the upper canopy for owls to fly (Thomas et al. 1990, USFWS 1990a). Forested stands with high canopy closure also provide thermal cover (Weathers et al. 2001), as well as protection from predation. Recent landscape-level analyses suggest that a mosaic of late-successional habitat interspersed with other vegetation types may benefit spotted owls more than large, homogeneous expanses of older forests (Franklin et al. 2000, Meyer et al. 1998). In redwood forests along the coast range of California, spotted owls may be found in younger forest stands with structural characteristics of older forests (Thomas et al. 1990). However, spotted owls do not generally appear to select for stands of intermediate or younger ages (Solis and Gutierrez 1990).

Ward (1990) found the spotted owls foraged in areas that had lower variance in prey densities (prey were more predictable in occurrence) within older forest and near ecotones of old forest and younger in brush seral stages. Presumably owls foraging in edge areas might encounter prey that ventured into the older forest. Zabel et al. (1995) showed that spotted owl home ranges are larger where flying squirrels are the predominant prey and, conversely, are smaller where woodrats are the predominant prey.

Population Dynamics and Trends

The spotted owl is a relatively long-lived bird, produces fewer and larger young, invests significantly in parental care, experiences later or delayed maturity, and exhibits high adult survivorship. The spotted owl's long reproductive life span allows for some eventual recruitment of offspring, even if recruitment does not occur each year (Franklin et al. 2000).

Annual variation in population parameters for spotted owls has been linked to environmental influences at various life history stages (Franklin et al. 2000). In coniferous forests, mean fledgling production of the California spotted owl (*Strix occidentalis occidentalis*), another closely related subspecies, was higher when minimum spring temperatures were higher (North et al. 1999), a relationship that may be a function of increased prey availability. Across their range, spotted owls show a pattern of alternating years of high and low reproduction, with highest reproduction occurring during even-numbered years (e.g., Franklin et al. 1999). Annual variation in breeding may be related to weather conditions and fluctuation in prey abundance (Zabel et al. 1995).

A variety of factors may regulate spotted owl population levels. These factors may be density-dependent (e.g., habitat quality, habitat abundance) or density-independent (e.g., climate). Interactions may occur among factors. For example, as habitat quality decreases, density-independent factors may have more influence on variation in rate of population growth, which tends to increase variation in the rate of growth (Franklin et al. 2000). A consequence of this pattern is that at some point, lower habitat quality may cause the population to be unregulated and decline to extinction (Franklin et al. 2000).

Lambda (λ) describes the rate of population growth in spotted owl populations. A rate of 1.0 indicates a stable population, neither increasing nor decreasing; a rate less than 1.0 indicates a decrease in population growth; and a rate greater than 1.0 indicates a growing population. On a range-wide basis, the rate of growth for individual spotted owl populations vary within consistent bounds around a mean value of $\lambda = 1$ (Franklin et al. 2000).

Spotted owls were located at approximately 4,600 sites (Federal and non-Federal lands) between 1987-1991. The status of these sites included 3,602 confirmed pairs and 957 territorial single spotted owls. Although a majority of owl sites occurred on Federal lands, a significant number also occurred on non-Federal lands, particularly in northwestern California. The actual population of owls across the range is undoubtedly larger than the number of individuals confirmed at that time because a significant portion of the range of the spotted owl remains unsurveyed (USFWS 1992, Thomas et al. 1993).

In California, surveys conducted through 1992, detected 1,039 confirmed pairs, 347 resident singles, and 242 sites with owls of unconfirmed status; about 40 percent of these sites were on non-Federal lands (USFWS 1992). A March 2003 query of the 2002 California Department of Fish and Game's spotted owl database shows 2,145 activity centers (pairs and territorial singles) occur in California. This estimate is rough and likely represents an over-estimate of currently active activity centers because surveys are not completed to determine if owls are still resident at many of these sites. Nevertheless, the number of known activity centers has increased since 1992, most likely due to increased survey effort.

To date, survey coverage of all suitable habitat is incomplete. Survey effort has been sporadic, not systematic. Survey coverage and effort are insufficient to produce reliable population estimates. Consequently, the Service now uses other indices, such as demographic data, to evaluate the current condition of the spotted owl population. Analysis of demographic data can provide an estimate of the rate and direction of population growth [i.e., lambda (λ)]

Demographic data from 1985 through 1998 from 16 independent study areas located throughout the owl's range (4 in Washington, 9 in Oregon, and 3 in California) were recently analyzed. Study areas encompassed 20,500 square miles, representing about 23 percent of the owl's range. They consisted primarily of Federal lands, but included some private, Tribal, and Oregon State lands. Overall, results indicated the owl population is still declining, but at a slower rate than previously reported (Franklin et al. 1999). Thomas and Raphael (1993) predicted a population decline, but did not present a specific rate of decline. Therefore, conformance of observed declines with those they anticipated cannot be determined.

On a range-wide basis, lambda (λ), adjusted for juvenile emigration, for territorial females is 0.961, indicating the population of territorial females declined 3.9 percent annually from 1985 to 1998 (Franklin et al. 1999). Although less than the 4.5 percent rate of decline estimated for the years from 1986 through 1993 (Burnham et al. 1996), the rate of decline is still significantly different from a stable population (Franklin et al. 1999). After accounting for juvenile emigration, 4 of 16 individual owl populations appear stable (λ =1.0), at least 8 have evidence to support a decline (λ<1.0), and the remainder are either stable or declining (Franklin et al. 1999).

Mean estimates of apparent survival across all study areas increased with age of individuals. Survival rates of adult females across all study areas varied among years, but no longer exhibited the negative range-wide trend apparent in the 1993 analysis (Forsman and Anthony 1999). However, survival rates of female spotted owls in the three California studies continue to show a downward trend. Fecundity varied by year and province. Across its range, the spotted owl continues to show alternating good and bad reproductive years. Owls found east of the crest of the Cascade Mountains exhibited higher fecundity and lower survival rates, compared to those found west of the crest.

Habitat Trends

The current condition of the species incorporates the effects of all past human and natural activities or events that have led to the present-day status of the species (USFWS and NMFS 1998). Baseline conditions for the owl were evaluated to some degree during formulation of the NWFP through qualitative and quantitative analyses of measures such as habitat availability, distribution, and condition. The following section reports on changes in those baseline conditions since 1994, relying particularly on information in documents the Service produced pursuant to section 7 (e.g., consultation, technical assistance) of the ESA.

Since 1994, the Service has consulted on many actions associated with implementation of the NWFP and other Federal and non-Federal activities that may affect the spotted owl or its Critical Habitat. The geographic scale of these consultations varied from individual actions (e.g., timber sales or habitat conservation plans) on one administrative unit to multiple actions covering multiple administrative units. In general, the analytical framework of these consultations was assessed in light of the reserve or connectivity goals established by the NWFP land-use allocations (USDA and USDI 1994a), and expressed in terms of changes in suitable spotted owl habitat within those land-use allocations.

The Service updated the environmental baseline for spotted owl habitat on several occasions since the owl was listed in 1990. Based on these assessments, habitat continues to decline on a range-wide basis. For example and perspective, about 7,397,098 acres of suitable habitat were estimated to exist on Federal lands in 1994 (Table 8). As of January 2007, the Service has consulted on the removal of 355,200 acres of spotted owl habitat on Federal lands managed under the NWFP (Table 8). This habitat loss was distributed throughout most provinces in the NWFP area, except the Western Lowland and Willamette Valley provinces.

The loss of suitable habitat since 1994 did not exceed 4 percent in most provinces (Table 8). However, habitat loss within the Oregon Klamath Mountain province was relatively high (about 8.5%), compared to other provinces, making up 37 percent of habitat loss range-wide. Most (98%) of this habitat loss was concentrated outside of reserves (i.e., LSRs, managed late successional reserves, and Congressionally Reserved Areas). Consequently, the Service concludes the following: loss of suitable habitat within LSRs was not significant; and loss of suitable habitat outside of LSRs did not preclude connectivity between LSRs, nor adjacent provinces (USFWS 2001a). Reasons for the comparatively large number of acres of habitat consulted-on for removal in the Oregon Klamath Mountain province include a higher percentage of Matrix acres and a shift to density management harvest, which can impact up to three times as many acres as a regeneration harvest for an equal amount of timber volume removed.

In 2002, the Biscuit Fire in southwest Oregon (Rogue River basin) and northern California burned over 500,000 acres, primarily on the Siskiyou National Forest. The fire and the associated fire suppression efforts resulted in a loss of approximately 112,000 acres of spotted owl habitat, including habitat within five LSRs. In the Service's 2003 programmatic BO (USFWS 2003b), the Service analyzed the amount and distribution of spotted owl dispersal habitat (based on agency habitat data) in the Rogue basin and found they were adequate in most areas, except in the location of this fire. This analysis also highlighted that the smaller LSRs in this area contained very little suitable or dispersal habitat and were unlikely to support large clusters of reproducing spotted owls. Although the Biscuit fire heavily affected one large LSR (Fishook), the distribution of areas affected by loss of suitable habitat would not likely preclude movement of spotted owls between the Coast and Cascade provinces.

Threats

The spotted owl was listed as threatened throughout its range "due to loss and adverse modification of suitable habitat as a result of timber harvesting and exacerbated by catastrophic events such as fire, volcanic eruption, and wind storms" (USFWS 1990). More specifically, significant threats to the spotted owl included the following: low populations; declining populations; limited habitat; declining habitat; distribution of habitat or populations; isolation of provinces; predation and competition; lack of coordinated conservation measures; and vulnerability to natural disturbance (USFWS 1992). These threats were characterized for each province as severe, moderate, low, or unknown. Declining habitat was recognized as a severe or moderate threat to the spotted owl in all 12 provinces, isolation of provinces within 11 provinces, and declining populations in 10 provinces. Consequently, these three factors represented the greatest concern range-wide to conservation of the spotted owl. Limited habitat was considered a severe or moderate threat in nine provinces, and low populations a severe or moderate concern in eight provinces, suggesting that these factors are a concern throughout the majority of the range.

Vulnerability to natural disturbances was rated as low in five provinces, indicating that habitat loss due to fire, wind throw, insects, or diseases was less of a concern from a range-wide perspective. However, the occurrence of recent, relatively large fires suggests that habitat loss due to natural disturbance may pose a more significant threat than previously thought. Past fire suppression efforts and other land management actions have resulted in vast forested areas that are susceptible to large-scale, stand-replacing fires. These events could reduce and possibly eliminate owl habitat from extensive areas.

The degree to which predation and competition might pose a threat the spotted owl was unknown in more provinces than any of the other threats, indicating a need for additional information. Since listing of the spotted owl, changing conditions and new information suggest that competition may now be a greater threat than previously anticipated. The recent range expansion of barred owls into the Pacific Northwest (Taylor and Forsman 1976, Dunbar et al. 1991, Dark et al. 1998) may compete with spotted owls through a variety of mechanisms: prey overlap (Hamer et al. 2001); habitat use (Dunbar et al 1991, Herter and Hicks 2000, Pearson and Livezey, in press); and/or agonistic encounters (Leskiw and Gutiérrez 1998, Kelly et al 2003). Kelly et al. (2003) found that spotted owls were displaced from their territories by barred owls.

Few empirical studies exist to confirm that habitat fragmentation contributes to increased levels of predation on spotted owls. However, great horned owls (*Bubo virginianus*), an effective predator on spotted owls, are closely associated with fragmented forest, openings, and clearcuts (Craighead and Craighead 1956, Johnson 1992, Laidig and Dobkin 1995). As mature forests are harvested, great horned owls may colonize fragmented forests, thereby increasing spotted owl vulnerability to predation.

Recovery and Conservation Planning

The conservation needs of the spotted owl address three primary threats: declining populations; declining habitat; and isolation of provinces. These needs are centered on the following biological principles: 1) presence of large blocks of habitat to support clusters or local population centers of owls (e.g., 15 to 20 breeding pairs); 2) habitat conditions and spacing between local populations of owls to facilitate survival and movement; and 3) managing habitat across a variety of ecological conditions within the owl's range to reduce risk of local or widespread extirpation (USDI Fish and Wildlife Service 1992b).

Since 1990, various efforts have addressed the conservation needs of the spotted owl and attempted to formulate conservation strategies based upon these needs. These efforts began with the ISC's Conservation Strategy (Thomas et al. 1990); they continued with the designation of Critical Habitat (57 FR 1796), the Draft Recovery Plan (USFWS 1992), and the Scientific Analysis Team report (Thomas et al. 1993), report of the Forest Ecosystem Management Assessment Team (Thomas and Raphael 1993); and they culminated with the NWFP (USDA and USDI 1994a). Each conservation strategy was based upon the reserve design principles first articulated in the ISC's report, which are summarized as follows.

- Species that are well distributed across their range are less prone to extinction than species confined to small portions of their range.
- Large blocks of habitat, containing multiple pairs of the species, are superior to small blocks of habitat with only one to a few pairs.
- Blocks of habitat that are close together are better than blocks far apart.
- Habitat that occurs in contiguous blocks is better than habitat that is more fragmented.
- Habitat between blocks is more effective as dispersal habitat if it resembles suitable habitat.

Conservation Efforts on Federal Lands

The NWFP is the current conservation strategy for the spotted owl on Federal lands. It is designed around the conservation needs of the owl and based upon the designation of a variety of land-use allocations whose objectives are either to provide for population clusters (i.e., demographic support) or to maintain connectivity between population clusters. Several land-use allocations are intended to contribute primarily to supporting population clusters: LSRs; Managed Late Successional Areas (MSLAs); Congressionally

Reserved Areas; and Managed Pair Areas and Reserve Pair Areas. The remaining land-use allocations [Matrix, Adaptive Management Areas, Riparian Reserves, Connectivity Blocks, and Administratively Withdrawn Areas (AWAs)] provide connectivity between habitat blocks intended for demographic support.

The range-wide system of LSRs set up under the NWFP captures the variety of ecological conditions within the 12 different provinces to which spotted owls are adapted. This design reduces the potential for extinction due to large catastrophic events in a single province. Multiple, large LSRs in each province reduce the potential that spotted owls will be extirpated in any individual province and reduce the potential that large wildfires or other events will eliminate all habitat within a LSR. In addition, LSRs are generally arranged and spaced so that spotted owls may disperse to two or more adjacent LSRs. This network of reserves reduces the likelihood that catastrophic events will impact habitat connectivity and population dynamics within and between provinces.

Although FEMAT scientists predicted that spotted owl populations would decline in the Matrix over time, populations were expected to stabilize and eventually increase within LSRs, as habitat conditions improved over the next 50 to 100 years (Thomas and Raphael 1993, USDA and USDI 1994a and 1994b). The NWFP included standards and guidelines for managing all agency actions.

Range-wide, consulted-on effects of timber harvest on NWFP lands from 1994 to March 12, 2004 are consistent with timber harvest rates assumptions for the first decade of the NWFP as discussed in the Service's 1994 BO (USFWS 1994). The amount of suitable habitat removed due to timber harvest in the first decade did not exceed the level (196,000 acres) expected under the NWFP. Most harvest was concentrated outside Reserves intended to provide for population clusters of owls. April 14, 2004, will mark the beginning of the second decade under the NWFP and will reset the calculation of expected habitat loss to timber harvest.

Conservation Efforts on Non-Federal Lands

FEMAT noted that limited Federal ownership in some areas constrained the ability to form an extensive reserve network to meet conservation needs of the spotted owl. Thus, non-Federal lands were an important contribution to the range-wide goal of achieving conservation and recovery of the spotted owl. The Service's primary expectation for private lands is for their contributions to demographic support (pair or cluster protection) to and/or connectivity with NWFP lands. In addition, timber harvest within each state is governed by rules that may provide protection of spotted owls and/or their habitat to varying degrees.

The Oregon Forest Practices Act provides for protection of 70-acre core areas around known spotted owl nest sites, but it does not provide for protection of owl habitat beyond these areas (ODF 2000). In general, no large-scale spotted owl habitat protection strategy or mechanism currently exists for non-Federal lands in Oregon.

Table 8. Acres of suitable (NRF[1]) habitat loss on Federal lands from 1994 to 2007, from proposed management activities and natural events: baseline and summary of effects by State, physiographic province and land use function.

Physiographic Province[4]		Evaluation Baseline[2]			Habitat Removed/Downgraded[3]				% Provincial Baseline Affected	% of Range-wide Effects
		Reserves[5]	Non-reserves[6]	Total	Reserves[5]	Non-reserves[6]	Habitat loss to natural events[7]	Total		
WA	Olympic Peninsula	548483	11734	560217	867	24	299	1190	0.21	0.33
	Eastern Cascades	506340	200509	706849	1795	4242	5754	11791	1.67	3.32
	Western Cascades	864683	247797	1112480	1181	11001	0	12182	1.09	3.43
	Western Lowlands	0	0	0	0	0	0	0	0.00	0.00
OR	Coast Range	422387	94190	516577	399	4074	66	4539	0.88	1.28
	Klamath Mountains	448509	337789	786298	1998	71957	101676[8]	175631	22.34	49.44
	Cascades East	247624	196035	443659	1243	11152	19547[9]	31942	7.20	8.99
	Cascades West	1012426	1033337	2015763	3581	57863	24583	86027	4.27	24.22
	Willamette Valley	593	5065	5658	0	0	0	0	0.00	0.00
CA	Coast	47566	3928	51494	381	69	100	550	1.06	0.15
	Cascades	61852	26385	88237	0	4808	0	4808	5.45	1.35
	Klamath	734103	345763	1079866	1470	9201	15869	26540	2.46	7.47
Total		4894566	2502532	7397098	12915	174391	167894	355200	4.80	100.0

[1] Nesting, roosting, foraging habitat. In California, suitable habitat is divided into two components; nesting – roosting (NR) habitat, and foraging (F) habitat. The NR component most closely resembles NRF habitat in Oregon and Washington. Due to differences in reporting methods, effects to suitable habitat compiled in this, and all subsequent tables include effects for nesting, roosting, and foraging (NRF) for 1994-6/26/2001. After 6/26/2001, suitable habitat includes NRF for Washington and Oregon but only nesting and roosting (NR) for California.

[2] 1994 FSEIS baseline (USDA FS and USDI BLM 1994b).

[3] Includes consulted-on effects reported by USDI FWS (2001) and subsequent effects compiled in the NSO Consultation Effects Tracking System database.

[4] Defined by the NWFP as the twelve physiographic provinces, as presented in Figure 3&4-1 on page 3&4-16 of the FSEIS.

[5] Land-use allocations intended to provide large blocks of habitat to support clusters of breeding pairs

[6] Land-use allocations intended to provide habitat to support movement of spotted owls among reserves.

[7] Acres for all physiographic provinces, except the Oregon Klamath Mountains and Oregon Cascades East, are from the Scientific Evaluation of the Status of the Northern Spotted Owl (Courtney et al. 2004).

[8] Acres are from the biological assessment entitled: Fiscal year 2006-2008 programmatic consultation: re-initiation on activities that may affect listed species in the Rogue-River/South Coast Basin, Medford BLM, and Rogue-Siskiyou National Forest.

[9] Acres are from the Scientific Evaluation of the Status of the Northern Spotted Owl (Courtney et al. 2004) and data in the NSO Consultation Effects Tracking Database.NSO Consultation Effects Tracking Database.

4.1.4 Northern Spotted Owl Critical Habitat

Critical habitat for the northern spotted owl was originally designated January 15, 1992 (57 FR 1796). In that designation the PCEs of spotted owl habitat were listed as (1) nesting, (2) roosting, (3) foraging, and (4) dispersal. Currently the USFWS has a proposed redesignation of critical habitat which provides a more useful description of the elements that comprise spotted owl habitat. Within areas of suitable spotted owl habitat, the USFWS has focused on the following primary constituent elements (PCEs):

1. Forest types known to support the northern spotted owl across its geographic range. These include Sitka spruce, western hemlock, mixed conifer and mixed evergreen, grand fir, Pacific silver fir, Douglas-fir, white fir, Shasta red fir, redwood/Douglas-fir and the moist end of ponderosa pine coniferous forest zones.

2. Forest types described in PCE 1of sufficient area, quality, and configuration, or that have the ability to develop these characteristics, to meet the home range needs of territorial pairs throughout the year. This PCE includes three habitat types:
    a. Nesting habitat
    b. Roosting habitat
    c. Foraging habitat

3. Dispersal habitat

These PCEs are essential to provide and support suitable nesting, roosting foraging and dispersal within a home range and across the landscape in western Oregon.

4.1.5 Oregon Chub (Oregonichthys crameri)

Detailed accounts of the taxonomy, ecology, and life history of the Oregon chub can be found in the final rule designating the species as endangered (58 FR 53800), the annual progress reports for Oregon chub investigations (Scheerer et al. 2002, 2003, 2004, 2005) and the Recovery Plan for the Oregon Chub (USFWS 1998). The Service officially downgraded the status of the Oregon chub from endangered to threatened 24 May, 2010 (USFWS 2010, 75 FR 21179-21189).

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 habitat is typically less than 6 feet and the summer temperatures typically exceed 16°C (61°F). 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). 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.

Current and Historical Range

The Oregon chub endemic to the Willamette River drainage of western Oregon (Markle et al. 1991). This species was formerly distributed throughout the Willamette River Valley in off-channel habitats such as beaver ponds, oxbows, side channels, backwater sloughs, low gradient tributaries, and flooded marshes (Snyder 1908). Historical records show Oregon chub were found as far downstream as Oregon City and as far upstream as Oakridge. Records of Oregon chub collections exist for the Clackamas River, Molalla River, Mill Creek, South Santiam River, North Santiam River, Luckiamute River, Long Tom River, McKenzie River, Calapooia River, Muddy Creek, Mary's River, Coast Fork Willamette River, Middle Fork Willamette River, and the mainstem Willamette River (Markle et al. 1991, Scheerer and McDonald 2000).

Based on a 1987 survey (Markle et al. 1989) and compilation of all known historical records, at the time of the petition for listing in 1991, viable populations of the Oregon chub occurred in the following locations: Dexter Reservoir, Shady Dell Pond, Buckhead Creek near Lookout Point Reservoir, Elijah Bristow State Park, William L. Finley National Wildlife Refuge, Greens Bridge, and East Fork Minnow Pond. These locations represented a small fraction - estimated as two percent based on stream miles - of the species' formerly extensive distribution within the Willamette River drainage.

Population dynamics

The current pattern of distribution and abundance of Oregon chub populations reflects the fundamental alteration in the natural processes under which the species evolved. Sites with Oregon chub can be categorized as having high or low connectivity to the Willamette and its tributaries; those sites with low connectivity tend to have large populations of chub and fewer species of non-native fish (Scheerer et al. 2002). Thus, Oregon chub now thrive only in habitats that are isolated and bear little resemblance to the species' dynamic natural environment. Efforts to restore floodplain function and connectivity may facilitate the introduction of non-native fishes into isolated habitats, which could have devastating effects to populations of Oregon chub (Scheerer 2002).

Population Status and Trends

In 2005, ODFW confirmed the continued existence of Oregon chub at 33 locations. These included 23 naturally occurring and 10 introduced populations. Locations of naturally occurring populations were: Santiam drainage (Geren Island, Santiam I-5 Side Channels, Santiam Conservation Easement, Stayton Public Works Pond, Green's Bridge Backwater, Pioneer Park, and Gray Slough), Mid-Willamette drainage (Finley Gray Creek Swamp and Dry Muddy Creek), McKenzie drainage (Shetzline Pond and Big

Island), Coast Fork Willamette drainage (Coast Fork Side Channels and Camas Swale), and the Middle Fork Willamette drainage (Dexter Reservoir and two alcoves, East Fork Minnow Creek Pond, Shady Dell Pond, Buckhead Creek, two Elijah Bristow State Park sloughs and an island pond, Barnhard Slough, and Hospital Pond). Introduced populations were located in the Middle Fork Willamette (Wicopee Pond and Fall Creek Spillway Ponds), Santiam (Foster Pullout Pond), McKenzie (Russell Pond), Coast Fork Willamette (Herman Pond), and Mid-Willamette drainages (Dunn Wetland, Finley Display Pond, Finley Cheadle Pond, Ankeny Willow Marsh, and Jampolsky Wetlands) (ODFW 2005).

Threats

A variety of factors are likely responsible for the decline of the Oregon chub. These include habitat loss and alteration; the proliferation of non-native fish and amphibians; accidental chemical spills; runoff from herbicide or pesticide application on farms and timberlands or along roadways, railways, and power line rights-of way; the application of rotenone to manage sport fisheries; desiccation of habitats; unauthorized water withdrawals, diversions, or fill and removal activities; sedimentation resulting from timber harvest in the watershed, and possibly the demographic risks that result from a fragmented distribution of small, isolated populations (USFWS 1998).

The decline of Oregon chub has been correlated with the construction of dams. Based on the date of last capture at a site, Pearsons (1989) estimated that the most severe decline occurred during the 1950s and 1960s. Ten of the 13 dams that make up the Willamette Valley flood control system were completed between 1953 and 1969 (USACE 2000). Other structural changes along the Willamette River corridor such as revetment and channelization, diking and drainage, and the removal of floodplain vegetation have eliminated or altered the slack water habitats of the Oregon chub (Willamette Basin Task Force 1969, Hjort et al. 1984, Sedell and Froggatt 1984, Li et al. 1987). Channel confinement, isolation of the Willamette River from the majority of its floodplain, and elimination or degradation of both seasonal and permanent wetland habitats within the floodplain began as early as 1872 and, for example, has reduced the 25 kilometer (15.5 mile) reach between Harrisburg and the McKenzie River confluence from over 250 kilometers (155 miles) of shoreline in 1854 to less than 64 kilometers (40 miles) currently (Sedell and Froggatt 1984, Sedell et al. 1990).

The establishment and expansion of non-native species in Oregon have contributed to the decline of the Oregon chub and limits the species' ability to expand beyond its current range. Many species of non-native fish have been introduced to, and are common throughout, the Willamette Valley, including largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*), crappie (*Pomoxis* sp.), bluegill (*Lepomis macrochirus*), and western mosquitofish (*Gambusia affinis*). The bullfrog (*Rana catesbiana*), a non-native amphibian, also occurs in the valley and breeds in habitats preferred by the Oregon chub (Willamette Basin Task Force 1969, Hjort et al. 1984, Li et al. 1984, Scheerer et al. 1992). The period of severe decline of the Oregon chub does not coincide well with the initial dates of introduction of nonindigenous species. However, many sites formerly inhabited by the Oregon chub are now occupied by non-native species (Markle et al. 1991). Currently, 25 sites are known to contain Oregon chub; over half of these sites are also inhabited by non-native fishes or amphibians (Scheerer and McDonald 2000). Since 1995, non-native fish have been discovered for the first time in six locations containing Oregon chub; the Oregon chub populations have subsequently declined or remained in low abundance in all of these sites. The 1996 flooding in the Santiam River was probably responsible for three of these movements of non-native fish. The other three sites, located in the Middle Fork Willamette River drainage, were likely the result of unauthorized introductions or spread of non-native fish from reservoirs (Scheerer and Jones 1997). Because all remaining population sites are easily accessible, there also continues to be a potential for unauthorized introductions of non-native species, particularly mosquitofish and game fishes such as bass and walleye (*Stizostedion vitreum*).

Many of the known extant populations of Oregon chub occur near rail, highway, and power transmission corridors and within public park and campground facilities. These populations are threatened by chemical spills from overturned truck or rail tankers; runoff or accidental spills of vegetation control chemicals; overflow from chemical toilets in campgrounds; sedimentation of shallow habitats from construction activities; and changes in water level or flow conditions from construction, diversions, or natural desiccation (USFWS 1998). In the early 1990s, a train derailment on the railroad line that parallels the Middle Fork Willamette River spilled methanol near the Minnow Pond population of Oregon chub; the methanol burned and did not contaminate the chub's habitat, yet this incident illustrates the risk to Oregon chub populations along transportation corridors (USFWS 2003c). Oregon chub populations near agricultural areas are subject to poor water quality as a result of runoff laden with sediment, pesticides, and nutrients. Logging in the watershed can result in increased sedimentation and herbicide runoff.

Recovery and Conservation Planning

The Oregon Chub Recovery Plan (USFWS 1998) set recovery criteria for downlisting the species to "threatened" and for delisting the species. The criteria for downlisting the species are: 1) establish and manage 10 populations of at least 500 adult fish, 2) all of these populations must exhibit a stable or increasing trend for five years, and 3) at least three populations meeting criterion 1 and 2 must be located in each of the three recovery areas (Middle Fork Willamette River, Santiam River, and Mid-Willamette River tributaries). In 2005, there were 20 populations totaling 500 or more individuals. Twelve of these populations met the above criteria. Nine were located in the Middle Fork Willamette drainage, one was located in the Mid-Willamette drainage, and two were located in the Santiam drainage (ODFW 2005).

Currently, there are twelve populations totaling 500 or more individuals that have exhibited a stable or increasing trend for the past five years. Nine of these populations are located in the Middle Fork Willamette recovery area, two populations are located in the Santiam recovery area, and one population is located in the Mid-Willamette recovery area. Significant progress has been made in increasing both the number of known populations of Oregon chub and the number of large populations (>500 fish) in the Willamette drainage over the past eight years (ODFW 2005).

Of the known Oregon chub populations, the sites with the highest diversity of native fish, amphibian, and reptile species have the largest populations of Oregon chub (Scheerer and McDonald 2000). Beavers (Castor canadensis) appear to be especially important in creating and maintaining habitats that support these diverse native species assemblages (Scheerer and Apke 1998).

Middle Fork Willamette Drainage

In 2005, ODFW estimated the population abundance of Oregon chub at 12 locations in the Middle Fork Willamette River drainage. The Middle Fork Willamette drainage contains the greatest concentration of large Oregon chub populations (>500 fish) in the Willamette Valley. In 2005, there were 11 populations in the Middle Fork Willamette drainage that totaled 500 or more adult Oregon chub. Nine of these populations have been stable or increasing in abundance for the past five years (ODFW 2005).

The largest population of Oregon chub in the Middle Fork Willamette drainage was located at Wicopee Pond ($\hat{N}$ =6,300), site of a 1988 introduction. The second largest population in the drainage was located in the Fall Creek Spillway Ponds ($\hat{N}$ =6,250), site of a 1996 introduction. The third largest population in the drainage was Hospital Pond ($\hat{N}$ =5,040). Other locations where chub abundance was estimated in the basin include: Buckhead Creek ($\hat{N}$ =3,130), Shady Dell Pond ($\hat{N}$ =3,110), Elijah Bristow Berry Slough ($\hat{N}$ =2,530), East Fork Minnow Creek Pond ($\hat{N}$ =1,850), Dexter Reservoir RV Alcove ($\hat{N}$ =1,850), Elijah Bristow Island Pond ($\hat{N}$ =1,700), Elijah Bristow State Park Northeast Slough ($\hat{N}$ =790), Dexter Reservoir Alcove "The Pit" ($\hat{N}$ =600), and Haws Pond ($\hat{N}$ =120). Notable increases in Oregon chub abundance occurred at Wicopee Pond, Dexter Alcoves, and Elijah Bristow Island Pond. Notable decreases in Oregon chub abundance occurred at Shady Dell Pond, East Fork Minnow Creek Pond, and Elijah Bristow Northeast Slough. The East Fork Minnow Creek Pond population had a declining 5-year abundance trend (ODFW 2005).

Santiam Drainage

In 2005, ODFW estimated the population abundance of Oregon chub at five locations in the Santiam River drainage. There were three populations in the Santiam drainage that totaled 500 or more adult Oregon chub. Two of these populations had an increasing trend in abundance for the past five years. The largest Oregon chub population in the Santiam drainage was located in the Geren Island North Channel. Population abundance has increased from a low of 360 fish in 2000 to 2,630 fish in 2005. The second largest chub population in the Santiam drainage was located in the Santiam I-5 Side Channels ($\hat{N}$ =580). Other large populations in the basin were located in Santiam Public Works Pond ($\hat{N}$ =530), Gray Slough ($\hat{N}$ =260), and Foster Pullout Pond ($\hat{N}$ =200). The Foster Pond population declined from 570 fish in 2004 (ODFW 2005).

Mid-Willamette River Drainage

In 2005, ODFW estimated the population abundance of Oregon chub at six locations in the Mid-Willamette River drainage. There were six populations in the Mid-Willamette drainage (including the McKenzie River) that totaled 500 or more adult Oregon chub. One of these populations had a stable 5-year trend in abundance. The largest Oregon chub population in the Willamette drainage was located at Dunn Wetland ($\hat{N}$ =28,290). This population was introduced in 1997-1998. The second largest population in the drainage was located at Ankeny Willow Marsh ($\hat{N}$ =10,110). Five hundred chub were introduced into this pond from Dunn Wetland in 2004. The third largest chub population in the drainage was located at Finley Cheadle Pond ($\hat{N}$ =1,300), site of a 2002 introduction. The fourth largest population in the drainage was located at Jampolsky Wetlands ($\hat{N}$ =1,230), site of a 2004 introduction. Other large populations in the basin were located at Finley Gray Creek Swamp ($\hat{N}$ =240) and Finley Display Pond ($\hat{N}$ =240). It should be noted that the 2005 population estimate at Finley Gray Swamp did not include fish inhabiting the private portion of the creek; access was denied by new landowners (ODFW 2005).

McKenzie Drainage

Historical records show that Oregon chub were collected in the McKenzie River subbasin, but until recently, no extant populations were known from the basin. In 2005, ODFW estimated the population abundance of three Oregon chub populations in the McKenzie River drainage. The most abundant chub population in the McKenzie drainage was located in Russell Pond ($\hat{N}$ =810), site of a 2001-2002 introduction. The second largest population in the drainage was located in Shetzline South Pond ($\hat{N}$ =730). The other large chub population in the McKenzie drainage was located at Big Island ($\hat{N}$ = 430). None of these populations currently has the five years of population data needed to assess abundance trends (ODFW 2005).

Coast Fork Willamette Drainage

In 2005, ODFW estimated the Oregon chub population abundance at one site in the Coast Fork Willamette drainage. The chub population introduced into Herman Pond in the Row River subbasin declined from 350 fish in 2004 to 110 fish in 2005. A habitat enhancement project was initiated by the U.S. Forest Service in 2005 to increase the amount of open water habitat (ODFW 2005).

4.1.6 Oregon Chub Critical Habitat

The Service designated critical habitat for the Oregon chub effective April 9, 2010 (USFWS 2010, 75 FR 11010 11067). In total, approximately 53 hectares (ha) (132 acres (ac)) located in Benton, Lane, Linn, and Marion Counties, Oregon, fall within the boundaries of the critical habitat designation.

Pursuant to our regulations, we are required to identify the known physical and biological features essential to the conservation of the Oregon chub and which may require special management considerations or protection. These features are the PCEs laid out in the appropriate quantity and spatial arrangement essential for the conservation of the species. The PCEs are listed below. All areas designated as critical habitat for Oregon chub are either occupied or within the species' historical geographic range.

Based on the above needs and our current knowledge of the life history, biology, and ecology of the species and the characteristics of the habitat necessary to sustain the essential life-history functions of the species, we have identified four PCEs for Oregon chub critical habitat:

1. Off-channel water bodies such as beaver ponds, oxbows, side-channels, stable backwater sloughs, low-gradient tributaries, and flooded marshes, including at least 500 continuous square meters (0.12 ac) of aquatic surface area at depths between approximately 0.5 and 2.0 m (1.6 and 6.6 ft).

2. Aquatic vegetation covering a minimum of 250 square meters (0.06 ac) (or between approximately 25 and 100 percent) of the total surface area of the habitat. This vegetation is primarily submergent for purposes of spawning, but also includes emergent and floating vegetation and algae, which are important for cover throughout the year. Areas with sufficient vegetation are likely to also have the following characteristics:
   - Gradient less than 2.5 percent;
   - No or very low water velocity in late spring and summer;
   - Silty, organic substrate; and
   - Abundant minute organisms such as rotifers, copepods, cladocerans, and chironomid larvae.

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

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

The need for space for individual and population growth and normal behavior is met by PCE (1); areas for reproduction, shelter, food, and habitat for prey are provided by PCE (2); optimal physiological processes for spawning and survival are ensured by PCE (3); habitat free from disturbance and, therefore, sufficient reproduction and survival opportunities are provided by PCE (4).

4.1.7 Bull trout (Salvelinus confluentus)

Detail accounts of life history, taxonomy and behavior can be found in the final rule listing the coterminous United States population of the bull trout as threatened (64 FR 58910), the proposal to designate critical habitat for the bull trout (67 FR 71235), and the Status of Oregon's Bull Trout; Distribution, Life History, Limiting Factors, management Considerations, and Status (Buchanan et al. 1997).

Current and Historical Range

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

Life History

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

The iteroparous reproductive strategy of bull trout has important repercussions for the management of this species. Bull trout require passage both upstream and downstream, not only for repeat spawning but also for foraging. Most fish ladders, however, were designed specifically for anadromous semelparous salmonids (fishes that spawn once and then die, and require only one-way passage upstream as adults). Therefore, even dams or other barriers with fish passage facilities are a factor in isolating bull trout populations if they do not provide a safe downstream passage route.

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

Habitat Affinities

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

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

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

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

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

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

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

Migratory corridors Migratory bull trout ensure regular interchange of genetic material between local populations within core areas (USFWS 2002, 67 FR 71439 71441), and sometimes facilitate genetic interchange among core areas on an evolutionary time scale, thereby promoting genetic variability. Intact migratory corridors also allow for the potential reestablishment of extirpated localpopulations. Unfortunately, many populations of migratory bull trout have been restricted or eliminated due to stream habitat alterations, including seasonal or permanent obstructions, detrimental changes in water quality, increased temperatures, and the alteration of natural stream flow patterns. Migratory corridors tie seasonal foraging, migrating and overwintering habitat (USFWS 2002) to spawning and rearing habitat (USFWS 2002) for anadromous, adfluvial, and fluvial forms. Such corridors could potentially allow for dispersal of resident forms for recolonization of recovering habitats (Rieman and McIntyre1993), though evidence indicates that resident fish are naturally less likely to disperse (Nelson et al. 2002). Dam and reservoir construction and operation have altered major portions of migratory bull trout habitat throughout the Columbia River Basin (USFWS 2002)(USFWS 2005 70 FR 56211 56311). Dams without fish passage create barriers to fluvial and adfluvial bull trout which isolates populations, and dams and reservoirs alter the natural hydrograph, thereby affecting forage, water temperature, and water quality (USFWS 1999). In addition, reservoirs sometimes do not contain suitable bull trout habitat during certain portions of the year when temperature or other factors may be limiting.

Population Dynamics and Trends

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

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

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

In the rules listing the bull trout as threatened, the Service identified local populations (i.e., isolated groups of bull trout thought to lack two-way exchange of individuals), for which status, distribution, and threats to bull trout were evaluated. Because habitat fragmentation and barriers have isolated bull trout throughout their current range, a local population was considered a reproductively isolated group of bull trout that spawns within a particular river or area of a river system. Overall, 187 local populations were identified throughout their coterminous range in the following interim recovery units: 7 in the Klamath River, 141 in the Columbia River, 1 in the Jarbidge River, 34 in the Coastal-Puget Sound, and 4 in the St. Mary-Belly River populations. No new local populations have been identified and no local populations have been lost since listing.

Population Structure

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

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

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

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

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

Reasons for Listing

Bull trout distribution, abundance, and habitat quality have declined rangewide (Schill 1992, Thomas 1992, Ziller 1992, Rieman and McIntyre 1993, Newton and Pribyl 1994, McPhail and Baxter 1996). Several local extirpations have been documented, beginning in the 1950s (Rode 1990, Ratliff and Howell 1992, Donald and Alger 1993, Newton and Pribyl 1994, Berg and Priest 1995, Light et al. 1996, Buchanan et al. 1997, WDFW 1998). Bull trout were extirpated from the southernmost portion of their historic range, the McCloud River in California, around 1975 (Moyle 1976, Rode 1990). Bull trout have been functionally extirpated (i.e., few individuals may occur there but do not constitute a viable population) in the Coeur d'Alene River basin in Idaho and in the Lake Chelan and Okanogan River basins in Washington (USFWS 1998, 63 FR 31647 31674).

These declines result from the combined effects of habitat degradation and fragmentation, the blockage of migratory corridors; poor water quality, angler harvest and poaching, entrainment (process by which aquatic organisms are pulled through a diversion or other device) into diversion channels and dams, and introduced nonnative species. Specific land and water management activities that depress bull trout populations and degrade habitat include the effects of dams and other diversion structures, forest management practices, livestock grazing, agriculture, agricultural diversions, road construction and maintenance, mining, and urban and rural development (Beschta et al. 1987; Chamberlain et al. 1991; Furniss et al. 1991; Meehan 1991; Nehlsen et al. 1991; Sedell and Everest 1991; Craig and Wissmar 1993; Henjum et al. 1994; McIntosh et al. 1994; Wissmar et al. 1994; MBTSG 1995a-e, 1996a-f; Light et al. 1996; USDA and USDI 1995, 1996, 1997).

Recovery and Conservation Planning

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

Although this rule consolidated the five bull trout DPSs into one listed taxon, based on conformance with the DPS policy for purposes of consultation under section 7 of the Act, we retain recognition of each DPS in light of available scientific information relating to their uniqueness and significance. Under this approach, these DPSs will be treated as interim recovery units with respect to application of the jeopardy standard until an approved recovery plan is developed. Formal establishment of bull trout recovery units will occur during the recovery planning process (USFWS 2006).

At the time of publication of the Draft Bull Trout Recovery Plan (October 2002), there were 27 recovery units described. Almost immediately upon publication, the FWS recognized that these units may not meet the FWS standard for "recovery units" and decided to call them "management units." In addition, the five DPSs described in the June 10, 1998, listing of bull trout (FR 63, 31647) were subsequently recognized as "interim recovery units" in the November 1, 1999, final listing rule for bull trout (FR 64, 58910). In summary, until the Draft Bull Trout Recovery Plan is finalized, the FWS has adopted the use of local population, core area, management unit, and interim recovery unit for purposes of consultation and recovery. Table 9 illustrates an example of the language used by the Service for purposes of consultation for bull trout, including this biological opinion, as well as the hierarchal relationship between these geographical units of analysis.

Table 9. Example hierarchal relationship of geographical units of analysis for bull trout consultations.

Name	Hierarchal Relationship
Columbia River Interim Recovery Unit (formerly a DPS)	One of 5 interim recovery units in the range of the species within the coterminous U.S.
Willamette River Management Unit (formerly a Recovery Unit)	One of 23 management units in the Columbia River Interim Recovery Unit
Upper Willamette Core Area (no change in terminology)	The only core area in the Willamette River Management Unit
South Fork McKenzie Local Population (no change in terminology)	One of four local populations in the Upper Willamette Core Area

The Service's jeopardy analyses for bull trout involve consideration of how actions are likely to affect the Columbia River and Klamath Basin interim recovery units for the bull trout based on uniqueness and significance as described in the DPS final listing rule, which is herein incorporated by reference. However, in accordance with Service national policy, the jeopardy determination is made at the scale of the listed species. In this case, that is the coterminous U.S. population of the bull trout.

Conservation Needs

Conservation needs reflect those biological and physical requirements of a species for its long-term survival and recovery. Based on the best available scientific information (Hard 1995, Healy and Prince 1995, MBTSG 1998, Rieman and Allendorf 2001, Rieman and McIntyre 1993) the conservation needs of the bull trout are to: (1) Maintain and restore multiple, interconnected populations in diverse habitats across the range of each DPS (interim recovery unit); (2) Preserve the diversity of life-history strategies (e.g., resident and migratory forms, emigration age, spawning frequency, local habitat adaptations); (3) Maintain genetic and phenotypic diversity across the range of each DPS (interim recovery unit); and, (4) Protect populations from catastrophic fires across the range of each DPS (interim recovery unit). Each of these needs is described below in more detail.

a) *Maintain and restore multiple, interconnected populations in diverse habitats across the range of each interim recovery unit.*

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

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

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

b) *Preserve the diversity of life-history strategies*

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

c) *Maintain the genetic diversity and evolutionary potential of bull trout populations.*

When the long-term persistence of a species, taxon, or phylogenetic lineage is considered, it is necessary to consider the amount of genetic variation necessary to uphold evolutionary potential needed for that taxon to adapt to a changing environment. Effective population size provides a standardized measure of the amount of genetic variation that is likely to be transmitted between generations within a population. Effective population size is a theoretical concept that allows one to predict potential future losses of genetic variation within a population due to small population size and genetic drift. Individuals within populations with very small effective population sizes are also subject to inbreeding depression because most individuals within small populations share one or more immediate ancestors (parents, grandparents, etc.) after only a few generations and will be closely related.

Effective population sizes (Ne) of 500 to 5000 have been recommended for the retention of evolutionary potential (Franklin and Frankham 1998).

Populations of this size are able to retain additive genetic variation for fitness related traits gained via mutation (Franklin 1980).

Bull trout specific benchmarks have been developed concerning the minimum Ne necessary to maintain genetic variation important for short-term fitness and long-term evolutionary potential. These benchmarks are based on the results of a generalized, age-structured, simulation model, VORTEX (Miller and Lacy 1999), used to relate effective population size to the number of adult bull trout spawning annually under a range of life histories and environmental conditions (Rieman and Allendorf 2001). In this study, the authors estimated Ne for bull trout to be between 0.5 and 1.0 times the mean number of adults spawning annually. Rieman and Allendorf (2001) concluded that an average of 100 (i.e., 100 x 0.5 = 50) adults spawning each year would be required to minimize risks of inbreeding in a population and 1000 adults (i.e., 1000 x 0.5 = 500) is necessary to maintain genetic variation important for long-term evolutionary potential. This latter value of 1000 spawners may also be reached with a collection of local populations among which gene flow occurs.

The combination of resident forms completing their entire life cycle within a stream and the homing behavior of the migratory forms returning to the streams where they hatched to spawn promotes reproductive isolation among bull trout local populations. This reproductive isolation creates the opportunity for genetic differentiation and local adaptations to occur. Nevertheless, within a core area local populations are usually connected through low rates of migration. This connection of local populations, linked by migration, is termed a metapopulation (Hanski and Gilpin 1997). Within a metapopulation, evolution primarily occurs at the local population level (i.e., it is the main demographic and genetic unit of concern). However, when longer time frames are considered (e.g., 10-plus generations), metapopulations become important. For example, metapopulations allow for the reintroduction of lost alleles and recolonization of extinct local breeding populations. Migration and gene flow among local populations ensures that the alleles within a metapopulation will be present in most local breeding populations and can be acted upon by natural selection (Allendorf 1983).

d) Maintain phenotypic diversity.

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

e) Protect bull trout from catastrophic fires.

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

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

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

Conservation Needs and Status of Bull Trout in the Columbia River Interim Recovery Unit

In recognition of available scientific information relating to their uniqueness and significance, five segments of the coterminous United States population of the bull trout are considered essential to the survival and recovery of this species and are identified as interim recovery units: 1) Jarbidge River, 2) Klamath River, 3) Columbia River, 4) Coastal-Puget Sound, and 5) St. Mary-Belly River (USFWS 2002). Each of these interim recovery units is necessary to maintain the bull trout's distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species' resilience to changing environmental conditions.

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

Central to the survival and recovery of bull trout is the maintenance of viable core areas (USFWS 2002). Each of the interim recovery units listed above consists of one or more core areas. There are 121 core areas recognized across the coterminous range of the bull trout (USFWS 2002).

The Columbia River interim recovery unit includes bull trout residing in portions of Oregon, Washington, Idaho, and Montana. Bull trout are estimated to have occupied about 60 percent of the Columbia River Basin, and presently occur in 45 percent of the estimated historical range (Quigley and Arbelbide 1997). This interim recovery unit currently contains 97 core areas and 527 local populations. About 65 percent of these core areas and local populations occur in central Idaho and northwestern Montana.

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

The Columbia River interim recovery unit has declined in overall range and numbers of fish (63 FR 31647). Although some strongholds still exist with migratory fish present, bull trout generally occur as isolated local populations in headwater lakes or tributaries where the migratory life history form has been lost. Though still widespread, there have been numerous local extirpations reported throughout the Columbia River basin. In Idaho, for example, bull trout have been extirpated from 119 reaches in 28 streams. The draft Columbia River bull trout recovery plan (USFWS 2002) identifies the following conservation needs for this interim recovery unit: 1) maintain or expand the current distribution of the bull trout within core areas; 2) maintain stable or increasing trends in bull trout abundance; 3) restore and maintain suitable habitat conditions for all bull trout life history stages and strategies; and, 4) conserve genetic diversity and provide opportunities for genetic exchange.

<u>New Threats</u>

The overall status of the Columbia River interim recovery unit has not changed appreciably since its listing on June 10, 1998. Populations of bull trout and their habitat in this area have been affected by a number of federal actions that have been reviewed under section 7 of the ESA. Most of these actions resulted in degradation of the environmental baseline of bull trout habitat, and analyzed and exempted incidental take of bull trout.

<u>Climate Change</u>

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

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

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

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

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

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

Bull trout require very cold water for spawning and incubation. Suitable spawning habitat is often found in accessible higher elevation tributaries and headwaters of rivers.

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

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

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

<u>Ongoing Conservation Actions</u>

a) Federal conservation actions:

Federal conservation actions include: (1) the development of a draft *Bull Trout Recovery Plan*; (2) ongoing implementation of the *Interim Strategy for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California* (PACFISH; USDA and USDI 1995) and the *Interim Strategy for Managing Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana and Portions of Nevada* (INFISH; USDA 1995); (3) ongoing implementation of the Northwest Forest Plan; (4) ongoing implementation of the Northwest Power and Conservation Council Fish and Wildlife Program targeting subbasin planning; (5) ongoing implementation of the Federal Caucus Fish and Wildlife Plan;

and, (6) ongoing implementation of Department of Agriculture Conservation Reserve Programs.

b) *State (Oregon) conservation actions.*

Since 1990, the State of Oregon has taken extensive action to address the conservation of bull trout, including: (1) Establishing bull trout working groups in the Klamath, Deschutes, Hood, Willamette, Odell Lake, Umatilla and Walla Walla, John Day, Malheur, and Pine Creek river basins for the purpose of developing bull trout conservation strategies; (2) establishment of more restrictive harvest regulations in 1990; (3) reduced stocking of hatchery-reared rainbow trout and brook trout into areas where bull trout occur; (4) angler outreach and education efforts are also being implemented in river basins occupied by bull trout; (5) research to further examine life history, genetics, habitat needs, and limiting factors of bull trout in Oregon; (6) reintroduction of bull trout fry from the McKenzie River watershed to the adjacent Middle Fork of the Willamette River, which is historical but currently unoccupied, isolated habitat; (7) the Oregon Department of Environmental Quality (DEQ) established a water temperature standard such that surface water temperatures may not exceed 10 degrees Celsius (50 degrees Fahrenheit) in waters that support or are necessary to maintain the viability of bull trout in the State (Oregon 1996); and, (8) expansion of the Oregon Plan for Salmon and Watersheds (Oregon 1997) to include all at-risk wild salmonids throughout the State.

c) *Tribal conservation activities.*

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

4.1.8 Bull Trout Critical Habitat

The Service published a final critical habitat designation for the coterminous United States population of the bull trout on September 26, 2005 (70 FR 56212); the rule became effective on October 26, 2005. The scope of the designation involved the Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments (also considered as interim recovery units). Rangewide, the Service designated 143,218 acres of reservoirs or lakes and 4,813 stream or shoreline miles as bull trout critical habitat (Table 10).

Table 10. Stream/shoreline distance and acres of reservoir or lakes designated as bull trout critical habitat by state.

	Stream/shoreline Miles	Stream/shoreline Kilometers	Acres	Hectares
Idaho	294	474	50,627	20,488
Montana	1,058	1,703	31,916	12,916
Oregon	939	1,511	27,322	11,057
Oregon/Idaho	17	27		
Washington	1,519	2,445	33,353	13,497
Washington (marine)	985	1,585		

Although critical habitat has been designated across a wide area, some critical habitat segments were excluded in the final designation based on a careful balancing of the benefits of inclusion versus the benefits of exclusion (see Section 3(5)(A) and Exclusions under Section 4(b)(2) in the final rule). This balancing process resulted in all proposed critical habitat being excluded in 9 proposed critical habitat units: Unit 7 (Odell Lake), Unit 8 (John Day River Basin), Unit 15 (Clearwater River Basin), Unit 16 (Salmon River Basin), Unit 17 (Southwest Idaho River Basins), Unit 18 (Little Lost River), Unit 21 (Upper Columbia River), Unit 24 (Columbia River), and Unit 26 (Jarbidge River Basin). The remaining 20 proposed critical habitat units were designated in the final rule. It is important to note that the exclusion of water bodies from designated critical habitat does not negate or diminish their importance for bull trout conservation.

Conservation Role and Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable core area populations (70 FR 56212). The core areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses. Critical habitat units generally encompass one or more core areas and may include foraging, migration, and overwintering (FMO) areas, outside of core areas, that are important to the survival and recovery of bull trout.

Because there are numerous exclusions that reflect land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments. These individual critical habitat segments are expected to contribute to the ability of the stream to support bull trout within local populations and core areas in each critical habitat unit.

The primary function of individual critical habitat units is to maintain and support core areas which: 1) contain bull trout populations with the demographic characteristics needed to ensure their persistence and contain the habitat needed to sustain those characteristics (Rieman and McIntyre 1993); 2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage movement of migratory fish (Rieman and McIntyre 1993, MBTSG 1998); 3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations (Rieman and McIntyre 1993, Hard 1995, Healey and Prince 1995, MBTSG 1998); and 4) are distributed throughout the historic range of the species to preserve both genetic and phenotypic adaptations (Rieman and McIntyre 1993, Hard 1995, MBTSG 1998, Rieman and Allendorf 2001).

Primary Constituent Elements

Within the designated critical habitat areas, the PCEs for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering. Note that all except PCE 3 apply to FMO habitat identified as critical habitat.

The PCEs are as follows:

(1) Water temperatures that support bull trout use. Bull trout have been documented in streams with temperatures from 32 to 72 °F (0 to 22 °C) but are found more frequently in temperatures ranging from 36 to 59 °F (2 to 15 °C). These temperature ranges may 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. Stream reaches with temperatures that preclude bull trout use are specifically excluded from designation.

(2) 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.

(3) 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. This should include a minimal amount of fine substrate less than 0.25 inch (0.63 centimeter) in diameter.

(4) A natural hydrograph, including peak, high, low, and base flows within historic ranges or, if regulated, currently operate under a biological opinion that addresses bull trout, or a hydrograph that demonstrates the ability to support bull trout populations by minimizing daily and day-to-day fluctuations and minimizing departures from the natural cycle of flow levels corresponding with seasonal variation.

(5) Springs, seeps, groundwater sources, and subsurface water to contribute to water quality and quantity as a cold water source.

(6) Migratory corridors with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows.

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

(8) Permanent water of sufficient quantity and quality such that normal reproduction, growth, and survival are not inhibited.

Critical habitat includes the stream channels within the designated stream reaches, the shoreline of designated lakes, and the inshore extent of marine nearshore areas, including tidally influenced freshwater heads of estuaries.

In freshwater habitat, critical habitat includes the stream channels within the designated stream reaches, and includes a lateral extent as defined by the ordinary high-water line. In areas where ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge that generally has a recurrence interval of one to two years on the annual flood series.

Activities that cause adverse effects to critical habitat are evaluated to determine if they are likely to "destroy or adversely modify" critical habitat by altering the PCEs to such an extent that critical habitat would not remain functional to serve the intended conservation role for the species (70 FR 56212, USFWS 2004). Our evaluation must be conducted at the scale of the entire critical habitat area designated. Therefore, adverse modification of bull trout critical habitat is evaluated at the scale of the final designation, which includes the critical habitat designated for the Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments.

Current Condition

The condition of bull trout critical habitat varies across its range from poor to good. Although still relatively widely distributed across its historic range, the bull trout occurs in low numbers in many areas, and populations are considered depressed or declining across much of its range (67 FR 71240).

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

4.1.9 Lost River (Deltistes luxatus) and Short-nosed Suckers (Chasmistes brevirostris)

The Lost River sucker (LRS) was first described by Cope (1879) as *Chasmistes luxatus*, based on specimens collected in Upper Klamath Lake (UKL). Shortly afterward, *Catostomus rex* was described from the Lost River and Tule Lake, in south-central Oregon and northern California, but has been regarded as a synonym of *D. luxatus* (Seale 1896). Currently *Deltistes* is the generic epithet most widely used by fish taxonomists (Andreasen 1975, Miller and Smith 1981, Williams et al. 1985, USFWS 1988, Markle et al. 2005), and it is the name accepted by the American Fisheries Society and the Service (Nelson et al. 2004).

The shortnose sucker (SNS) was described by Cope (1879) as *Chasmistes brevirostris*, based on specimens collected from UKL. Fowler (1913) suggested that *C. brevirostris* should be transferred to the genus *Lipomyzon*, but this was not adopted by subsequent taxonomists. Two additional nominal taxa, *C. stomias* and *C. copei,* were later described from UKL and vicinity (Evermann and Meek 1897, Gilbert 1897), but both were later synonomized with *C. brevirostris* by Miller and Smith (1981). Molecular genetic evidence suggests that the genus *Chasmistes* is artificial, perhaps due to convergent evolution based on use of lake habitats, and should perhaps be synonomized under *Catostomus* (Wagman and Markle 2000), but no formal revision has been published.

<u>Current and Historical Distribution</u>

Prior to settlement LRS and SNS occurred in UKL, Tule Lake, Lower Klamath Lake, and presumably Clear Lake, as well as their tributaries. However, at the time of listing, these species were known from UKL and its tributaries and outlet (Klamath Co., Oregon), including a "substantial population" of shortnose sucker in Copco Reservoir (Siskiyou Co., California), as well as collections of both species from Iron Gate Reservoir (Siskiyou Co., California) and J.C. Boyle Reservoir (Klamath Co., Oregon), and Lost River sucker from Sheepy Lake and Lower Klamath Lake (Siskiyou Co., California). Remnants and/or highly hybridized populations were also stated to occur in the Lost River system (Klamath Co., Oregon, and Modoc and Siskiyou Co., California) including both species in Clear Lake Reservoir (Modoc Co., California) and Lost River sucker in Tule Lake (Siskiyou Co., California; USFWS 1988, p. 27130). Although not stated explicitly, the reference in the listing to "highly hybridized populations" in the Lost River Basin probably refers to shortnose sucker within Gerber Reservoir (Klamath Co., Oregon). See Figure 1 below. Spawning likely occurred throughout the Upper Klamath Lake drainage in both rivers and springs along shoreline of the lake (Andreasen 1975, Stine 1982, NRC 2004). Spawning also occurred in significant numbers in the Lost River system (Bendire 1889, Howe 1969), some of which in the Big Springs area near Bonanza, OR.
These two fishes were once very abundant and were important seasonal foods of Native Americans and white settlers in the upper Klamath River basin (Cope 1879, Gilbert 1897, Howe 1969). Sucker spawning migrations occurred in the spring at a critical time when

winter food stores had been exhausted. The Klamath and Modoc Indians dried suckers for later use. It was estimated that the aboriginal harvest at one site on the Lost River may have been 50 tons annually (Stern 1965). Settlers built a cannery on the Lost River and suckers were also processed into oil and salted for shipment. In 1900, the Klamath Republican newspaper reported that "mullet," as suckers were referred to, were so thick in the Lost River that a man with a pitch fork could throw out a wagon load in an hour. The first reference to sport fishing of "mullet" appears to be a 1909 reference to sportsmen snagging "mullet" in the Link River at Klamath Falls (Klamath Republican, Oct. 14, 1909).

In 1959, suckers were made a game species under Oregon State law and snagging suckers in the Williamson and Sprague River was popular with locals and out-of-town sportsmen (Bragg 2001, Markle and Cooperman 2002). In the 1960's ODFW estimated 100,000 pounds of suckers per year (ca. 12,500 fish) were harvested (Eugene Register-Guard, May 7, 1967). ODFW data indicated from 1966 through 1978, an approximate 50 percent decline in catches (from 3.5-5.6 suckers per angler before the 1969 bag limit, to 1.5-3.0 afterwards). More than 3,000 suckers were taken in the snag fishery in 1968 (Golden 1969). Numbers of harvested suckers from spawning runs in the Sprague and lower Williamson Rivers increased from 1.2 fish per hour in 1966 to 4.7 fish/hour in 1969 and then, from 1969 on, there was a steady decline to 0.8 fish/hour in 1974 (Andreasen 1975). Average weight of suckers caught in the fishery declined about 40 percent from 1966 to 1974 (from 7.5 to 4.9 pounds), and declines continued to the time of listing. By 1985, Bienz and Ziller (1987) estimated the harvest had dropped by about 95 percent. Based on this information, the game fishery was terminated in 1987, just prior to federal listing (USFWS 1988).

Currently, the overall distribution of the listed species has not changed significantly compared to when they were listed, but occurrences of shortnose sucker within Tule Lake have been subsequently documented (Figure 1). Clear Lake Reservoir and Upper Klamath Lake support the largest populations. The total area of occupied lake habitat for LRS and SNS is about 118,000 acres, of which approximately 65 percent is in UKL, which covers approximately 77,000 acres at full pool. The remaining habitat is in Clear Lake (25,000 acres); Tule Lake sump 1A (9,000 acres); Gerber Reservoir (4,000 acres); and Keno Reservoir (2,500 acres). Several populations outside of their known historic distribution, such as in Copco, Iron Gate, and J.C. Boyle reservoirs on the Klamath River are most likely the result of downstream movement of suckers from UKL (Desjardins and Markle 2000). All life stages of listed suckers have also been found in Link River, the outlet of Upper Klamath Lake, in recent years (Bureau of Reclamation [BOR] 2000, Piaskowski 2003, PacifiCorp 2004).

Additionally, a small group of LRS appears to reside year-around in the Sprague River near Beatty. In 2007, the Service located small groups of adult LRS above the confluence of the Sycan River and below Beatty Gap and near the Town of Sprague River (Murphy and Parrish 2008). Although there was a substantial fish survey effort conducted in the Sprague River in the summer of 2007 by Oregon State University (OSU) and Service fish biologists, no adult SNS were collected.

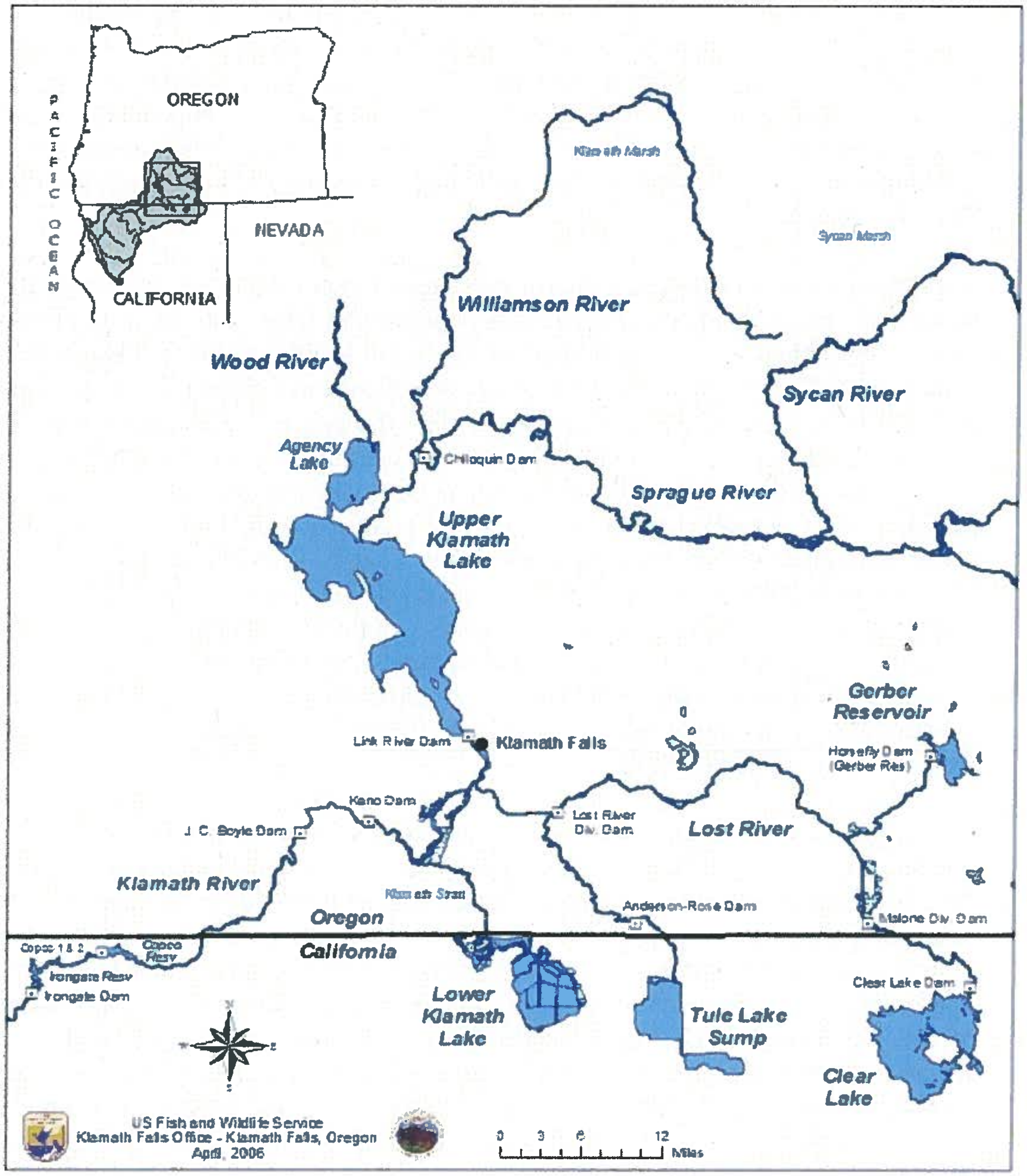

Figure 1. Map of the Upper Klamath River Basin showing primary water bodies.

Spawning is only known to occur in three systems: Clear Lake Reservoir, UKL, and Gerber Reservoir. Both species utilize the only known spawning tributary to Clear Lake Reservoir, Willow Creek. Investigations have not located suckers in Upper Klamath Lake tributaries other than the Williamson, Sprague, and Wood Rivers; although, some have reported much broader historical distribution of spawning among Upper Klamath Lake tributaries (Stine 1982).

Lost River sucker spawning predominantly occurs in the lower Williamson River from river mile 6 to the confluence of the Sprague River (river mile 11), the lower Sprague River below Chiloquin Dam area, and in the Beatty Gap area around river mile 75 of the upper Sprague River (Buettner and Scoppettone 1990, Tyler et al. 2004, Ellsworth et al. 2007). However, suckers have been observed at various locations throughout the system (Figure 2). A significant contingent of LRS spawn at sites on the eastern shore of UKL (Figure 3; Shively et al. 2000a, Hayes et al. 2002). These spawning Mark-recapture data indicate that the two stocks (the river spawning individuals and the shoreline spring spawning individuals) maintain a high degree of fidelity to spawning areas and seldom interbreed (Hayes et al. 2002, Barry et al. 2007b), although lack of genetic distinction suggests that some mixing may occur (Dowling 2005).

Shortnose sucker from Upper Klamath Lake also currently spawn primarily in the lower Williamson and Sprague Rivers (Figure 2; Tyler et al. 2004, Ellsworth et al. 2007). The few adult shortnose sucker captured at shoreline spawning areas in Upper Klamath Lake suggests that minimal shortnose sucker spawning occurs at these locations (Hayes et al. 2002, Barry et al. 2007b). A small number of suckers, approximately 70 individuals, primarily shortnose suckers, were captured during spring sampling in 1996, 1999, and 2000 near the mouth of the Wood River in Agency Lake, presumably preparing to spawn (BOR 2001). Spawning within Gerber Reservoir by SNS apparently occurs in several tributaries (USBLM 2000).

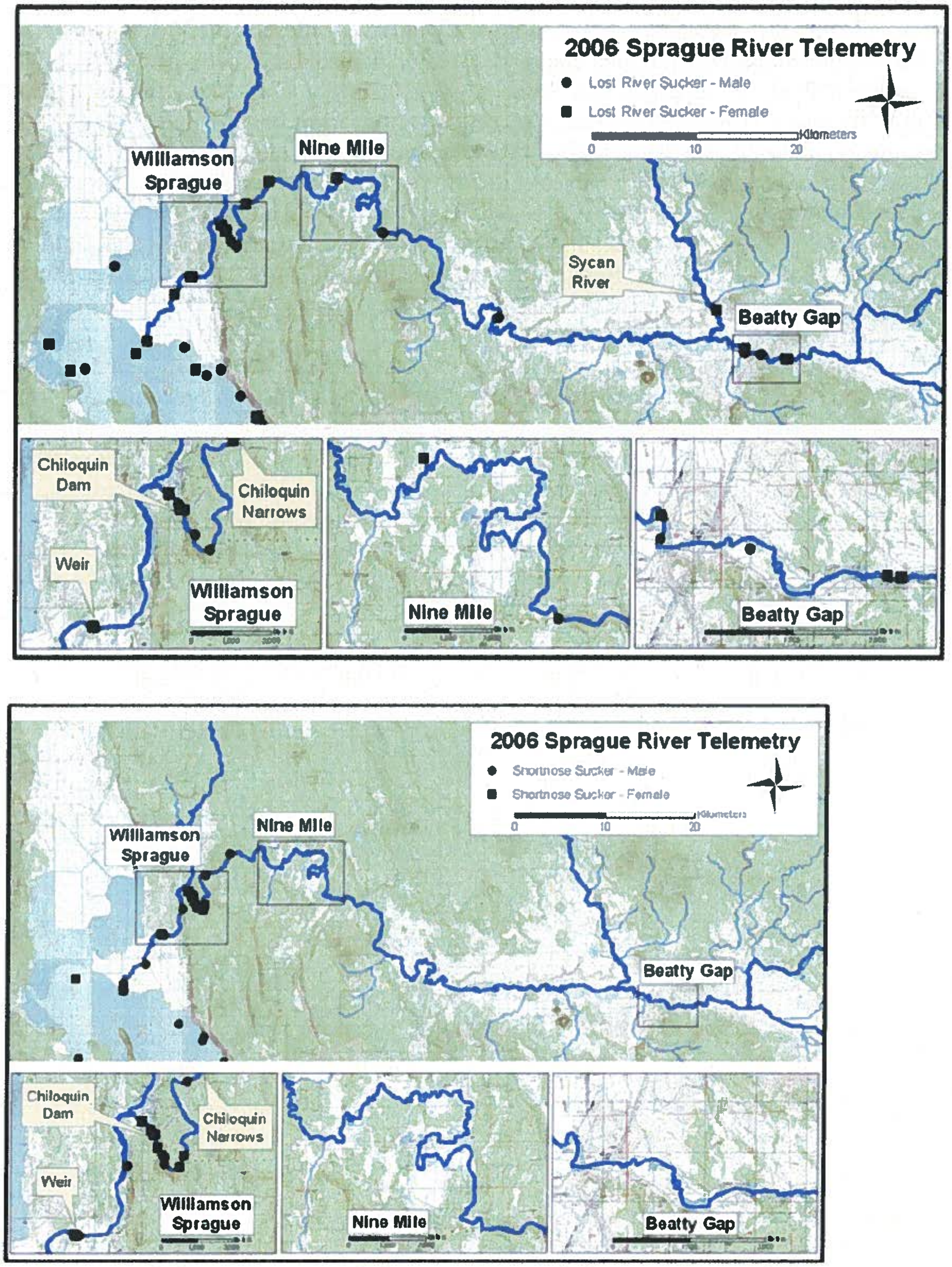

Figure 2. Detections of radio-tagged LRS (top panel) and SNS (lower panel) within the Williamson and Sprague Rivers during the spawning migration (Ellsworth et al. 2007).

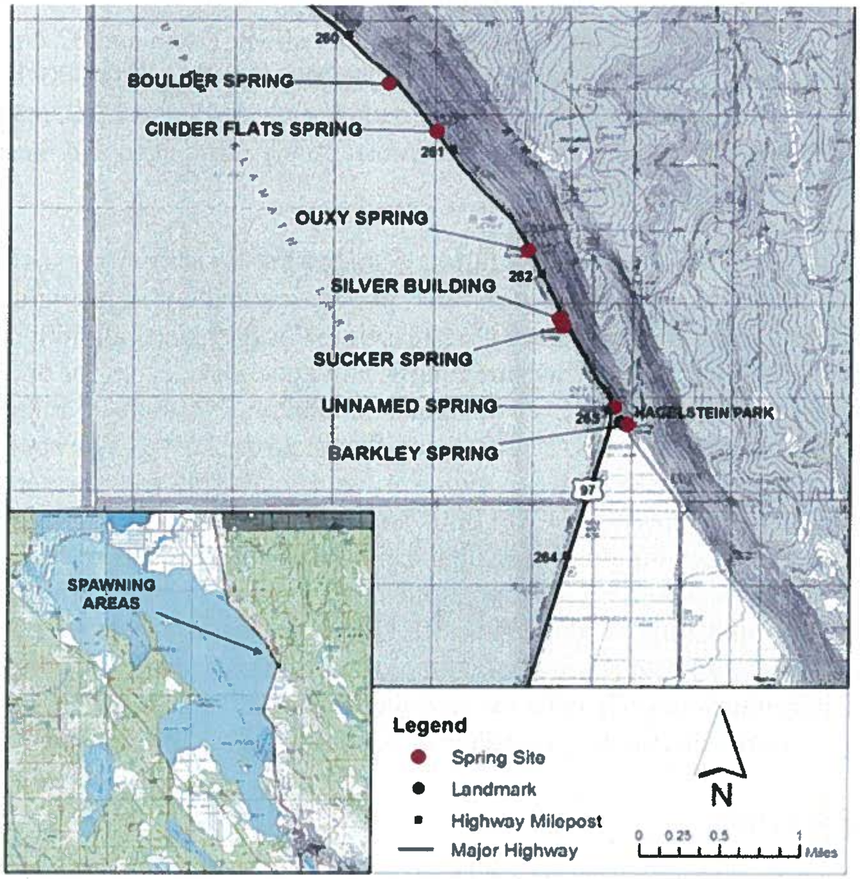

Figure 3. Map of the eastern shore of UKL showing springs were suckers have historically spawned. Lost River suckers continue to utilize these areas, with the exception of Barkley Spring and the nearby "unnamed spring."

Life History

Growth Rates

LRS and SNS have been aged to 55 and 33 years, respectively. Both species grow relatively rapidly in their first ten years of life (Perkins et al. 2000b), but this rate slows as they mature. Annual growth rates for adult suckers in Upper Klamath Lake currently average 5 mm for SNS and 10 mm for LRS (Hewitt et al. 2011). Barry et al. (2009) observed growth rates of both species in Clear Lake Reservoir substantially greater than observed in Upper Klamath Lake. Growth rates for suckers in other parts of their range are not known.

Reproduction

LRS and SNS do not die after spawning and can spawn many times during their lifetime. LRS males are typically at least 4 years old and 38 cm Fork Length (FL) when they join the spawning population, although the size mode is closer to 46 cm FL. Female LRS are typically older (age 7+) and larger (54 cm FL) when they enter the spawning population (Buettner and Scoppettone 1990, Perkins et al. 2000b). Male and female SNS reach sexual maturity at about 4+ years and minimum sizes of about 27 cm and 32 cm, respectively. Both species are highly fecund with 18,000-72,000 and 44,000-236,000 eggs being produced in one spawning season by each female SNS and LRS, respectively (Perkins et al. 2000b). Larger females produce substantially more eggs and therefore can contribute relatively more to production.

The timing and duration of spawning migration is somewhat variable from year to year, and is apparently dependent on age, species, sex, population and environmental conditions, such as flow and temperature (Andreasen 1975, Perkins et al. 2000b). Spawning is associated with the springtime runoff, and generally occurs for both species from February through May over gravel substrates in habitats less than 1.3 meters (4.3 feet) in rivers and shoreline springs (Buettner and Scoppettone 1990). The spawning migration in UKL usually peaks between mid-April and early May when water temperatures are greater than 10-12° C (Perkins and Scoppettone 1996, Hewitt et al. 2011). However, the spawning run from Clear Lake Reservoir tends to be earlier when temperatures are between 4 – 10° C (Scoppettone et al. 1995). Temperatures at these spring outlets where spawning occurs can be 10° C or more above ambient lake temperatures, and the substrate is predominantly gravel and cobble. Annual variability in the number of individuals participating in spawning runs into Willow Creek can be attributed to spring time discharge; large runs occur during years of high flow.

Larvae and Juveniles

After spawning, the fertilized eggs settle within the top few inches of the substrate until hatching, around one week later. Approximately 10 days after hatching, larvae emerge out of the gravel (Coleman et al. 1988, Buettner and Scoppettone 1990). Generally, larvae spend little time in rivers after swim-up, but quickly drift downstream to the lakes. In the Williamson River, larval movement away from the spawning grounds begins in April and is typically completed by July. Once in the lake, larvae inhabit near-shore areas (Cooperman 2004, Cooperman and Markle 2004), such as the newly restored Williamson River Delta. Larvae density is generally higher within and adjacent to emergent vegetation than in areas devoid of vegetation (Klamath Tribes 1996, Cooperman and Markle 2004, Crandall et al. 2008). Larvae transform into juveniles by mid-July. Juvenile suckers primarily use relatively shallow (less than approximately 1.2 meters [3.9 feet]) vegetated areas, but may also begin to move into deeper, un-vegetated off-shore habitats (Buettner and Scoppettone 1990, Terwilliger et al. 2004, Hendrixson et al. 2007a, b, Burdick et al. 2008, Bottcher and Burdick 2010, Burdick and Brown 2010). One year old juveniles occupy shallow habitats during April and May, but may afterwards move into deeper areas along the western shore of Upper Klamath Lake until dissolved oxygen levels become unsuitably low (Bottcher and Burdick 2010, Burdick and Vanderkooi 2010).

Sub-adults and Adults

It is assumed that sub-adults (individuals which display all of the characteristics of adults with the exception of reproductive maturity) utilize habitats similar to adults (NRC

2004). Adult suckers inhabit water depths of 1 to 4.5 meters (3.3 – 14.8 feet), but appear to prefer depths from 1.5 to 3.4 meters (Peck 2000, Reiser et al. 2001, Banish et al. 2009).

Population Dynamics and Trends

Upper Klamath Lake LRS and SNS Populations

The largest populations of both species are found within Upper Klamath Lake. Between 1999 and 2008, roughly 10,000 Lost River suckers were captured and tagged at shoreline-spring spawning sites, with another 15,000 handled as part of the spawning run up the Williamson River (Janney et al. 2009). During a similar time period, 1995 – 2008, approximately 14,000 shortnose suckers were captured, predominantly associated with the Williamson River spawning runs (Janney et al. 2009). Nevertheless, the size of Upper Klamath Lake and the relative scarcity of Lost River sucker and shortnose sucker in the lake make it difficult to accurately estimate their abundance.

At the time of listing, Upper Klamath Lake spawning populations of Lost River sucker and presumably shortnose sucker, received little recruitment and were dominated by older individuals (Scoppettone and Vinyard 1991, Janney and Shively 2007, Janney et al. 2008). A 1986 survey of 190 Lost River sucker opercles from Upper Klamath Lake revealed an age distribution of individuals between 8 and 43 years (Scoppettone and Vinyard 1991). The majority of individuals were 16 to 30 years old, and only 9 were less than 16 years old. Similarly, ages, determined from opercles, of 19 shortnose sucker from Copco Reservoir in 1987 ranged from 16 to 33 (mean = 23 years) suggesting that shortnose sucker populations were also comprised primarily of older individuals (Scoppettone and Vinyard 1991).

Recent size distribution trends reveal that Upper Klamath Lake spawning populations are comprised mostly of similarly-aged, older individuals. Since the late 1990s populations of both species have exhibited an increasing trend in length indicative of an aging population with little recruitment (Hewitt et al. 2011). During 1995 through 1997, significant fish kills of suckers in Upper Klamath Lake were documented each year. Over 7,000 dead suckers, ranging in age from 2 years old to 33 years old were collected during the late summer months of these three years (D. Hewitt, USGS, unpubl. data. 2010, Perkins et al. 2000b). Collections of dead suckers were comprised predominantly of adult-sized suckers, with the exception of 1997, which included relatively smaller Lost River sucker (330 to 400 millimeters fork length) and shortnose sucker (290 to 330 millimeters fork length; Perkins et al. 2000b).

Mark-recapture analyses in Upper Klamath Lake from 2002 to 2007 estimate annual survival rates for shoreline spring-spawning Lost River sucker to be on average 0.90, but with the low levels of recruitment this equates to an average annual loss of approximately 7 percent during this period. Survival in the river-spawning sub-population of LRS is comparable to that of the spring spawning sub-population (Hewitt et al. 2011), but the declining trend appears to be more precipitous. River-spawning shortnose sucker annual survival rates from 2001 to 2007 are estimated to average 0.82. This population declined by approximately 10 percent each year during this period, on average.

Clear Lake LRS and SNS Populations

Clear Lake Reservoir currently supports the only substantial populations of SNS and LRS in the Lost River system. Less is known about SNS and LRS in Clear Lake Reservoir than those in UKL because monitoring studies have been sporadic over the past 35 years, and demographic studies similar those conducted in UKL were not initiated in Clear Lake Reservoir until 2006 (Barry et al. 2009). However, mark-recapture data from Clear Lake Reservoir are currently limited. Of primary concern are the comparably low detection rates, which introduce uncertainty into the parameter estimates. Additionally, detection rates apparently depend on whether spring runoff is low, which tends to produce low detection rates, or high, which produces relatively high detection rates. This suggests that each individual may not be available to be detected in low runoff years, which is a violation of a central assumption of mark-recapture analysis. Violation of this assumption can negatively bias survival estimates. Therefore, information similar to that generated in Upper Klamath Lake is currently unavailable for Clear Lake Reservoir until detection probabilities can be improved (Hewitt and Janney 2011, pers. comm.)

Variability in age class structure, longevity, and abundance LRS and SNS in Clear Lake is poorly understood in comparison with populations in UKL. Summarizing historical and recently collected data, Barry et al. (2009) observed that populations of both species in Clear Lake have undergone major demographic changes during the past 15 years. Populations in the mid-1990s showed little evidence of recruitment and consisted mostly of large and presumably older suckers. The abundance of large suckers decreased in the late 1990s and early 2000s, and current populations are mostly ones recruited into the adult population in the late 1990s (Barry et al. 2009). However, length-frequencies from 2005 – 2009 reveal evidence of shortnose sucker recruitment, but recruitment into the Lost River sucker population has been sparse over that period (Hewitt and Janney 2011, pers. comm.).

Tule Lake LRS and SNS Populations

Currently, populations of LRS and SNS in Tule Lake are a remnant of the historical levels. In 1991 individuals of both species were observed spawning below Anderson-Rose Dam, which acts as a complete barrier to any upstream passage. Subsequent sampling at Tule Lake in the early 1990s captured and recaptured several adults of each species suggesting populations of both species were present (Scoppettone et al. 1995). Accurate estimates of the population size are not possible from the low number of recaptured individuals, but the number of captures suggest that sucker population sizes for both species are limited to a few hundred individuals of each species (Scoppettone et al. 1995, Hodge and Buettner 2009). Because of concerns that Tule Lake water conditions would likely be adverse in the summer of 2010 as a result of drought, Bureau of Reclamation began removing suckers from Sump 1A in May 2010, and as a result 223 SNS and 186 LRS were moved to UKL and associated tributaries (Courter et al. 2010).

Sampling in the 1990s and 2006-2008 observed suckers of both species spawning in the Lost River below Anderson-Rose Dam (Hodge and Buettner 2009). However, documentation of successful spawning was infrequent and during years when larvae were observed they were generally present in small numbers. It is also possible that larvae observed in the lower Lost River may be vagrants from UKL because most of the water in the river during the late spring originates from UKL and is diverted into the Lost River Diversion Channel and then into the Lost River at Station 48. In 2007, an intensive trap-netting effort was made in Tule Lake sumps to assess the presence and relative abundance of juvenile and sub-adult suckers. With over 1,000 hours of effort throughout both Sumps 1A and 1B, only two juvenile suckers were captured, suggesting little recent recruitment had occurred and that Tule Lake is primarily a sink population for LRS and SNS (Hodge and Buettner 2009). Any recruitment now occurring in Tule Lake is most likely due to larvae coming from UKL and moving through the canal system to the sump. Bureau of Reclamation has also salvaged thousands of juvenile suckers from J–Canal and put them in the sump over the past two decades and that has likely lead to some recruitment. Although the new A-Canal fish screen now reduces the numbers of young suckers reaching Tule Lake, it has not stopped it entirely because Bureau of Reclamation continues to salvage them from the J-Canal.

Gerber Reservoir SNS Population

SNS occur in Gerber Reservoir. LRS do not occur in Gerber Reservoir probably because none were upstream of dam when it was constructed (BOR 2001, Piaskowski 2003, Barry et al. 2007a). Little information exists on the spawning areas for populations from Gerber Reservoir; however surveys of spawning areas during spring 2006 detected more than 1,700 suckers ascending Ben Hall Creek and Barnes Valley Creek (Barry et al. 2007a). Monitoring in Gerber Reservoir has documented a substantial SNS population (or possibly SNS x KLS hybrids), exhibiting multiple size classes and presumably multiple age classes. Data from 2004 to 2006 indicate a lower frequency of larger adults compared to those from 2000 (Piaskowski 2003, Barry et al. 2007a, Leeseberg et al. 2007).

While the population of SNS in Gerber Reservoir appears to have more frequent recruitment than some other populations, the problems of restricted distribution and lack of genetic connectivity with other populations still exist (USFWS 2002). A high degree of hybridization between SNS and Klamath largescale sucker is thought to occur in Gerber Reservoir (Markle et al. 2005). However, until the status of these fish has been resolved, the Service considers the Gerber sucker population to be SNS.

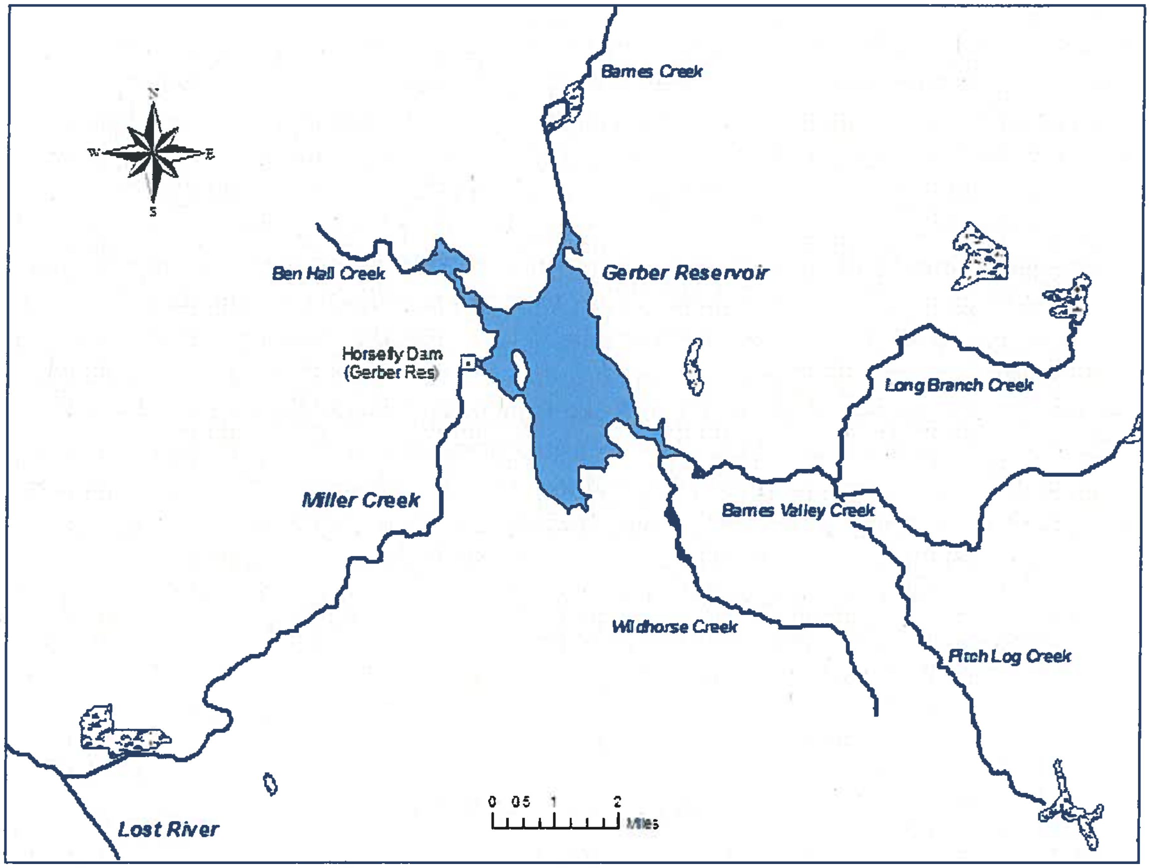

Figure 4. Vicinity map for the Gerber Reservoir area in Klamath County, Oregon.

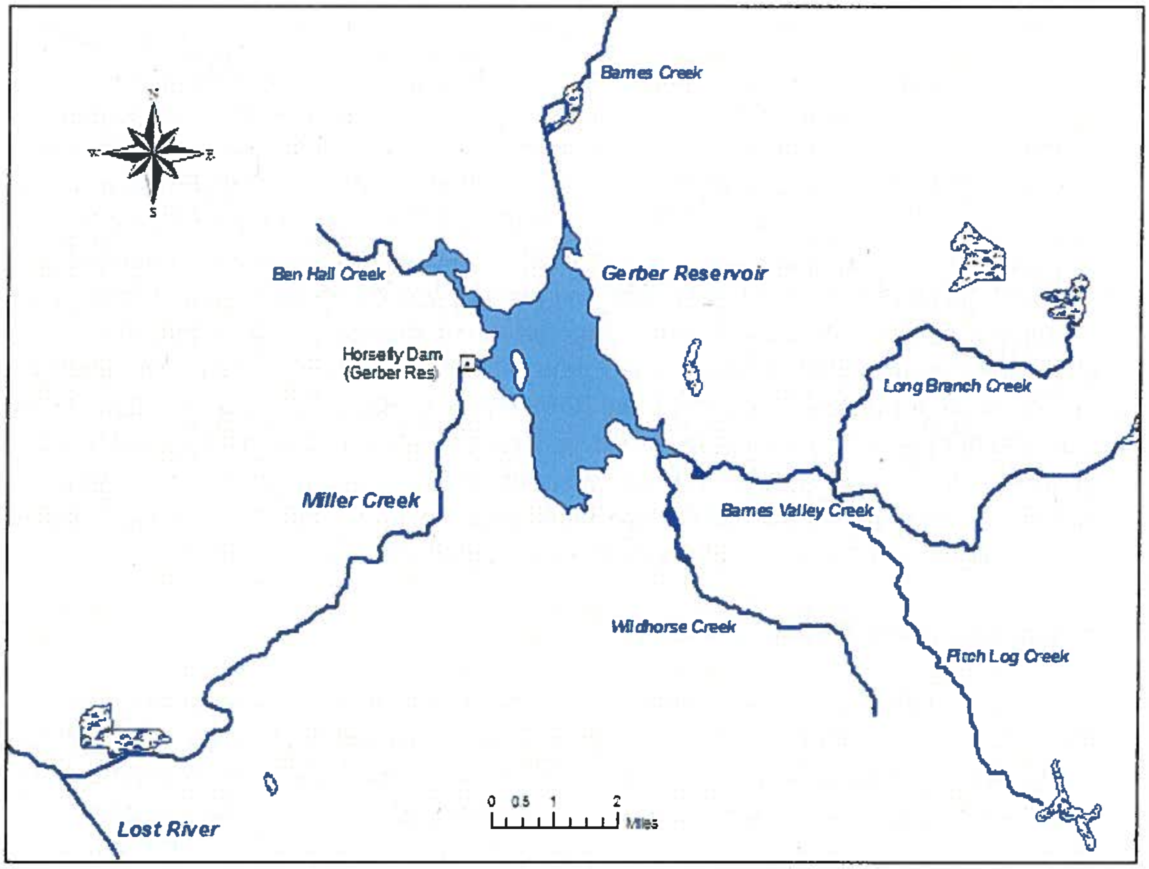

Figure 4. Vicinity map for the Gerber Reservoir area in Klamath County, Oregon.

Reasons for Listing

The LRS and SNS were listed as endangered throughout their entire range in 1988 (USFWS 1988), under the Endangered Species Act of 1973, as amended. Both species are also listed as endangered by the states of Oregon and California. A recovery plan for both species was finalized in 1993 (USFWS 1993). A draft revision of this recovery plan has been developed and will be finalized in 2012. Review of the federal status for each The Lost River sucker and shortnose sucker were federally listed as endangered on July 18, 1988 (USFWS 1988). At the time of listing, perceived threats to the species included: 1) loss of historical populations and range; 2) habitat loss, degradation and fragmentation; 3) drastically reduced adult populations; 4) overharvesting by sport fishing; 5) large summer fish die-offs caused by declines in water quality. 6) lack of significant recruitment; 7) hybridization with the other sucker species native to the Klamath Basin; 8) potential competition with and introduced exotic fishes; and 9) lack of regulatory protection from Federal actions that might adversely affect or jeopardize the species.

The draft revised recovery plan states that the most pressing threat to these species is the lack of both resiliency and redundancy due to severe reduction of viable populations range wide (USFWS, *in review*). Of the few populations that do remain from historic distributions, most are very restricted and many lack the ability to successfully reproduce. Reproducing populations are only known to exist in Upper Klamath Lake, Clear Lake Reservoir, and Gerber Reservoir (shortnose sucker only). This condition means that a threat to any single reproducing population becomes a threat to the entire species. Populations in Upper Klamath Lake are able to spawn, but are threatened by a uniformly aged population, due to relatively few or no individuals progressing from larvae to spawning adults. The actual causes of this lack of recruitment are complex and poorly understood, but include loss of spawning and nursery habitat, degradation of juvenile and adult habitat, loss of individuals to sink populations or mortality, and, potentially, negative interactions with introduced and/or predatory species. The limited amount of information on populations in Clear Lake Reservoir prevent rigorous assessment of status and trends, but many characteristics of the lake (such as susceptibility to drought and only one known spawning stream) raise concerns of potential stochastic loss of the populations. Similar threats face the shortnose population in Gerber Reservoir, with the added complexity of hybridization with Klamath largescale sucker.

Recovery and Conservation Planning

In general, the strategy to recover the LRS and SNS is to reduce threats throughout the species' range in order to restore natural population dynamics in the upper Klamath Basin systems, primarily populations of Upper Klamath Lake and Clear Lake Reservoir. This will include efforts to prevent extinction through establishment of viable auxiliary populations, to determine the specific threats to and needs of distinct portions or populations of the species, to reduce threats to the extent possible through restoration or manipulation, and to promote the growth of populations (USFWS, *in review*).

Based on the broad recovery strategy and current threats to the species the following objectives are identified:

1. Threat-based Objectives—

    i. Restore or enhance spawning and nursery habitat in Upper Klamath Lake and Clear Lake Reservoir systems.
    ii. Reduce negative impacts of poor water quality
    iii. Clarify and reduce the effects of non-native organisms on all life stages
    iv. Reduce the loss of individuals to entrainment
    v. Establish a redundancy and resiliency enhancement program

2. Demographic-based Objectives—

    i. Maintain or increase larval production
    ii. Increase juvenile survival and recruitment to spawning populations
    iii. Protect existing and increase the number of recurring, successful spawning populations. (In this context recurring is defined as at

least five consecutive years, and successful is defined as production of individuals attaining the juvenile stage.)

New Threats

The overall status of these species has not changed since listing. In the 2008 Klamath Project BO (USFWS 2008), the Service identified the following as the current range-wide threats to the LRS and SNS: 1) degradation and loss of habitat; 2) migration barriers; 3) inadequate instream flows; 4) poor water quality; 5) fish health issues (i.e., diseases, parasites, and biotoxins); 6) entrainment; 7) water pollution from fertilizers and pesticides; 8) nonnative fishes; 9) fish-eating birds; and 10) human-induced climate change. Some of the threats are the same or similar to those at the time of listing but others such as fish health and climate change were identified as new threats.

Ongoing Conservation Actions

The most urgent conservation need for LRS and SNS is to improve recruitment. Because of that, the Service has worked with other agencies and stakeholders since 1994 to improve larval and juvenile habitat, reduce larval and juvenile entrainment, and to take other actions directed towards improving survival and productivity of young suckers and increase spawning. Important cooperators include the U.S. Bureau of Reclamation (USBR), National Resources Conservation Service (NRCS), The Nature Conservancy, Oregon Department of Environmental Quality (ODEQ), National Fish and Wildlife Conservation Fund, Klamath Water Users, and Modoc Irrigation District. Approximately 300 on-the-ground restoration projects, including 90 wetland, 130 riparian, 45 in-stream, 25 upland, and 15 fish passage projects have been funded and implemented in the Upper Klamath Basin that directly or indirectly benefit LRS and SNS since 2009. Many of the projects included elements of more than one category of restoration project type taking a holistic or ecosystem approach based on the assumption that restoration of natural ecosystem functioning will ultimately benefit multiple species, including listed suckers. These projects have had significant cost share from multiple sources, including Federal programs such as Partners for Fish and Wildlife, Hatfield, Jobs in the Woods, and Oregon Resources Conservation Act programs, as well as state and private grants and contributions from landowners.

Major sucker recovery oriented projects that have been recently completed include: screening of the main irrigation diversion on the Klamath Project (A-Canal) in 2002 and the outlet to Clear Lake Dam in 2003, and screening of Modoc Irrigation District's diversion on the Williamson River (2007), and the Geary Canal diversion on UKL in 2009; construction of a new fish ladder at Link River Dam (2004); restoration of Williamson River Delta approximately 6,000 ac between 2000 and 2008, restoration of the lower 3 mi of the Wood River in 1999; and removal of Chiloquin Dam in 2008, a major impediment to upstream migration of listed suckers. Removal of Chiloquin Dam opened access to approximately 56 mile of river that may be used by spawning LRS and SNS. It is too early to assess the efficacy of these projects to support recovery, and some project modification may be required for the full benefit of each program to be realized.

This is particularly true with the Klamath Project screening the A-Canal. Under present design, fish screened from entering the A-Canal are delivered via pipeline to UKL at a point that is near the Link River Dam. Investigations are needed to determine if these fish remain in UKL or pass downstream into Lake Ewauna, and possibly lost to the spawning population because of poor water quality conditions in the lake during the summer. The NRCS completed a large number of projects under the 2002 Farm Bill to improve water quality and water conservation. This has resulted in restoration of over 2,200 acres of wetland habitat and conservation of over 6,700 acre-feet of on-farm water. Conservation systems on over 70,000 acres have been planned, and practices have been applied to over 30,000 acres to manage soil, water, air, plants, and animals on private lands.

The Sprague River, the primary spawning habitat for suckers in UKL and the largest tributary to the Williamson River, is listed as water quality-impaired for nutrients, temperature, sediment, and DO under the section 303(d) of the Clean Water Act. In 2002, ODEQ completed a Total Maximum Daily Load (TMDL) process for the Sprague River and UKL (Boyd et al. 2002). Water quality management plans were developed to provide targets and guidance on improvements to water quality in the Sprague River and UKL. Many wetland and riparian restoration projects are now designed to address TMDL issues. More recent TMDLs and action plans were developed for the Klamath and Lost Rivers (Kirk et al. 2010, NCWQCB 2010b, a).

In 2004, Oregon State University Agricultural Extension Service and the Klamath Watershed Council (now Klamath Watershed Partnership) began a series of monthly meetings with rural landowners in the Sprague River Valley to discuss watershed restoration goals. With the help of the Service, NRCS and the Klamath Soil & Water Conservation District, this effort has effectively connected landowners with appropriate state and federal resource conservation programs. As a result, more than 70 percent of the private lands within the Sprague River Valley are partnering with local, state and federal agencies on land conservation and natural resource actions. The efforts of the Klamath Watershed Partnership have brought additional fiscal partners (e.g., Oregon Department of Agriculture, Klamath County, and Oregon Watershed Enhancement Board) into the conservation partnership. These partnership-forming actions will continue and build on themselves and enable more restoration to be done in the future.

The tributaries in the Wood River Valley supply a large portion of the inflow to UKL. This valley also supports about half of the livestock in the Upper Basin and is responsible for approximately 30 percent of the external phosphorus loading to the lake. Because of this, it was identified by ODEQ as a priority water quality-impaired area. The Klamath Basin Rangeland Trust (KBRT) has been active in the Wood River Valley encouraging landowners to adopt sustainable land and water management practices. Since 2002, the number of landowners who partner with KBRT on conservation and restoration activities has increased to include approximately 50 percent of the agricultural lands in the watershed.

Klamath River Basin stakeholders, including the States of Oregon and California, the Karuk, Klamath, and Yurok Tribes, several counties, 26 parties associated with the Klamath Reclamation Project or irrigators above Upper Klamath Lake, and 7 other conservation organizations, signed the Klamath Basin Restoration Agreement (KBRA) in early 2010. This agreement "is intended to result in effective and durable solutions which: (i) restore and sustain natural production and provide for Full Participation in Harvest Opportunities of fish species throughout the Klamath Basin; (ii) establish reliable water and power supplies which sustain agricultural uses and communities and National Wildlife Refuges; (iii) contribute to the public welfare and the sustainability of all Klamath Basin communities..."(KBRA 2010:4). Although further events such as legislation and funding authorizations must occur prior to full implementation, we believe that implementation of this agreement will produce substantial progress toward the recovery of Lost River sucker and shortnose sucker.

4.1.10 Lost River Sucker and Short-nosed Sucker Critical Habitat

Critical habitat was proposed in 1994 by the Service (USFWS 1994), but has not been finalized. Per a settlement agreement, the Service began working on a new critical habitat proposal in 2010, which is scheduled for completion in 2012. The PCEs identified in the Service's 1994 proposal are as follows: (1) water of sufficient quantity and suitable quality; (2) sufficient physical habitat, including water quality refuge areas, and habitat for spawning, feeding, rearing, and travel corridors; and (3) a sufficient biological environment, including adequate food levels, and patterns of predation, parasitism, and competition that are compatible with recovery. Six critical habitat units were proposed by the Service in 1994 and these are: (1) Clear Lake and watershed; (2) Tule Lake; (3) Klamath River; (4) UKL and watershed; (5) Williamson and Sprague Rivers; and (6) Gerber Reservoir and watershed.

4.1.11 Fender's Blue Butterfly (Icaricia icarioides fenderi) and Kincaid's Lupine (Lupinus sulphureus ssp. kincaidii)

Fender's blue butterfly was listed as federally endangered and Kincaid's lupine as threatened, on January 25, 2000 (67 FR 3875).

<u>Current and Historical Range</u>

Kincaid's lupine and Fenders blue are thought originally to have been widely distributed on upland prairie habitats throughout the Willamette Valley, Oregon, with the lupine extending into the Umpqua Valley, Oregon. Early settlers to the Willamette Valley in the 1840s found a mosaic of open prairies, Oregon white oak or "Garry oak" (*Quercus garryana*) savannas, extensive Oregon ash (*Fraxinus latifolius*) and cottonwood (*Populus tricocarpus*) floodplain gallery forests, and red alder (*Alnus rubra*) and willow (*Salix* sp.) swamps (Boag 1992, Towle 1982, Johannessen et al. 1971, Thilenius 1968, Habeck 1961, Sprague and Hansen 1946).

Of the estimated 1,010,000 ac of native prairie that existed before 1850, approximately

685,000 acre or 67.8 percent consisted of upland prairie (Habeck 1961, The Nature Conservancy 1998). This extensive resource has been dramatically depleted since European settlement began in the 1840s, through fire suppression, agricultural conversion, urbanization (Boag 1992), and the introduction of non-native vegetation (Franklin and Dyrness 1973). Current estimates of the remaining native upland prairie in the Willamette Valley are less than 988 acre (The Nature Conservancy 2000). This estimate represents only 0.1 percent of the original upland prairie once present.

Currently, Kincaid's lupine occurs in 97 remnant upland prairie patches, scattered from Lewis County, Washington to Douglas County, Oregon. Fender's blue butterfly was considered to be extinct until rediscovered by Dr. Paul Hammond in 1989 in McDonald Forest, Benton County, Oregon. The historical distribution of Fender's blue butterfly is not precisely known, due to the limited information collected on this species prior to its description in 1931. Recent surveys have determined that Fender's blue butterfly is confined to 33 habitat patches in Yamhill, Polk, Benton, and Lane counties, Oregon. One population at Willow Creek Nature Conservancy preserve in Eugene, Lane County, Oregon is found in wet Deschampsia-type prairie, while the remaining sites are generally found on drier upland prairies characterized by fescue species.

Life Histories and Habitat Relationships

Kincaid's lupine is the primary host food plant for Fender's caterpillars, and the two species are currently known to co-occur at 25 sites on approximately 279 acres across their ranges but Fender's is also known to use spur lupine *(Lupinus laxiflorus = L. arbustus)* and sickle-keeled lupine *(L. albicaulis)* as secondary host plants (Table 11). Female Fender's blue butterfly lay their eggs on lupine foliage in late May or early June; and larvae emerge to feed on foliage during late June. In July, larvae crawl to the base of the plant and enter diapause. From this point until the larvae emerge and begin feeding on foliage again the following April, the larvae remain at the base of the senescent plant, or in the litter immediately adjacent to the lupine stem. Fender's density has been positively correlated with the number of Kincaid's lupine flowering racemes, and more recently, to nectar production in native flowering species used as nectar sources by Fender's. Survivorship of larvae to adult butterflies has been estimated at 0.025-0.060 percent (Schultz and Crone 1998).

Recent research (Schultz and Dlugosh in litt. 1999) indicates that native wildflowers in the Willamette Valley prairies provide more nectar than nonnative flowers for adult butterflies, and that Fender's blue butterfly population density is positively correlated with the density of native wildflowers. In Lane County, key native flowers include: wild onion, (*Allium amplectans*), cat's ear mariposa lily (*Calachortus tolmiei*), common camas (*Camassia quamash*), Oregon sunshine (*Eriophyllum lanatum*), and rose checkermallow (*Sidalcea virgata)* (Schultz and Dlugosh in litt. 1999). Tall oatgrass (*Arrenatherum elatius*) and other non-native grasses can out-compete these native forb species (Hammond 1996). The abundance of exotic grasses can effectively preclude butterflies from using a Kincaid's lupine patch (Hammond 1996).

Anecdotal evidence indicates that under ideal conditions adult Fender's blue butterflies may disperse as far as 5-6 km (3.1 to 3.7 mi) from their natal lupine patches (Hammond and Wilson 1992; and Schultz 1994). According to Schultz (1997), adult dispersal of this magnitude is not likely anymore. Schultz (1997) found that the butterflies are generally found within 10 m (32.8 ft) of lupine patches, although they might disperse more than 2 km (1.2 mi) between lupine patches. Hammond (1998) reports recolonization of a site by Fender's blue butterfly from a distance of approximately 3 km (1.9 mi). Schultz (1997) further theorizes that Fender's blue originally would have had a high probability of dispersing between patches, which were historically located an average of 0.5 km (0.3 mi) apart. Current distribution of lupine patches range well beyond this distance, and barriers to migration between close sites may be present.

Kincaid's lupine is a perennial forb 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). Kincaid's lupine is thought to have historically colonized areas along the edge of oak woodlands in upland prairies. Schultz (1997) theorizes that lupine patches were historically distributed no greater than 0.5 km (0.3 mi) apart, allowing dispersal of Fender's blue butterfly between lupine patches.

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 m (33 ft) in diameter. Leaves are oval-palmate, with very narrow leaflets. The small, purplish-blue pea flowers grow in loose racemes that are 15.2-20.3 cm (6-8 in) tall. The flowering period has been reported from April to June (Hitchcock et al. 1973), but generally occurs during May and June. 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.

Within the Willamette Valley, Kincaid's lupine occupies 86 habitat patches averaging 1.395 km2 (0.539 mi2) in size. In the Umpqua Valley, Douglas County, Oregon, Kincaid's lupine occupies eight small patches, averaging 0.057 km2 (0.022 mi2) in size, and in Lewis County, Washington, three tiny patches, averaging 0.002 km2 (0.0008 mi2) in size.

Population Dynamics and Trends

Censuses of Fender's blue butterfly were started in 1991; most of the 22 census units have been surveyed every year since 1993 (Fitzpatrick and Schultz 2001, Hammond 2001, 1998, 1996 and 1994, Hammond and Wilson 1993, Schultz 1994-1998). Total range-wide population numbers (once most sites were monitored) of Fender's blues have ranged from a low of 1,384 in 1998 to a high in 2000 of 3,492. Although population size appears to have increased between 1998 and 2000, this could be a result of poor weather conditions in 1998, and thus poor flight conditions, and it could also be an artifact of increasing survey effort at these sites. However, some of this increase may be attributed to habitat enhancement activities such as tree and shrub removal from lupine sites. In the 2012 survey in the Willamette Valley, the population estimate was approximately 11,630 adults (Fitzpatrick 2013).

Threats

Over 80 percent of the remaining upland prairies where these species are known to occur are threatened by agriculture and forest practices, development, grazing, and road construction and maintenance (67 FR 3875).

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 (Franklin and Dyrness 1973; Hammond and Wilson 1993; Johannessen et al. 1971; 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.

The presence of tall, fast-growing, non-native herbaceous species speeds the conversion of upland native prairie to dense, rank prairies and shrub lands. Invasion by non-native plant species has been documented at most Kincaid's lupine and Fender's blue butterfly sites (Fish and Wildlife Service 2000). Nonnative grass species aggressive enough to suppress native species include velvet grass (*Holcus lanatus*), orchard grass (*Dactylis glomerata*), false-brome (*Brachypodium sylvaticum*), tall oat-grass (*Arrhenatherum elatius*), tall fescue (*Festuca arundinacea)*, and bent grass (*Agrostis tenuis*) (Hammond 1996).

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 (Andy Robinson, botanist, Fish and Wildlife Service, Portland, Oregon, personal communication, 2003).

Today, remnant upland prairie acreage is extremely fragmented and remaining Fender's blue butterfly populations so small that migration processes are not expected to maintain the population over time. Extirpation of remaining small populations is expected from localized events and low genetic diversity of very small populations. The low availability of host lupine patches and fragmentation of habitat are seen today as the major ecological factors limiting reproduction, dispersal, and subsequent colonization of new habitat (Hammond 1994, Hammond and Wilson 1993 &1992, Schultz 1997, Schultz and Dugosch 1999),

Remnant upland prairie acreage is extremely fragmented and remaining Fender's blue butterfly populations are so small that migration processes are not expected to maintain the population over time. Extirpation of remaining small populations is expected from localized events and low genetic diversity of very small populations. The low availability of host lupine patches and fragmentation of habitat are seen today as the major ecological factors limiting reproduction, dispersal, and subsequent colonization of new habitat (Hammond 1994, Hammond and Wilson 1993 and 1992, Schultz 1997, Schultz and Dlugosch 1999). Exotic vegetation and succession to woody vegetation contribute to habitat loss and degradation for Fender's and Kincaid's lupine. The decline in Fender's numbers is likely due to the encroachment of false brome and woody vegetation into the prairie habitat. (Fitzpatrick 2013).

Recovery and Conservation Planning

In May 2010 the Service released a final recovery plan to address the survival needs of 13 rare species (two butterflies and 11 plants) native to the prairies of Oregon's Willamette and Umpqua Valleys and southwestern Washington, including Fender's blue butterfly and Kinkaid's lupine.

The general recovery strategy for these species is to restore and maintain multiple viable populations of the species by protecting, restoring, maintaining, and connecting the remaining fragments of prairie habitats or areas with potential for restoration to prairie habitats within their historical range. These areas should be restored to functional prairie ecosystems with management that restores and maintains a diversity of native species typical of these prairie communities. The primary threats to be addressed through this recovery strategy are habitat destruction, isolation and fragmentation, invasion by non-native plant species, and succession. The recovery plan also recommends actions to help better understand and respond to potential threats posed by changing climate conditions in the region.

For Fender's blue butterfly, three recovery zones have been delineated that encompass the historical range of the species. Actions needed to recover Fender's blue butterfly include:

1. Preserve, restore, and manage existing populations and habitat for Fender's blue butterfly.

2. Coordinate management with recovery efforts for *Lupinus sulphureus* ssp. *kincaidii*, the larval host plant for Fender's blue butterfly.

3. Implement a standardized population monitoring protocol.

4. Monitor prairie quality and diversity at all population sites.

5. Reintroduce populations and restore habitat, as necessary, to meet recovery goals.

6. Implement further research needed for the conservation of the species.

Actions needed to recover Kinkaid's lupine include:

1. Preserve, restore, and manage existing populations and habitat.

2. Develop and implement a standardized population monitoring protocol.

3. Monitor prairie quality and diversity at all population sites.

4. Collect and bank seeds.

5. Identify reintroduction sites, develop and implement outplanting protocol, reintroduce populations and restore habitat, as necessary, to meet recovery goals, and manage and monitor reintroduced populations.

6. Identify and implement further research needed for the conservation of the species.

7. Monitor effectiveness of management actions and apply adaptive management measures, as needed.

For both species, habitat enhancements in and around large metapopulations are needed to ensure the viability of core metapopulations and to provide opportunities for population growth and expansion (Fish and Wildlife Service 2010). Habitat enhancements to restore and/or add stepping stone habitat patches are also needed to increase and enhance the connectivity between core Fender's metapopulations (Fish and Wildlife Service 2010).

4.1.12 Fender's Blue Butterfly and Kincaid's Lupine Critical Habitat

Critical habitat for the Fender's blue butterfly, Kincaid's lupine and Willamette daisy was designated November 2, 2005 (70 FR 66492). The PCEs for Fender's Blue butterfly include:

1. Early seral upland prairie, oak savanna habitat with undisturbed subsoils that provides a mosaic of low growing grasses and forbs, and an absence of dense

canopy vegetation allowing access to sunlight needed to seek nectar and search for mates.

2. Larval host-plants; *Lupinus sulphureus* ssp. *kincaidii*, *L. arbustus*, and *L. albicaulis.*
3. Adult nectar sources.
4. Stepping stone habitat. Undeveloped open areas with the physical characteristics appropriate for supporting the short-stature prairie, oak/savanna plant community.

4.1.13 Bradshaw's Lomatium (Lomatium bradshawii)

Bradshaw's lomatium (also known as Bradshaw's desert-parsley) was listed as endangered on September 30, 1988 (U.S. Fish and Wildlife Service 1988).

Population Trends and Distribution

Bradshaw's lomatium was historically overlooked and poorly documented, 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 (Kagan 1980). Since 1980, over 40 new sites have been discovered, including three large populations.

For many years Bradshaw's lomatium was considered an Oregon 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. There are currently about 38 occurrences of Bradshaw's lomatium in three population centers located in Benton, Lane, Linn, and Marion Counties, Oregon (Gisler 2004, Oregon Natural Heritage Information Center 2004). Most of these populations are small, ranging from about 10 to 1,000 individuals, although the two largest sites each have over 100,000 plants.

Some populations that were large when discovered have since declined in size substantially. A large population at Buford Park near Eugene, Oregon, dropped from about 23,000 plants in 1993 to just over 3,000 plants in 1994 (Greenlee and Kaye 1995), and continued to decline to less than 1,000 plants in 1999. Herbivory by a booming vole population was suspected to be the cause of the decline. The Washington populations, though fewer in number, are larger in size, with one site estimated to have over 800,000 individuals (U.S. Fish and Wildlife Service unpublished data).

Life History and Ecology

Bradshaw's lomatium blooms in the spring, usually in April and early May. The flowers have a spatial and temporal separation of sexual phases, presumably to promote outcrossing, resulting in protandry on a whole plant basis, and protogyny within the flowers. A typical population is composed of many more vegetative plants than reproductive plants. The plant is pollinated by insects. Over 30 species of solitary 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. The fine-scale population patterns at a given site appear to follow seasonal, microchannels in the tufted hairgrass prairies, but whether this is due to dispersal, habitat preference, or both, is not clear (Kaye 1992, Kaye and Kirkland 1994).

In a genetic study that included six populations of Bradshaw's lomatium, the species displayed little population differentiation but the level of diversity was high across the species (Gitzendanner 2000). Isolated populations in Washington appear to have lower levels of diversity, but they do not appear to be genetically differentiated from the other populations of the species, consistent with historical gene flow among all populations, and a recent bottleneck in the Washington populations.

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 increased following fires (Kaye and Pendergrass 1998, Pendergrass *et al.* 1999), although monitoring showed the effects to be temporary, dissipating after one to three years. Frequent burns may be required to sustain population growth, as determined from population models (Caswell and Kaye 2001, Kaye *et al.* 2001).

Habitat Characteristics

Bradshaw's lomatium is restricted to wet prairie habitats. These sites have heavy, sticky clay soils or a dense clay layer below the surface that results in seasonal hydric 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 (Kagan 1980). The soils at these sites are dense, heavy clays with a slowly permeable clay layer located between 15 and 30 cm (6 and 12 inches) below the surface. This slowly permeable clay layer, which results in a perched water table in winter and spring, allows soils to be saturated to the surface or slightly inundated during the wet season. The soils include Dayton silt loams, Natroy silty clay loams or Bashaw clays; other soils on which the species has been found include Amity, Awbrig , Coburg, Conser, Courtney, Cove, Hazelair, Linslaw, Oxley, Panther, Pengra, Salem, Willamette, and Witzel.

Less frequently, Bradshaw's lomatium populations are found on shallow, basalt areas in Marion and Linn County near the Santiam River. The soil type is characterized as Stayton Silt Loam; it is described as well drained, in alluvium underlain by basalt (Kaye and Kirkland 1994). The shallow depth to bedrock, 50 cm (20 inches) or less, results in sites which are poorly suited to agriculture. This soil type occurs at scattered locations in sites with deeper soils belonging to the Nekia-Jory association, which were originally vegetated by grassland and oak savanna (Alverson 1990). Bradshaw's lomatium at these sites occurs in areas with very shallow soil, usually in vernal wetlands or along stream channels.

Bradshaw's lomatium is often associated with *Deschampsia cespitosa*, and frequently occurs on and around the small mounds created by senescent *Deschampsia cespitosa* plants. In wetter areas, Bradshaw's lomatium occurs on the edges of *Deschampsia cespitosa* 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. The grassland habitat of Bradshaw's lomatium frequently includes these species: *Carex* spp., *Danthonia californica*, *Eryngium petiolatum* (coyote-thistle), *Galium cymosum* (bedstraw), *Grindelia integrifolia* (Willamette Valley gumweed), *Hordeum brachyantherum* (meadow barley), *Juncus* spp., *Luzula campestris* (field woodrush), *Microseris laciniata* (cut-leaved microseris), and *Perideridia* sp. (yampah) (Siddall and Chambers 1978, Kagan 1980). In most sites, introduced pasture grasses (*Anthoxanthum odoratum* [sweet vernal grass], *Holcus lanatus* [velvet grass], *Poa pratensis* [Kentucky bluegrass], *Agrostis capillaries* [colonial bentgrass], *Dactylis glomerata* [orchard-grass] and *Festuca arundinacea* [tall fescue]) are present.

<u>*Reasons for Listing*</u>

Expanding urban development, pesticides, encroachment of woody and invasive species, herbivory and grazing are threats to remaining Bradshaw's lomatium populations (U.S. Fish and Wildlife Service 1988). 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 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 1978). The populations in Washington occur on private lands and are not protected (Gisler 2004).

Populations occurring on roadsides are at risk from maintenance activities, and from adverse effects of management on adjacent lands. Pesticide use on agricultural fields and herbicide application adjacent to roads may harm Bradshaw's lomatium populations across its range. There is concern that pesticides 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). Herbicides may drift, and even when Bradshaw's lomatium is not the target, applications near a population may damage or kill the plants outright. For example, an herbicide application on private land adjacent to the William L. Finley National Wildlife Refuge drifted onto the refuge and damaged or killed Bradshaw's lomatium plants in 2006 (Jock Beall, U.S. Fish and Wildlife Service, Corvallis, Oregon, pers. comm., 2008).

One of the most significant threats is the continued encroachment into prairie habitats 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 ultimately will replace the open prairies with woody plant communities.

Recovery and Conservation Planning

Recovery Plan information and general recovery strategies are as described above for Fender's blue butterfly and Kinkaid's lupine.

Ongoing Conservation Actions

Extensive research has been conducted on the ecology and population biology of Bradshaw's lomatium, effective methods for habitat enhancement, and propagation and reintroduction techniques (Kagan 1980, Kaye 1992, Kaye and Kirkland 1994, Kaye and Meinke 1996, Caswell and Kaye 2001, Kaye and Kuykendall 2001b, Kaye *et al.* 2003a). The results of these studies have been used to direct the management of the species at sites managed for wet prairies.

Propagation studies have found that long-term (8 weeks) cold stratification was necessary to fully break dormancy in this species (Kaye *et al.* 2003a). Bradshaw's lomatium plants can be grown from seed in a greenhouse environment (Kaye *et al.* 2003a). Plants may be successfully established at existing populations or new locations throughout-planting of greenhouse-grown plants. Fertilizing transplants may have a negative effect on survival in some cases. Direct seeding has a relatively high success rate (17 to 38 percent), and is improved by removal of competing vegetation (Kaye and Kuykendall 2001b, Kaye *et al.* 2003a). Seeds of this species have been banked at the Berry Botanic Garden in Portland, Oregon (Berry Botanic Garden 2005) and the University of Washington Botanic Garden.

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). Observed increases in seedlings may be due to small disturbances in the soil, a reduction of shading by nearby plants, and reduced herbivory by small mammals.

Populations of Bradshaw's lomatium occur on public lands or lands that are managed by a conservation organization at the U.S. Fish and Wildlife Service's William L. Finley and Oak Creek units of the Willamette Valley National Wildlife Refuge Complex, the U.S. Army Corps of Engineers at Fern Ridge Reservoir, the Bureau of Land Management at the West Eugene Wetlands, The Nature Conservancy at Willow Creek Natural Area and Kingston Prairie Preserve, and Lane County at Howard Buford Recreation Area. All of these parcels have some level of management for native prairie habitat values. The U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program works with private landowners to restore wildlife habitats; native prairie restoration is a key focus area of the program in the Willamette Valley.

4.1.14 Nelson's Checkermallow (Sidelcea nelsoniana)

Nelson's checker-mallow was federally listed as threatened on February 12, 1993 (58 FR 8243). The plant is endemic to the Willamette Valley and the northern Coastal Mountain Range (Hitchcock and Cronquist 1973, Hitchcock 1957), and the Puget Trough of Washington. The historic distribution of the species is thought to be similar to what is found today, although its abundance is thought to be significantly lower than it once was (58 FR 8243, Alverson 1990). In the Willamette Valley, Nelson's checker-mallow populations typically occur in or along margins of seasonally moist, grassy valley bottoms. Coast range Nelson's checker-mallow populations occupy open grassy meadows ranging from 1,600 feet to 1,960 feet in elevation (USFWS 1998).

Current and Historic Distribution

There are currently 93 extant Willamette Valley populations distributed in Oregon's Benton, Linn, Marion, Polk, Washington, and Yamhill counties, and two extant Puget Trough occurrences in Lewis and Cowlitz counties in Washington. Currently 45 percent are in public ownership and 44 percent in private ownership. At least 14 known occurrences have been extirpated.

There are 12 extant Coast Range occurrences in Yamhill, Washington, Clatsop, and Tillamook counties. Fifty percent are entirely in public ownership and 50 percent in private ownership. At least two known occurrences have been extirpated.

The most recent Oregon Natural Heritage Program Database (ORNHIC 2004) has mapped a total of 2,061,919 square meters (m^2) of occupied habitat in 77 habitat patches; the occupied habitat ranges in size from 1 m^2 to 624,302 m^2 for Oregon.

A number of large sites (greater than 25 ac [10 ha]) of Nelson's checker-mallow are being actively managed, are secured from habitat loss, and have relatively stable populations. These larger sites provide the greatest potential for long-term persistence of the species if the current condition of these sites can be sustained or improved. Small populations are more vulnerable to environmental changes than relatively large and contiguous populations. Generally, the direct and indirect effects of small population size on most species, plant and animal, include loss of connectivity for dispersal, a decrease in genetic exchange, a resultant loss of population viability and vigor, and a hastening towards extinction. The importance of small populations lies in their potential to serve as stepping stones between larger neighboring populations. The loss of small populations and remnant prairie habitats further isolates larger populations and limits opportunities for genetic exchange, migrations and/or re-colonization.

Prior to European settlement in the 1840s, the Willamette Valley was a landscape of riparian and oak woodlands, oak savanna and expansive wetlands and prairies (Boag 1992, Towle 1982, Johannessen et al. 1971, Habeck 1961). Of the estimated 1,010,000 ac (409,000 ha) of historic native prairie extant prior to 1850, approximately 685,000 ac (277,000 ha, or 67.8 %) consisted of upland prairie and 325,000 ac (132,000 ha, or 32.2 %) of wet prairie (Habeck 1961). This extensive resource has been dramatically depleted since European settlement from the 1840s to present through conversion of native prairie to agricultural use and urbanization (Boag 1992).

Prairie has also 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). Prior to European settlement, the native Kalapuya people are attributed with the maintenance of prairie habitats through intentional burning. They used fire for warfare and a variety of subsistence purposes (Boyd 1986).

Habitat Requirements

Habeck (1961) described the plant's habitat as "moist, open ground and thickets." Others have described the plant as growing on moist to dry sites with poorly drained to well drained clay, clay loam, and gravelly loam soils, in meadow, and rarely, wooded habitats (CH2M Hill 1986, Glad et al. 1987). Nelson's checker-mallow is often found in areas where prairie or grassland remnants persist, such as along fence rows, drainage swales, and at the edges of plowed fields adjacent to wooded areas. The woody, rhizomatous (underground) stem of Nelson's checker-mallow enables the plant to persist in some disturbed situations such as roadside ditches and mowed hayfields.

Current fire control and prevention practices allow succession of introduced and native species, which may gradually replace habitat for Nelson's checker-mallow (U.S. Bureau of Land Management 1985). Nelson's checker-mallow primarily occurs in open areas with little or no shade and will not tolerate closed-canopy forested habitat. Shrub and tree intrusion has been documented on most of the relic prairie sites occupied by Nelson's checker-mallow.

Threats to the Species

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*) 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).

Recovery and Conservation Planning

Recovery Plan information and general recovery strategies are as described above for Fender's blue butterfly and Kinkaid's lupine.

APPENDIX C: ENVIRONMENTAL BASELINE SUPPORTING DOCUMENTATION (section 4.2 of PBO)

Ecoregion Context

Oregon comprises ten ecoregions, each of which contains multiple habitat types. Ecoregions are relatively uniform geographic areas that respond in a similar manner to physical activities (i.e., rainfall, fire, human land use activities, etc.) (SOER 2000). These ecoregions are based on similarity of important environmental variables such as climate, geology, physiography, vegetation, soils, land use, wildlife, and hydrology. The ecoregion descriptions provide an overview to the current conditions of the regional environment.

The ecoregions used in this analysis were the EPA Level III ecoregion descriptions used by the State of the Environment Report (SOER) Science Panel in the Oregon State of the Environment Report (SOER 2000), the EPA Level IV ecoregion descriptions used in the Oregon Watershed Enhancement Board's Oregon Watershed Assessment Manual (Watershed Professionals Network 2001), and the ODFW and Oregon Natural Resources Heritage Program Level III ecoregion characterizations of patterns within a watershed (Bryce and Woods 2000). Because watersheds within an ecoregion have common attributes, the ecoregion descriptions assist with the effects analysis. Table 1 provides the acreage of the various habitat types within each ecoregion.

Basin & Range

(Bull trout) The Basin and Range ecoregion includes a large portion of southeastern Oregon and is the least populated area of the State (SOER 2000). This ecoregion is Oregon's high desert, and contains numerous flat basins separated by isolated, generally north-south mountain ranges. Malheur Lake is the major drainage basin in this arid ecoregion (Watershed Professionals Network 2001). Runoff from precipitation and mountain snowpacks and basins often flows into flat, alkaline playas, where it forms seasonal shallow lakes and marshes (Bryce and Woods 2000). In addition, the terrestrial landscape is open and treeless, plants are widely spaced, and soils are exposed to the elements. The Basin and Range ecoregion contains many diverse habitats.

The most significant are the sagebrush (*Artemisia* spp.) steppe types, salt desert scrub (Bryce and Woods 2000), and riparian and wetland types, as well as mountain mahogany (*Cercocarpus* spp.) and aspen (Populus spp.) woodlands (SOER 2000).

Many of the major wetland complexes within this arid ecoregion are managed for waterfowl production by State, Federal, or private agencies, although most wetlands are privately owned (SOER 2000). The large wildlife refuges here support some of the largest populations of pronghorn antelope, white pelicans, and sage waterfowl, and are well known for their wildlife diversity (Bryce and Woods 2000). Flooding and drying now occur sooner in the year than they did historically. Historically, playa lakes were wet during winter and spring, and then dried as summer approached. Some playa lakes have been altered for livestock watering, and in drier years water is concentrated in deep pools, thus affecting a smaller area (SOER 2000).

Water is the limiting factor in this ecoregion. Declines in riparian condition and water quality occurred during the heavy grazing early in the 20th century. Stream water quality here is the lowest in the State, generally measured as poor or very poor. The trend in water quality shows no improvement, although in some areas, primarily fenced enclosures, riparian conditions have dramatically improved. Surface water is fully allocated. Much of the water is dammed, and releases from dams keep instream flows close to the required minimums (SOER 2000).

Many of the region's historical wetlands and riparian areas have been converted to agriculture or have been degraded through water diversions and grazing. The region has been heavily affected by grazing pressure, which affects different parts of the landscape in different ways. Improper grazing is particularly destructive in wetland and riparian areas. More than 145 species depend on tall sagebrush-bunchgrass communities. In other places, fire suppression has increased the relative density of sagebrush while diminishing bunchgrasses, which has negatively affected many native species. An additional threat to ecological integrity in upland areas as well as in wetland and riparian areas is the encroachment of invasive plant species (SOER 2000).

Blue Mountains (Bull trout)

The Blue Mountains ecoregion occupies most of northeastern Oregon and encompasses three major ranges: the Ochoco, Blue, and Wallowa Mountains. Deep, rock-walled canyons, glacially cut gorges, dissected plateaus, and broad alluvial river valleys characterize the landscape. Extreme changes in elevation across the ecoregion result in a broad range of temperature and precipitation, supporting habitat diversity second only to the Klamath Mountains ecoregion (SOER 2000).

Vegetation in the lowland areas consists of bunchgrasses, sagebrush, and juniper (*Juniperus* spp.) (Bryce and Woods 2000). Ponderosa pine (*Pinus ponderosa*) and juniper woodlands are characteristic of mid-elevation areas, with mixed coniferous forests dominating higher altitudes and north- facing slopes at mid-elevations. Extensive grasslands occur in and north of the Wallowa Mountains (SOER 2000).

Riparian areas in valley bottoms are important for aquatic and terrestrial organisms in arid landscapes where streamside vegetation provides shade and refuge. Riparian areas are among the most diverse natural communities in the region, largely concentrated in intermountain basins (SOER 2000). These seasonally flooded wet meadows provide important habitat; the largest remaining blocks of these wetlands, almost all on private lands, are found at Big Summit Prairie, along the upper Silvies River, and in Logan Valley (Watershed Professionals Network 2001).

The diversity of the Blue Mountains landscape provides goods and services long valued by the people of the region. Most of the uplands in the region are federally owned forest and rangeland. Private land generally follows valleys and water courses, where most of the region's agriculture occurs; however, several parcels of privately-owned timber in uplands are present (SOER 2000).

The large, central valleys of the Grande Ronde and Powder Rivers historically contained native riparian forests, wetlands, and grasslands that have been primarily converted to agriculture. Most stream reaches have been simplified by channelization and straightening. Riparian conditions are degraded throughout the region, particularly in the middle and lower reaches of large river valleys such as the Grande Ronde and Umatilla (SOER 2000, OWEB 2001).

Four activities have had profound effects on the landscape of the region: timber harvest, fire suppression, grazing, and agriculture. Fire suppression, in concert with timber harvest, has changed the structure and function of the region's forests; it has also allowed a dense build-up of young trees, creating more biomass than can be supported through times of drought. These dense, over-stocked forests are far more vulnerable to fire and insects (SOER 2000).

Virtually all of the Grande Ronde Valley's historical wetlands have been drained and converted to agriculture. Many wetland sites have been affected, at least temporarily, by water flow alterations as well as by increased sediment and nutrients from agricultural and other activities (SOER 2000). Much of the ecoregion is within a complex of aquatic diversity areas identified by the American Fisheries Society. Much of this complex lies in Federal wilderness areas (SOER 2000, OWEB 2001).

In coordination with regional planning efforts, complex plans for total maximum daily loads of non-point sources of pollution are being developed for stream segments with limited water quality, as identified by the Clean Water Act 303(d) list. Many of the low-lying streams in this ecoregion are listed, primarily as a result of high stream temperatures during the summer. Upland water is of relatively high quality and the conditions of upstream fish habitats are improving (SOER 2000).

Coast Range (Marbled murrelet and northern spotted owl)

The Coast Range ecoregion extends the entire length of the Oregon coastline as a narrow, jumbled mountain range from the edge of the Pacific Ocean to the Willamette Valley and Klamath Mountains. Along the north coast, cliffs and grassy headlands are separated by stretches of flat coastal plain and estuaries. A broad coastal terrace characterizes much of the south coast, punctuated by steep headlands, inland lakes, and rocky offshore islands (SOER 2000). The region's marine climate causes the wettest habitats in the State, including temperate rainforests, which are some of the most productive forests in the world (SOER 2000).

Much of the commercial and residential development in the region is clustered along 101 and around the larger estuaries and streamside riparian areas. The coastal economies are distinctly different from north to south. The northern counties are evolving from a dependence on fishing and timber to a reliance on tourism and retirement. To the south, the coastal economy has been more dependent on the forest products industry (SOER 2000).

Oregon's 22 estuaries are ecological transition zones, integrating features of the watersheds they drain with those of the marine environment. Although protection currently exists, most Oregon estuaries are dramatically smaller than they were historically—mostly, as a result of the conversion of tidal wetlands to diked and drained pastures in the early 1900s, followed by the filling of bayfront lands for urban and port development. In addition, the construction of jetties has disrupted the natural movement of sand along the coast, burying some areas and eroding others. Further inland, residential development has significantly reduced riparian vegetation along streams (SOER 2000).

Streams in the Coast Range are relatively free-flowing, are heavily relied upon by the fishing industry and summer tourism, and are important sources of drinking water. Coastal streams have been disrupted by logging practices. The density of streams in the Coast Range is among the highest in the State; therefore, a high percentage of the landscape falls within riparian buffers. As a result, timber harvests throughout the region have had adverse effects on aquatic organisms such as coho salmon. Removal of large conifers and erosion from logging are the most significant past human effects on riparian areas in the Coast Range (SOER 2000).

Past logging patterns led to dense forests with a high percentage of early successional stages consisting of young trees (less than 40 years old). However, modern logging and silvicultural practices (under the guidance and implementation of new Forest Practice Rules) have greatly minimized effects from recent logging operations. Historically, large fires left a complex matrix of large trees, snags, and downed wood, which provided a diversity of habitats for fish and wildlife. Modern commercial forest management encourages diversity, though not to the same extent as wildfires in unmanaged landscapes.

Almost 40 percent of the ecoregion is publicly owned, primarily as State and Federal forests. Much of the balance is private timberland, interspersed with the public forest. Timber harvest in the late 1990s was about two-thirds of the levels of the late 1980s, due to a major reduction of harvest on Federal lands. About half of Oregon's future timber harvest is projected to come from this ecoregion (SOER 2000).

The lowland rivers and wetlands have been altered by agriculture and development more than the forested portions of the ecoregion have. Acquisition of coastal wetlands by private land conservancies and State and Federal fish and wildlife agencies have protected some high quality wetlands and restored many acres of degraded wetlands (SOER 2000).

Columbia Basin (Bull trout)

The Columbia Basin ecoregion is semi-arid, with cold winters and hot summers. Farther from the Columbia River, annual precipitation decreases and soil changes from sandy deposits to windblown silts. Most of the ecoregion receives less than 15 inches (38 centimeter) of precipitation per year, mostly in the form of snow.

Much of the ecoregion's natural vegetation is native bunchgrass prairie. Sandy deposits along the big bend of the Columbia River have created open dunes and areas of shrub-steppe and western juniper. The rivers were once lined with intermountain riparian vegetation, such as black cottonwood (*Populus trichocarpa*), willows, chokecherry (*Prunus* spp.), and aspen, and wetlands were located throughout the plateau. Fire was a natural component of this ecoregion, though the fire recurrence interval is not as clear as in other ecoregions.

The ecoregion has undergone extensive changes over the last 150 years; it is second only to the Willamette Valley in the extent of landscape change. It consists largely of privately-owned agricultural and range land, with over 85 percent of the former sagebrush steppe, grassland, and riparian communities converted to dry land wheat or irrigated agriculture. Only marginal lands that cannot be farmed, such as the steep canyon grasslands and scablands, retain a semblance of native vegetation. Protected areas and publicly owned lands are very limited in this region.

In the conversion to farmland, much of the natural function of the landscape has been lost. Bottomland forests and wetlands have been replaced by irrigated agriculture and rural residential development. Changes in the upland have occurred as sagebrush steppe has been reduced by over 85 percent. Invasive plant species are a major threat to native habitats as well as to the productivity of farmlands and pastures.

Dam construction and subsequent inundation has degraded riparian resource conditions along the Columbia River and confluences. Lake habitats have largely replaced riparian and floodplain wetlands. Large rivers such as the Umatilla River have decreased riparian function and water quality.

East Cascades Slope and Foothills Ecoregion (Bull trout, Lost River and short-nosed sucker and northern spotted owl)

The East Cascades ecoregion is geologically young, with lava flows, volcanic vents, and a mantle of pumice soil. Ponderosa pine forests predominate, with extensive stands of lodgepole pine (*Pinus contorta*) on deep Mazama ash. The ecoregion is a transition zone that extends from below the crest of the Cascade Range east to where the pine forests intersect with sagebrush-juniper steppe. The northern two-thirds of the East Cascades ecoregion is drained by the Deschutes River system, which includes a series of large lakes and reservoirs near its headwaters high in the Cascade Mountains. The southern third is drained by the Klamath River, which rises from a vast interior wetland before it flows south and west into California. Forests, mostly federally owned, cover most of the region's uplands, with privately-owned agricultural land in the valleys.

The Deschutes River watershed spreads across several ecoregions, with headwaters to the east in the Blue Mountains and to the west in the high Cascades. Several dams have been constructed on the Deschutes River. This has affected flow and sediment, which have influenced the establishment and natural succession of riparian vegetation throughout the downstream river course. Riparian areas have been further altered by dredging, dikes, and flood control activities. Today, all major river systems in the region are dammed, and many of these dams provide no fish passage. Agricultural practices and related water delivery systems remain a significant threat to the recovery of aquatic health in the southern part of the region.

The contrasts of this ecoregion are reflected in its water quality. Clean, cold water flows from perennial springs along the east slope into streams such as the Metolius River and the Little Deschutes, which have some of the highest quality water in the State. The low-lying Klamath Basin, in contrast, has sites such as Klamath Strait and Lost River with some of the poorest water quality in the State. Several of these streams have been placed on the 303(d) list as a result of high temperatures in summer, total dissolved gas, habitat modification, flow modification, pH, sedimentation, turbidity, bacteria, and dissolved oxygen.

Enormous efforts were made in the 1900s to drain vast acreage of wetlands in the Klamath Basin. As a result, the great shallow lake and marsh systems of the upper Klamath Basin have been reduced by an estimated 75 percent. Reductions in riparian vegetation and associated wetlands have contributed to nutrient loading in the rivers and lakes of the region by decreasing the potential for nutrient filtration and uptake in streamside areas. Similarly, riparian areas throughout the Klamath basin have been highly altered and in many cases eliminated by agricultural activities.

Activities affecting key resource systems in this region include changes in the fire regime, alterations of rivers, streams, and wetlands, and rapid urban development.

Klamath Mountains (Marbled murrelet and northern spotted owl)

Douglas-fir forests, oak woodlands, and ponderosa pine woodlands. Many of these plant communities have changed significantly since fire suppression was widely instituted in the early 20th century, although the plant communities of the Klamath Mountains continue to be among the most diverse in the world. There are pockets of plant communities that occur nowhere else, endemic to a particular condition of the climate or soil type. Of the 4,000 kinds of native plants found in Oregon, about half are found in this ecoregion, and about a quarter of these are found only here.

Nearly a century of fire suppression has dramatically altered the ecology of the forests, savannas, and shrublands in this region. The steep terrain makes the Klamath Mountain ecoregion particularly susceptible to landslides and debris flows, especially in extensively logged basins. Relatively few large conifers remain in the active flood plain, although historic evidence shows that conifers were once abundant in low gradient valley bottoms and were selectively logged in the 1950s and 1960s.

Today the rate of population growth in this region is second only to the Willamette Valley. Most of the population is concentrated in the valleys along Interstate 5, but rapid population growth in the southern and eastern parts of the ecoregion has brought new pressures to the landscape, particularly to the rural areas along rivers such as the Rogue, Umpqua, and Applegate, which were already affected by past development activities. Industrial and rural residential developments are the major threats to ecological health.

High Lava Plains (Bull trout)

The High Lava Plains ecoregion is located in the dry foothills that surround the western perimeter of the Blue Mountains, and separates the north-central Blue Mountains from the southern Blue Mountains and Ochoco Mountains. The drainage basins in this ecoregion are the John Day, the Goose and Summer Lakes, the Malheur Lakes, and the Deschutes. The land use in this ecoregion is primarily irrigated pasture, grazing, and recreation.

The geology here is ash beds and the eroded remnants of a mountain chain. The erosion rate is high in ash-dominated areas; most erosion occurs during high intensity runoff events during snow melt periods or during thunderstorms. This ecoregion consists of highly dissected hills, palisades, and ash beds. The steep-sided canyons of the John Day and Crooked Rivers cut deeply through the surrounding terrain. Streams have low to moderate gradient, and the main rivers originate within surrounding ecoregions that have more rain and snow.

This ecoregion has a continental climate with low precipitation (mean annual precipitation is 10 to 20 in [25 to 50 cm]) and wide temperature extremes. This climate is moderated by a marine influence spreading southward from the Columbia River Gorge and eastward through the low passes of the Cascade Mountain range. The marine influence brings more moisture into the region and causes less extreme temperature fluctuations than in other parts of the Blue Mountains. Precipitation falls primarily as rain during the spring and fall months and as light snow in the winter months; most precipitation occurs in the winter months of November, December, and January. Shallow snowpacks can accumulate at higher elevations.

The most frequent natural disturbance in this ecoregion is fire. Fire suppression and grazing have caused an increase in juniper abundance and a decline in grass abundance. The native upland vegetation includes juniper, bluebunch wheatgrass (*Pseudoroegnria spicata*), and Idaho fescue (*Festuca idahoensis*), and the native riparian vegetation includes hardwoods (cottonwood and alder) and shrubs (willows, Douglas spirea [*Spirea douglasii*] and common snowberry [*Symphoricarpos albus*]). Ponderosa pine and juniper are found infrequently in the riparian areas.

Owyhee Uplands (Bull trout)

The Owyhee Uplands ecoregion is located in the southeastern section of Oregon. This ecoregion is similar to the adjacent Basin and Range ecoregion in vegetation; however, it differs markedly in terrain, as the landscape is basically a broad, undulating plateau cut by deep riverine canyons. The Owyhee River and the lower basin of the Malheur River generally drain north through these canyons and to the Snake River Basin located at the border of Oregon and Idaho (Bryce and Woods 2000).

An extreme climate characterizes the ecoregion. Moist springs and cold winters bring precipitation primarily in the form of snow, while summers are hot and dry. Vegetative types are consistent with the high deserts of the Intermountain west, with sagebrush steppe communities being the most dominant. Within this ecoregion less extensive vegetative communities include herbaceous wetland and riparian habitats, mountain mahogany woodlands, and a few examples of salt desert scrub (Bryce and Woods 2000).

Like the adjacent Basin and Range ecoregion, presently, the population of the Owyhee Uplands is sparse, with most of the population centered along the major drainages near the towns of Vail and Ontario. These towns border the confluence of the Malheur and Owyhee Rivers with the Snake River. Irrigated agriculture in these fertile lowlands is the foundation of the local economy (Bryce and Woods 2000). In contrast, the remainder of this ecoregion relies almost entirely on local ranching as their source economy (Bryce and Woods 2000). Decades of livestock grazing has degraded the habitat.

West Cascade Mountains (Northern spotted owl, Bull trout and Oregon chub)

The West Cascade Mountains ecoregion is a mountainous spine of volcanic peaks and dense forests. Relatively few people live in the area, which is geologically composed of two parts. The older western Cascade Mountains feature long ridges with steep sides and wide, glaciated valleys—remnants of long-extinct volcanoes. The younger high Cascades to the east include more than a dozen major peaks formed from more recent volcanic activity. Most of the rivers draining the northern two-thirds of the ecoregion flow into the Willamette Valley and then to the Columbia River system; the southern third drains to the Pacific Ocean through the Umpqua and Rogue River systems.

The drier southern half has a fire regime similar to that of the Klamath Mountains, with frequent, lightning-caused fires. In the northern half, the natural fire regime has historically produced less frequent but more severe fires.

Higher elevations receive heavy winter snows. Dense forests cloak the entire ecoregion. Douglas-fir/western hemlock forests dominate large areas up to elevations of about 3,300 feet. Pacific silver fir and mountain hemlock forests occur at higher elevations. Above 7,000 feet, the montane forests often open into alpine parklands with patches of forest interspersed with a variety of habitats, ranging from dwarf shrubs to wetlands and barren expanses of rock and ice.

The conifer forests of the Cascades have been the foundation of a timber-based economy in the ecoregion and in neighboring communities to the east and west; most of the population in the ecoregion is found in small towns where recreation use increasingly supplements this traditional timber-based economy. A continuous ribbon of national forests at middle and high elevations dominates this ecoregion, with private ownership (especially forest industry) at lower elevations. The USFS manages approximately two-thirds of the forest in this ecoregion. More than two-thirds of the Federal forest land in this ecoregion is managed for biological diversity—as late successional reserves, riparian reserves, and extensive wilderness areas.

The major factors that have influenced patterns of riparian condition in the western Cascades are: 1) Fire; 2) floods; 3) timber harvest and log transport; 4) road construction and residential development; and 5) flow regulation by dams (SOER 2000). In the absence of human activities, moist riparian forests were not as susceptible as surrounding uplands to disturbance by fire.

Cascade wetland types are highly variable and include snowmelt-fed slope wetland meadows, high elevation lakes with broad fringing wetlands, bogs, and riparian wetlands along streams. Although many of the high-elevation wetlands along the crest of the Cascades are largely intact, some lower-elevation wetlands have been altered by road construction, timber harvest, and the construction of reservoirs as well as by the offsite changes that result from regulated flows. For the most part, these activities have altered, rather than eliminated, the region's wetlands.

The high proportion of streams with good to excellent water quality is a strong indicator of the health of water resources in this region; this area consistently has the highest water quality in the State. Extensive public ownership of the landscape has protected these upstream reaches from some of the disruptions common farther downstream.

Willamette Valley (Fender's blue butterfly, Bradshaw's lomatium, Kincaid's lupine, Nelson's checkermallow and Oregon chub)

The Willamette Valley ecoregion is defined by the Willamette River and Oregon's largest river valley. The river's upper reaches and much of its watershed lie in the Cascade Mountains and Coast Range beyond the ecoregion borders. The ecoregion itself is characterized by broad alluvial flats and low basalt hills, with soils of deep alluvial silts from river deposits, and dense heavy clays from fluvial deposits in the valley bottom's numerous oxbow lakes and ponds. This ecoregion has 70 percent of the State's population, the majority of its industry, and almost half of its farmland. The Willamette Valley ecoregion is largely in private ownership; agriculture, urban areas, and forestland dominate the landscape.

Over the past 150 years, the prairies have been largely converted to farmland, as have most of the riparian forests and wetlands. The rivers have been dammed and channelized to reduce flooding. Open oak savannas and oak-conifer woodlands have been logged to become closed-canopy forests. A growing urban population has replaced agriculture in many areas, and rural residential development continues to encroach on remaining woodlands. Due to the pattern of development, the Willamette Valley is the most altered ecoregion in Oregon, with the most significant natural processes, fire and flooding, almost entirely excluded.

Trends in riparian condition in the Willamette Valley have shown an 80 percent reduction in total riparian area since the 1850s. An estimated 72 percent of the original riparian and bottomland forest is gone, as well as an estimated 99 percent of wet prairies, 88 percent of upland prairies, and 87 percent of upland forests at the margins of the valley (SOER 2000). Much of the valley's agricultural development converted native wet prairie; less than one percent of the original wet prairie remains today and several wet prairie plants are rare or endangered.

Water development projects have reduced the frequency of extremely high and low flows, and have moderated the once dynamic hydrologic pattern of floods and dry spells. Flood control modifications have largely disconnected the Willamette River from its braided channels, oxbows and sloughs—wetland types that characterized much of the historical floodplain. This fundamental alteration to the valley's hydrologic regime has changed the character of the valley's wetlands and greatly altered their functions. Today, most of the mainstem Willamette River exceeds standards for bacteria, temperature, and toxics such as mercury.

The encroachment of invasive species has greatly altered the composition of riparian plant communities, with introduced plants increasing from 10 percent in the headwaters to more than 50 percent of the number of species in the mainstem Willamette.

Table 1. Total acreage of Johnson and O'Neil habitat type within each ecoregion.

Habitat Type	Acreage of Habitat Type within Each Ecoregion									
	Basin and Range	Blue Mountains	Coast Range	Columbia Basin	East Cascades Slopes and Foothills	Klamath Mountains	High Lava Plains	Owyhee Uplands	West Cascade Mountains	Willamette Valley
Agriculture, Pasture, and Mixed Environments	250,430	550,910	164,950	1,740,960	459,780	609,980	299,810	250,250	83,900	1,779,280
Alpine Grasslands and Shrublands	1,180	214,120	0	0	8,920	960	0	0	66,250	0
Bays and Estuaries	0	0	22,450	0	0	0	0	0	860	8,940
Ceanothus-Manzanita Shrublands	0	0	0	0	2,970	48,530	0	0	590	0
Coastal Dunes & Beaches	0	0	42,710	0	0	0	0	0	0	0
Coastal Headlands & Islets	0	0	8,460	0	0	0	0	0	0	0
Desert Playa & Salt Scrub	707,880	0	0	0	90	0	0	11,370	0	0
Dwarf Shrub-steppe	408,120	110	0	0	61,090	0	21,700	22,760	0	0
Eastside (Interior) Canyon Shrublands	0	0	0	239,970	0	0	7570	110,600	0	0
Eastside (Interior) Grasslands	0	1,366,980	12,180	497,510	45,090	0	5,530	0	0	0

Table 1. (continued)

Habitat Type	Acreage of Habitat Type within Each Ecoregion									
	Basin and Range	Blue Mountains	Coast Range	Columbia Basin	East Cascades Slopes and Foothills	Klamath Mountains	High Lava Plains	Owyhee Uplands	West Cascade Mountains	Willamette Valley
Eastside (Interior) Mixed Conifer Forest	3,630	3,038,490	0	4,990	905,830	0	42,280	0	131,220	0
Eastside (Interior) Riparian-Wetlands	21,280	560	0	4,410	200	0	870	3,550	0	0
Herbaceous Wetlands	397,240	1,273,780	59,040	4,980	329,230	4,860	36,030	50,650	9,270	10,780
Lakes, Rivers, Ponds, & Reservoirs	322,520	25,050	24,800	13,540	158,690	16,080	14,540	36,280	76,550	44,050
Lodgepole Pine Forest and Woodlands	20	2,260	0	0	507,590	0	0	0	22,340	0
Marine Nearshore	0	0	3,610	0	0	0	0	0	0	0
Montane Coniferous Wetlands	0	5,400	0	0	41,350	90	130	0	8,930	190
Montane Mixed Conifer Forest	280	485,720	0	0	190,740	39,710	0	0	2,234,840	0
Ponderosa Pine and Eastside White Oak Forest and Woodlands	13,790	2,890,730	0	37,820	2,919,020	79,220	213,630	10	72,420	0
Shrub-steppe	7,093,000	1,986,120	0	1,641,770	457,950	0	1,327,67 0	4,911,800	0	0

Table 1. (continued)

Habitat Type	Acreage of Habitat Type within Each Ecoregion									
	Basin and Range	Blue Mountains	Coast Range	Columbia Basin	East Cascades Slopes and Foothills	Klamath Mountains	High Lava Plains	Owyhee Uplands	West Cascade Mountains	Willamette Valley
Southwest Oregon Mixed Conifer-Hardwood Forest	0	0	369,470	0	3,580	2,649,320	0	0	989,560	8,240
Subalpine Parklands	4600	0	0	0	7,380	5,650	0	0	66,570	0
Upland Aspen Forest	19,480	210	0	0	0	0	0	0	0	0
Urban and Mixed Environments	3,190	16,270	57,810	29,340	22,570	42,170	20,560	6,030	5,960	366,010
Western Juniper and Mountain Mahogany Woodlands	555,940	471,600	0	72,190	642,080	0	2,178,37 0	116,900	110	0
Westside Lowland Conifer-Hardwood Forest	0	0	4,961,680	0	10,720	256,560	0	0	3,324,250	785,870
Westside Oak and Dry Douglas-fir Forest and Woodlands	0	0	1,430	0	5,890	106,060	0	0	46,290	273,150
Westside Riparian - Wetlands	0	0	29,070	0	0	6,270	0	0	2,470	120,290
Total Acreage in Ecoregion	9,802,580	11,181,910	5,757,660	4,287,480	6,780,760	3,865,460	4,168,.69	5,520,200	7,142,380	3,396,800