Columbia River Basin Tributary Habitat Restoration

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1 Purpose and Need for Action

1.1 Introduction

The Bonneville Power Administration (Bonneville, as lead agency) and Bureau of Reclamation (Reclamation, as cooperating agency) (collectively referred to as the Agencies) are evaluating certain categories of habitat restoration actions in the tributaries of the Columbia River in the states of Oregon Washington, Idaho, western Montana, and northern Nevada. These actions range from those such as monitoring, fencing, and planting, to bridge construction, instream habitat improvement and stream channel reconstruction.

Bonneville, in cooperation with Reclamation, is preparing this Columbia River Basin Tributary Habitat Restoration Programmatic Environmental Assessment (Programmatic EA) to analyze the potential impacts of tributary habitat restoration actions that may occur at locations across the Columbia River Basin (hereinafter, the "Basin"), excluding the Columbia River estuary[1], to support more efficient environmental review of site-specific restoration proposals. Numerous aquatic and terrestrial habitat restoration projects[2], which incorporate one or more of the actions evaluated here, have already been completed, are in progress, are currently proposed, or will be identified over the coming years.

In accordance with the National Environmental Policy Act of 1969 (NEPA) (42 USC § 4321 *et seq.*), its implementing regulations, and CEQ guidance, including its 2014 memorandum of "Effective Use of Programmatic NEPA Reviews"[3]), which require federal agencies to assess the impacts their actions may have on the environment, the Agencies are preparing this Programmatic EA to evaluate the environmental impacts of implementing habitat restoration in the Columbia River Basin and its tributaries.

Bonneville is the lead agency for this effort due to the number and complexity of tributary habitat restoration projects that it anticipates proposing. Reclamation is a cooperating agency due to its jurisdiction by law (authorities) and special expertise (design and technical services) (see Section 1.5.2), and both agencies coordinate on many projects where Bonneville would be funding projects that Reclamation would design.

1.2 Need

Bonneville and the Reclamation need a programmatic approach to support efficient and timely environmental review of numerous[4] site-specific tributary habitat improvement and restoration projects proposed each year, many of which are similar in terms of methods, location, and impacts. The Agencies propose to continue restoring habitat in the Basin to improve fish and wildlife habitat

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[1] A programmatic Environmental Assessment for restoration actions in in the Columbia River Estuary was completed in 2016: the "*Columbia Estuary Ecosystem Restoration Program Final Environmental Assessment*" DOE/EA-2006. The estuary is considered the tidally-influenced area along the Columbia River from its mouth at the Pacific Ocean (river mile 0) upstream to Bonneville Dam (river mile 146).

[2] The term "project" throughout this EA is used to refer to an undertaking which incorporates one or more discrete species or habitat restoration "actions". While the term "Project" has a specific meaning in the Northwest Power Conservation Council's program (Section 1.5.1) that specific meaning is not intended in this EA.

[3] https://ceq.doe.gov/docs/ceq-regulations-and-guidance/Effective_Use_of_Programmatic_NEPA_Reviews_Final_Dec2014_searchable.pdf

[4] Bonneville manages over 150 contracts for habitat restoration each year. The contracts include over 1,000 individual actions as characterized in Section 2.1.

and survival of at-risk species as proposed in the action consulted upon in the 2020 National Marine Fisheries Service (NMFS) Columbia River System Biological Opinion (2020 NMFS CRS BiOp) and the 2020 U.S. Fish and Wildlife Service (USFWS) Columbia River System Biological Opinion (2020 USFWS CRS BiOp). At present, the Agencies conduct environmental review of all tributary habitat restoration projects on a project-by-project basis. These projects include many routine actions with well-understood and predictable environmental effects common to restoration projects in riverine and terrestrial ecosystems in the larger Columbia River Basin. This approach is inefficient because the Agencies must analyze these routine actions and predictable impacts repeatedly with each successive project. This inefficiency can delay implementation of projects that have little controversy or adverse impact, but provide long-term ecosystem benefits to fish and wildlife.

The Agencies need a coordinated and programmatic evaluation of the environmental impacts of the various tributary habitat restoration actions that they routinely propose and implement. Such a programmatic evaluation can provide comprehensive effects analysis and an analytical framework to which subsequent site-specific analyses can efficiently tier (see Section 2.2.3).

1.3 Purposes

In meeting the need for action, the Agencies seek to achieve the following purposes:

- Help meet the Agencies' obligations under the Endangered Species Act (ESA) by fulfilling commitments begun under the 2008 NMFS Federal Columbia River Power System BiOp (as supplemented in 2010 and 2014) (2008 BiOp) and ongoing commitments under the 2020 NMFS Columbia River System BiOp (2020 CRS BiOp). The 2008 BiOp called for identifying tributary habitat restoration projects and the 2020 CRS BiOp largely continues the tributary habitat restoration program.
- Help meet the Agencies' obligations under the ESA by fulfilling commitments under the 2020 USFWS CRS BiOp for continued and improved-upon Kootenai River white sturgeon habitat restoration, and to leverage benefits for bull trout from tributary habitat restoration projects.
- Minimize adverse effects to the human environment, avoid jeopardizing the continued existence of ESA-listed species, and avoid adverse modification or destruction of designated critical habitat.

In addition, Bonneville seeks to achieve the following purposes

- Bonneville needs to mitigate for effects of development and operation of the Federal Columbia River Power System (FCRPS) on fish and wildlife in the Columbia River and its tributaries, under the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Northwest Power Act) (16 USC § 839b(h)(10)(A)) in a manner consistent with the Northwest Power and Conservation Council's Fish and Wildlife Program and the purposes of the Northwest Power Act.
- Fulfill Bonneville's commitment related to proposed projects that are contained in the 2008 Columbia River Basin Fish Accords Memorandum of Agreement among the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes and Bands of the Yakama Nation, the Columbia River Inter-Tribal Fish Commission, Bonneville, the U.S. Army Corps of Engineers, and U.S. Bureau of Reclamation; the Accords Memorandum of Agreement with the State of Idaho; and the Accords Memorandum of Agreement with the

State of Montana; all extended in 2018 (Fish Accord Extension); and the 2019 Memorandum of Agreement with the Kootenai Tribe of Idaho.

1.4 Background

1.4.1 The Columbia River Basin

The Basin covers a major portion of North America, providing drainage for hundreds of rivers, creeks, and streams - covering an area of more than 260,000 square miles (Figure 1). The Basin drains portions of seven U.S. states and two Canadian provinces, and contains great geographic and land-use diversity, including alpine peaks, forested slopes, semi-arid grassland and rangeland, arable agricultural land, and an extensive estuary. The Columbia River is the fourth-largest river by volume in North America, and the second largest river in the U.S. in volume of water flow, behind only the Mississippi River. It begins at Columbia Lake in the mountains of southeastern British Columbia and enters the United States at river mile 749 in northeastern Washington. From there, the river travels south and west through Washington, then along the Oregon and Washington state border before entering the ocean 1,214 miles later, at Astoria, Oregon. It has been an important resource for urban settlement and development, agriculture, transportation, recreation, fisheries, and hydropower generation.

Figure 1 the Columbia River Basin, in the United States

Rivers, streams, and lakes in the Basin historically provided migration corridors and important spawning and rearing habitat for anadromous Chinook salmon (*Oncorhynchus tshawytscha*), sockeye salmon (*Oncorhynchus nerka*), coho salmon (*Oncorhynchus kisutch*), and steelhead (*Oncorhynchus mykiss*). The Independent Scientific Advisory Board estimated that 5 to 9 million salmon and steelhead were believed to have returned to the river from the ocean each year up until the mid-1800s (ISAB 2015). The river was also ideal habitat for other cold-water fish such as lamprey and sturgeon that migrated to the ocean and back.

Beginning in the mid-1800s, however, development in the Northwest began impacting fish populations and fish habitat in the Basin. Commercial salmon fishing was intense, and human development altered aquatic habitats by water withdrawals, stream channelization, stream dewatering, road construction, beaver removal, cattle grazing, urban development, agriculture, logging, and mining. The rivers in the Basin were altered by dams built to generate power, to control flooding, and to provide navigation, irrigation, and recreation services. By the time Bonneville Dam was built in 1937, annual runs averaged around one-half million salmon and steelhead.

The development in the Columbia River Basin has altered river flow regimes and habitat, reduced stream flows, removed cover, elevated water temperatures, or altered water chemistry in many areas to levels reducing the habitat quality for spawning, rearing, or overwintering of anadromous fish and other aquatic species. Summer streamflow modifications (July through September) have affected fish habitat and also have affected migration and access to suitable spawning and rearing habitat for these fish (Munther, 1974; Scott and others, 1981). Reduced summer stream flows have decreased juvenile rearing space, resulting in poor growth and survival (Quinn, 2005).

The actions evaluated in this Programmatic EA for funding by the Agencies have been proposed to restore fish and wildlife tributary habitat in the Basin. The Agencies' actions restore fish passage, lower stream temperatures, reduce unnatural erosion and turbidity, improve sediment capture, and develop fish and wildlife habitat structure in streams and uplands. These actions are all intended to restore aquatic and upland habitats sufficient to support life history needs for fish and wildlife.

1.4.2 Federal Columbia River Power System

The Federal Columbia River Power System (FCRPS) is a series of 31 dams in the Pacific Northwest that are operated and maintained by the US Army Corps of Engineers and Reclamation (Figure 2). The FCRPS is jointly managed to address an array of treaty, statutory, and regulatory responsibilities. Bonneville markets and distributes the power generated from the FCRPS pursuant to the Bonneville Power Act of 1937 (16 USC § 832 *et seq.*) and other applicable statutes. The Columbia River System (CRS) is a subset of the FCRPS and includes fourteen dam and reservoir projects that are operated as a coordinated water management system to meet their congressionally authorized purposes.

Figure 2 Dams on the Columbia River

1.4.3 Biological Opinions for the Continued Operation and Maintenance of the Columbia River System

Under the ESA and its implementing regulations, federal agencies must ensure that their actions are not likely to jeopardize the continued existence of ESA-listed species or result in destruction or adverse modification of designated critical habitat. When a federal agency determines that its proposed action may affect listed species or critical habitat, it must initiate interagency consultation.

Currently, there are thirteen species of anadromous salmon and steelhead listed as threatened or endangered under the ESA (with designated critical habitat for all thirteen species) affected by operations of the CRS. Beginning in 1992, the CRS Action Agencies[5] initiated Section 7 consultations with NMFS and USFWS on the effects of the operation and maintenance of the CRS on

[5] The Action Agencies for the CRS Section 7 ESA consultation with NMFS included the U.S. Army Corps of Engineers, Reclamation, and Bonneville.

these and other listed species and their designated critical habitat. NMFS and USFWS have issued biological opinions and incidental take statements on the operation of the CRS and related actions since that time.

In its BiOp dated December 21, 2000, NMFS concluded that the Action Agencies' proposed operation of the FCRPS was likely to jeopardize ESA-listed fish and included a Reasonable and Prudent Alternative to the proposed action that reflected a life cycle management approach, incorporating habitat restoration to help address uncertainty related to any residual effects of the operation and maintenance of the FCRPS (NMFS 2000). A number of updates, supplemental opinions, and legal challenges to this consultation led to modifications of system operations and shaped the program of tributary habitat improvement actions over the past 20 years, including in a new BiOp produced in 2020 (NMFS 2020).

In the 2020 opinion, NMFS consulted on a proposed action that included system operations designed for more protections for anadromous fish than that in the 2000 consultation, and a set of non-operational conservation measures to benefit ESA-listed salmon and steelhead. Included in those non-operational conservation measures was strategic implementation of tributary habitat improvement actions to address residual adverse effects of the proposed system operations. NMFS concluded that the effects of this proposed action would not be likely to jeopardize the continued existence of the thirteen ESA-listed species of anadromous salmonids or adversely modify designated critical habitat (NMFS 2020).

In 2000, the USFWS issued a biological opinion (BiOp) for the effects of CRS operations and maintenance on Kootenai River white sturgeon and bull trout (USFWS 2000). After the USFWS designated Kootenai River white sturgeon critical habitat, the U.S. Army Corps of Engineers reinitiated consultation and the USFWS issued a new BiOp on February 18, 2006 (USFWS 2006), which considered the effects of the proposed operation of Libby Dam on the endangered Kootenai River white sturgeon, its designated critical habitat, and bull trout. This BiOp was challenged and the parties entered into a settlement agreement whereby the USFWS issued a clarified Reasonable and Prudent Alternative (RPA) in 2008 on specific to the effects of Libby Dam operations on ESA-listed species. The 2000 USFWS BiOp and the 2008 clarified RPA were the most recent consultations for Kootenai River white sturgeon and bull trout until the 2020 USFWS CRS BiOp., wherein the USFWS concluded that the effects of this proposed action would not be likely to jeopardize the continued existence of the Kootenai River white sturgeon and bull trout, or adversely modify designated critical habitat (USFWS 2020). The proposed action in the 2020 USFWS CRS BiOp included Kootenai River white sturgeon habitat projects as well as leveraging benefits for bull trout where feasible when developing tributary habitat projects for salmon.

1.5 Lead and Cooperating Agencies

1.5.1 Bonneville Power Administration

Bonneville is a federal power marketing agency within the U.S. Department of Energy with responsibility for marketing and selling power generated by the FCRPS. Bonneville's operations are governed by several statutes, including the Northwest Power Act. The Northwest Power Act (16 U.S.C. § 839b (h) (10) (A)), directs Bonneville to protect, mitigate, and enhance fish and wildlife affected by the development and operation of the FCRPS. To assist in accomplishing this, the act requires Bonneville to fund fish and wildlife protection, mitigation, and enhancement actions consistent with the Northwest Power and Conservation Council's Fish and Wildlife Program and other purposes of the act.

The Northwest Power and Conservation Council (Council) is an interstate agency established under the authority of the Northwest Power Act to develop and maintain a regional power plan and a fish and wildlife program to balance the Northwest's environment and energy needs. The Northwest Power Act directs the Council to develop a program to "protect, mitigate, and enhance fish and wildlife, including related spawning grounds and habitat, on the Columbia River and its tributaries... affected by the development, operation, and management of hydroelectric projects while assuring the Pacific Northwest an adequate, efficient, economical, and reliable power supply." (NPCC 2014). Under this program, the Council makes recommendations to Bonneville, Reclamation, the Corps, and the Federal Energy Regulatory Commission about which mitigation measures to implement to aid in the protection, mitigation, and enhancement of fish and wildlife and their habitats. To implement mitigation consistent with the measures recommended by the Council in its Program, Bonneville funds projects to protect and enhance tributary habitat. Many of these projects also help meet Bonneville's obligations under other statutes, such as the ESA.

1.5.2 Bureau of Reclamation

Reclamation is a water management agency under the Department of Interior that implements programs, initiatives, and activities to help the Western States, Native American Tribes and others meet new water needs and balance the multitude of competing uses of water in the West. Its mission is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public. The action area falls within Reclamation's Columbia-Pacific Northwest Region which encompasses the Columbia River Basin.

Reclamation and Bonneville contribute to the implementation of salmonid habitat improvement projects in the Columbia River Basin to help meet commitments contained in the 2020 CRS BiOp (NMFS 2020). This Biological Opinion includes a Reasonable and Prudent Alternative (RPA), or a suite of actions, to protect salmon and steelhead listed under the ESA across their life cycles. Habitat improvement projects in various Columbia River tributaries are one aspect of this RPA. Reclamation's contributions to habitat improvement fulfill its Cooperating Agency special expertise requirements for this EA and are intended to be within the framework of the RPA or related commitments. Reclamation has contributed to over 200 Habitat Projects to meet various BiOp requirements to date.

Reclamation's jurisdiction as a Cooperating Agency on this EA is encompassed in its authorities to conduct Tributary Habitat Program activities required by Section 7 of P.L. 93-205, ESA (16 U.S.C. 1536). These authorities include the Reclamation Act of June 17, 1902 (43 U.S.C. 391, et seq.) and acts amendatory and supplementary thereto; Section 14 of the Reclamation Project Act of August 1939 (43 U.S.C. 389); the Fish and Wildlife Coordination Act (16 U.S.C. 661, et seq.), as amended; and individual Reclamation Project authorizing acts. Reclamation is conducting its Tributary Habitat Program under authorities contained in Sec. 5 of the ESA (16 U.S.C. 1534); the Fish and Wildlife Coordination Act (16 U.S.C.661-666c) and Sec. 7(a) of the Fish and Wildlife Act of 1956 (16 U.S.C. 742f(a)) as delegated from the Secretary of the Interior to the Bureau of Reclamation in Secretarial Order No. 3274, as amended in Amendment No. 2, dated January 27, 2010; and Departmental Manual 255 DM 1, dated October 5, 2010 (to carry out off-site habitat improvements in the Pacific Northwest Region [now known as the Columbia-Pacific Northwest Region] when required to comply with Sec. 7(a)(2) of the ESA).

1.6 Public Involvement

1.6.1 Scoping

To help determine issues to be addressed in the EA, Bonneville conducted public scoping outreach. Bonneville mailed letters on November 1, 2019, to landowners, tribes, government agencies, and other potentially affected or concerned citizens and interest groups. The public letter provided information about the Proposed Action and the Programmatic EA scoping period, requested comments on issues to be addressed in the EA, and described how to comment (mail, fax, telephone, the Bonneville website, and at scoping meetings). The public letter was posted on a project website established by Bonneville to provide information about the program and the EA process. The public comment period began on November 1, 2019, and Bonneville accepted comments on the project from the public until November 30, 2019. All project documents and comments received were made available for public review on Bonneville's website at https://www.bpa.gov/efw/Analysis/NEPADocuments/Pages/Columbia-River-Basin-Tributary-Habitat-Restoration.aspx.

1.6.2 Public Comments

Bonneville received responses from eight parties which included 29 distinct comments. The following issues relevant to the Proposed Action and this assessment were raised (the section references in italics and parentheses are where in the EA the comment is primarily addressed):

- Assure shading by preserving or restoring riparian vegetation that could potentially be impacted (*Section 2.4 and Appendix B*)
- Focus on increasing abundance of Chinook salmon (*Sections 1.3 and 1.4.1*)
- Efforts should align with state water quality cleanup plans (*Section 2.4 and 4.4*)
- Implement Best Management Practices (BMPs) that are appropriate for specific regions (*Section 2.4, and Appendix B*
- Implement agriculture-specific BMPs that Washington State has identified as effective (*Section 2.4, and Appendix B*)
- Broaden beyond instream and hatchery work to holistic riparian restoration (*Section 2.1.2*)
- For site-specific actions, coordinate with local officials to ensure full compliance (*Section 2.2.2*)
- Fund projects in close consultation with the Council and State/Tribal co-managers (*Section 2.2.4*)
- Emphasize science-based restoration with vigorous effectiveness monitoring (*Sections 2.1, 3.0, and Appendix B*)
- Invest in highest impact actions, even if it takes years to realize the benefit (*Section 2.1*)
- Invest in actions with near-term benefit if needed for adaptive management (*Section 2.1*)
- Outline how this EA will inform ESA consultations (*Section 2.2, 2.2.2, 2.2.3*)
- Integrate this EA with upcoming FCRPS Biological Opinion's mitigation and adaptive management strategies (*Section 2.2*)
- Focus efforts on imperiled stocks and maintaining strongholds (*Sections 1.3 and 1.4.1*)

- Outline how Bonneville will work with the Council to improve understanding of the efficacy of restoration actions and their interaction with hydropower impacts (*Section 1.5.1*)
- Consider impacts to birds and their aquatic & riparian habitats and food supplies (*Section 3.3.5*)
- Recommendation for the following types of actions: (*Section 2.1*)
    - Actions to improve instream flow, such as water right acquisitions (*Section 2.1.7.8*)
    - Actions to reduce high water temperatures such as riparian planting, meadow and floodplain restoration (*Section 2.1.2., 2.1.3*)
    - Actions to improve ecosystem processes including increased floodplain connectivity, multi-thread channels, side channels, and instream habitat complexity, along with reduced peak flows and sediment (*Section 2.1.2*)
    - Maintaining, monitoring, and improving irrigation diversion screening (*Section 2.1.7.7*)
    - Ensure passage past irrigation canal crossings and consolidate irrigation diversions where feasible (*Section 2.1.7*)
    - Removal of harmful and outdated fish barriers, from poorly designed culverts to abandoned or uneconomic dams (*Section 2.1.1*)
    - Fencing to keep livestock out of streams and alternative water sources for livestock away from streams (*Section 2.1.9.2*)
    - Work with state fish and wildlife agencies on strategies to reduce unnatural levels of predation in tributaries (to the extent that tributary predation is covered in this category of Fish and Wildlife Program work) (*Section 2.1.2.10*)

2 Proposed Action and Alternatives

2.1 Proposed Action

Under the Proposed Action, the Agencies would use this Programmatic EA for a coordinated approach to help evaluate the potential environmental impacts of a number of routine potential actions that Reclamation and Bonneville are likely to choose from when proposing to implement tributary habitat restoration actions and projects to benefit fish and wildlife[6]. These categories of actions represent well-established aquatic and terrestrial restoration techniques that have been applied throughout the Basin and have been demonstrated to be effective in the support and restoration of aquatic and upland species and habitats. Because the nature and extent of environmental effects from these well-established techniques are generally well known and documented, the Agencies have chosen to evaluate them programmatically to gain more consistent environmental impact evaluations, streamline contracting and implementation processes, save costs, and bring the benefits of improved habitat to fish and wildlife more quickly. This programmatic analysis would facilitate, but would not eliminate, the need for site-specific evaluations for each specific action (see Section 2.2.2).

Habitat restoration and enhancement actions would be conducted within stream channels, riparian areas, floodplains, wetlands, and uplands. They would be accomplished using manual labor, hand tools (chainsaws, tree planting tools, augers, shovels, and more), all-terrain vehicles, flat-bed trucks, and heavy equipment (backhoes, excavators, bulldozers, front-end loaders, dump trucks, winch machinery, cable yarding, etc.). Helicopters or fixed-wing aircraft may be used for large wood removal and placement, seeding, aerial application of herbicides, and salmon carcass placement.

The categories of actions that the Agencies may implement in their tributary habitat restoration work include:

1. Reestablishing and Improving Fish Passage
2. Improving River, Stream, Floodplain, and Wetland Habitat
3. Invasive Plant Control and Vegetation Management
4. Piling Removal
5. Road and Trail Erosion Control, Maintenance, Decommissioning, and Construction
6. In-Channel Nutrient Enhancement
7. Irrigation, Water Delivery, and Water Use Actions
8. Fish, Hydrologic, Wildlife, and Geomorphic Surveys
9. Riparian and Upland Habitat Improvements and Structures
10. Artificial Pond Development and Operation

Each project would be constrained as appropriate by the application of general mitigation measures applicable to all actions as detailed in Appendix B, and by action-specific design criteria

[6] The actions described in this EA are organized and discussed in a manner consistent with how similar actions were structured in consultations with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) in Bonneville's Habitat Improvement Program (HIP) consultation (2003- present), now in its fourth iteration (HIP IV). Many more actions are included in this assessment than were consulted on in HIP, but for similar actions, their categorization in this EA was kept consistent with the HIP Biological Opinion to maintain consistency in reference and to facilitate communication. This EA is not limited to actions in the HIP consultation.

and mitigation measures (if any) as detailed in Appendix A. Mitigation measures for herbicide applications for invasive plant control are detailed in Appendix C.

Resources that may be required for projects that would not be available in the immediate project area (*e.g.* logs, rocks, gravel) may require additional or independent NEPA evaluation. In some instances, the acquisition of the necessary resources may be considered as part of the project, if the effects of the acquisition of those resources are reasonably foreseeable, and would be assessed as a connected action in the site-specific analysis. In other situations, these items may simply be purchased as a supply item from the open market for the project. In the latter case, the Agencies would not control the areas or means by which the items are procured, and their removal would not be a connected action considered part of the project for NEPA purposes because the effects of the procurement of the resources would not be reasonably foreseeable. The procurement of these resources would be reviewed on a project-by-project basis. Where such procurement would be considered part of a connected action to the project, preferential sources would be from sites or unconnected projects where the requirements of NEPA, ESA, and the National Historic Preservation Act (NHPA) concerning tree, rock, or gravel removal have already been met. If such a source is not available, then the effects would be assessed as a connected action in the site-specific analysis.

2.1.1 Category 1 - Reestablishing and Improving Fish Passage

The objective of reestablishing and improving fish passage restoration would be to allow all life stages of salmonids access to historical habitat from which they have been excluded, and focuses on restoring safe upstream and downstream fish passage to stream reaches[7] that have become isolated by obstructions, non-functioning structures, or instream profile discontinuities resulting from insufficient depth, or excessive jump heights and velocities.

2.1.1.1 Dams, Water Control, or Legacy Structure Removal

These actions would restore more natural channel and flow conditions by removing small dams, channel-spanning weirs, earthen embankments, subsurface drainage features, spillway systems, outfalls, pipes, instream flow redirection structures (*e.g.*, drop structure, gabion, groin), or similar devices used to control, discharge, or maintain water levels. The size of dam to be removed and the degree of NEPA evaluation necessary for its removal would be determined on a site-specific basis.

2.1.1.2 Consolidate or Replace Existing Irrigation Diversions

These actions would consolidate or replace existing diversion check structures with pump stations or engineered riffles (including cross vanes, "W" weirs, or "A" frame weirs) to reduce the number of diversions on streams and thereby conserve water and improve habitat for fish; improve the design of diversions (with adequate fish-screening) to allow for fish passage; or reduce the annual instream construction of push-up dams and instream structures.

Unneeded or abandoned irrigation diversion structures would be removed where they are barriers to fish passage; have created wide, shallow, channels or simplified habitat; or are causing sediment concerns through downstream scour or deposition behind the structure.

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[7] A "reach" is a length of a stream or river. Its beginning and ending points may be selected for many different reasons (geographical, historical, etc.) but its context throughout this EA refers to sections meaningful for restoration purposes.

2.1.1.3 *Headcut and Grade Stabilization*

These actions involve the restoration of fish passage and stream-channel grade control (i.e., headcut[8] stabilization) with structures constructed from rock or large wood as is appropriate to the local landscape and natural features. Boulder weirs and roughened channels would be installed for grade control at culverts to mitigate headcuts, and to provide fish passage at small dams or other channel obstructions that cannot otherwise be removed. In wood-dominated stream systems, grade-control engineered log jams would be considered.

Grade-control engineered log jams are designed to arrest channel down-cutting or incision, retain sediment, lower stream energy, and increase water elevations to reconnect floodplain habitat and diffuse downstream flood peaks. Grade-control engineered log jams also serve to protect infrastructure that is exposed by channel incision, and to stabilize over-steepened banks. Unlike hard weirs or grade control structures constructed with rock, a grade-control engineered log jam is a complex broad-crested structure that dissipates energy more gradually.

If geomorphic conditions are appropriate, a roughened channel or constructed riffle would be developed to minimize the potential for future development of a passage (jump height) barrier.

2.1.1.4 *Low Flow Consolidation*

These actions involve modifying diffused or braided flow conditions that impede fish passage; modifying dam aprons with shallow depths; or utilizing temporary placement of sandbags, straw bales, and ecology blocks to provide depths and velocities passable to upstream migrants.

2.1.1.5 *Providing Fish Passage at an Existing Facility*

These actions would re-engineer fish passage or fish collection facilities that are improperly designed; periodically maintain fish passage or fish collection facilities to ensure proper functioning (*e.g.*, cleaning debris buildup, replacement of parts); and install fish ladders at existing facilities.

2.1.1.6 *Transportation Infrastructure*

These actions involve the maintenance, removal, or replacement of bridges, culverts, and fords to improve fish passage; prevent streambank and roadbed erosion; facilitate natural sediment and wood movement; and eliminate or reduce excess sediment loading.

2.1.1.6.1 ***Bridge and Culvert Removal or Replacement***

These actions involve the replacement of stream-crossing road structures that limit passage of fish. Where fish passage is needed, culverts would be replaced with bridges, open-bottom culverts (designed with the streambed-simulation design method[9]), and closed-bottom culverts (designed with either the streambed-simulation design method or the no-slope method[10]).

Culvert installation where fish passage is not a consideration would be included in Section 2.1.9.7.

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[8] A headcut is an abrupt step in the channel profile, creating a vertical drop that is often a fish passage barrier. They characteristically migrate upstream thereby creating an incised stream channel in their wake, downstream.

[9] The Stream Simulation Design method is a design process for stream crossings that is intended to mimic the natural stream processes within a culvert or beneath a bridge.

[10] The No-Slope method developed by the Washington Department of Fish and Wildlife (Bates 2003) is a design for short culverts whereby the culvert is specifically sized and placed according to stream dimensions and with no slope between the upstream and downstream openings.

2.1.1.6.2 *Bridge and Culvert Maintenance*

These actions would be to maintain or repair bridges and culverts to retain or return them to their original as-built conditions.

2.1.1.6.3 *Installation of Fords*

Fords would be installed where needed to improve existing stream crossing conditions. For the purposes of this proposed action category, fords are defined as crossings for vehicles, off-highway vehicles (OHVs), bikes, pack animals, and livestock.

2.1.1.7 *Removal of Instream Barriers*

These actions would include the removal or relocation of rocks, logs, or other natural materials or debris from waterways that prevent passage of fish. These passage barriers may be natural, or the result of human activity such as railway or highway construction. The removal would be accomplished by blasting or mechanical methods.

To remove rock by blasting, holes drilled into the rock are packed with explosive to direct the force of the blast into the rock. The depth and placement of the holes and the size of the charges control the amount of rock that is broken. Removal would be conducted by repeatedly drilling, blasting, and excavating sections of the barrier until the required amount and area of rock is removed. The rock, logs, or other debris would be removed from the river channel, relocated elsewhere along the river, or placed intentionally at or near the former barrier site in a manner that provides fish passage.

2.1.2 Category 2 – Improving River, Stream, Floodplain, and Wetland Habitat

This category would cover restoration actions in rivers, streams, floodplains, or wetlands with the objective of providing appropriate habitat conditions for foraging, rearing, and migrating fish, including ESA-listed fish. Bonneville funds approximately 20 actions of this type each year that may affect up to 100 acres or more. They are most frequently proposed for rivers and streams low in their watersheds where floodplains are present and connection between the stream and its floodplain is compromised.

Habitat restoration actions proposed in this activity category are intended to address limiting factors identified in watershed subbasin plans, recovery plans for ESA-listed species, or as recommended by a local technical oversight group or committee (*e.g.*, the Technical Team for the Upper Salmon Basin watershed, or the Grand Ronde Model Watershed). Projects may utilize a combination of the activities listed in this category.

2.1.2.1 *Improve Secondary Channel and Floodplain Interactions*

These actions would re-establish historical stream channels within floodplains; restore or modify hydrologic and other essential habitat features of historical river floodplain swales, abandoned side channels, spring-flow channels, wetlands, and historical floodplain channels; and create new self-sustaining side channel habitats, which are maintained through natural processes.

2.1.2.2 *Set-back or Removal of Existing Berms, Dikes, and Levees*

This action category includes the removal of fill (*e.g.*, dredge spoils) from past channelization, roads, trails, railroad beds, dikes, berms, and levees in order to restore natural freshwater floodplain functions.

Actions in freshwater include full and partial removal of levees, dikes, and berms; breaching of levees, dikes, and berms; lowering of levees, dikes, and berms; setback of levees, dikes, and berms; and removal of spoils piles from floodplains.

2.1.2.3 Protect Streambanks Using Bioengineering Methods

These actions would restore eroding streambanks through bank shaping; installation of soil reinforcements (*e.g.*, coir logs, large wood, etc.) and other bioengineering techniques, as necessary, to support development of riparian vegetation; or planting of trees, shrubs, and herbaceous cover, as necessary, to restore ecological functions in riparian and floodplain habitats.

The primary structural streambank protection action proposed is the installation of large wood and riparian vegetation configured to increase bank strength and resistance to erosion. This is considered to be an ecological approach to managing streambank erosion (i.e., bioengineering).

2.1.2.4 Install Habitat-Forming Instream Structures (Large Wood, Small Wood & Boulders)

These actions include placement of structures comprised of natural habitat-forming materials to provide complexity and to support spawning, rearing, and resting habitat for salmonids and other aquatic species. Structures consisting of large wood, small wood and boulders would be placed in stream channels either individually or in combination.

Actions utilizing structures would be designed to increase instream structural complexity and diversity; and mimic the processes and functions of natural input of large wood (*e.g.*, whole conifer and hardwood trees, logs, root wads, etc.).

2.1.2.4.1 Large Wood Placements

Large wood placements would use trees that are greater than one foot in diameter as measured at diameter at breast height, (DBH), (measured 4.5 feet from the end of the root wad or cut end) and 15 feet or greater in length as the primary pieces within the placement or structure. Materials with dimensions less than this size class (*e.g.,* shrubs, branches, smaller trees, etc.) may be incorporated (woven) into the structures for racking.

Techniques for wood placements include felling, pushing, or hauling trees from the riparian zone into the active stream channel. Locations for wood placement would be driven by the objectives to increase coarse sediment storage, increase habitat diversity and complexity, retain gravel for spawning habitat, improve flow heterogeneity, provide long-term nutrient storage and substrate for aquatic macroinvertebrates, moderate flow disturbances, increase retention of leaf litter, and provide refugia for fish during high flows.

Design criteria would be focused on balancing biological benefit, structural resiliency, enhancing and complementing hydrologic processes, and would be specific to the stream, and the fish species and age class for which the benefits are intended.

2.1.2.4.2 Small Wood Placements

Small wood placements would use trees that are less than one foot DBH, and 15 feet or less in length and may completely or partially span the channel. They would be constructed with small diameter trees, woody debris, riparian cuttings, or other inert materials that would be structurally reinforced with small diameter posts driven into the streambed. These structures would be porous: allowing water, sediment, fish, and other aquatic organisms to move through them.

This would include structures that mimic the functions of beaver dams (*e.g.,* flattening stream gradients, increasing interactions between the stream and floodplain, increasing bank storage, capturing fine sediment, pool formation, etc.).

Structure types would include:

- small, whole tree placement,
- beaver dam analogues,
- post assisted log structures,
- post lines only,
- post lines with wicker weaves,
- construction of starter dams,
- reinforcement of existing active beaver dams,
- reinforcement of abandoned beaver dams as described by Pollock *et al*. (2012)

2.1.2.4.3 __Boulder Placements__

Boulder placements would be used to restore or enhance in-stream habitat diversity in streambeds from which boulders have been removed; in newly constructed or reconstructed channels; in natural stream reaches that lack pools or bars, and in altered channels that were historically dominated by wood.

2.1.2.5 Riparian and Wetland Vegetation Planting

This category of action would include the planting of trees, shrubs, herbaceous plants, and aquatic macrophytes to help stabilize soils or restore riparian plant communities. Plantings would be guided by vegetation management strategies that specify seed/plant source, seed/plant mixes, and soil preparation needs, and that are conforming and suitable to local native plant community succession and disturbance regimes.

Large trees such as cottonwoods and conifers would be planted in areas where they historically occurred but are currently either scarce or absent.

Native plant species and seeds would be obtained from local sources to ensure plants are adapted to the local climate and soil chemistry.

Certified noxious-weed-free seed (99.9%), straw, mulch or other vegetation material for site stability, erosion protection, and revegetation actions would also be applied.

2.1.2.6 Channel Reconstruction

This category of action would include channel reconstruction actions to improve aquatic and riparian habitat diversity and complexity, reconnect stream channels to floodplains, reduce bed and bank erosion, increase hyporheic exchange, provide long-term nutrient storage, provide substrate for macroinvertebrates, moderate flow disturbance, increase retention of organic material, and provide refuge for fish and other aquatic species.

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

Most projects would incorporate a primary channel with secondary channels that are activated at various flow levels to increase floodplain connectivity and to improve aquatic habitat through a range of flows. The reconstructed stream system would be composed of a naturally sustainable and dynamic planform, cross-section, and longitudinal profile and would incorporate unimpeded fish passage, and temporary storage of water, sediment, organic material, and species. Proposed reconstruction projects would be designed to be appropriate to the channel's watershed context and geomorphic setting.

This channel reconstruction is not intended to artificially stabilize streams into a single location or into a single channel. Natural adjustment of the reconstructed stream channel would be anticipated over time (as it would be in naturally dynamic systems) and would be a component of restoration actions. Allowing the river or stream to adjust naturally may impact surrounding land uses or infrastructure. Where there may be potential impacts to resources, including land use or infrastructure from the proposed restoration action, a NEPA analysis with scoping that identifies such impacts would be considered.

2.1.2.7 Install Habitat-Forming Gravels

Placement of gravel would improve spawning substrate to compensate for loss of a natural gravel supply (usually below reservoirs), and may be applied in conjunction with other habitat components such as simulated log jams and boulders.

2.1.2.8 Remove Mine Tailings

These actions would remove or re-contour remnant landscapes shaped by the effects of past mining operations. Most mine tailings considered here would be the remnant piles from historical in-stream gold-dredge mining that constrain natural hydrologic function and hinder development of healthy in-stream and riparian habitats. This action would usually be accompanied by restoration actions from Category 2.1.2.1 and 2.1.2.6, above, but may also be a stand-alone action, or part of a habitat-restoration project with actions from other categories of actions.

2.1.2.9 Introduction or Translocation of Beavers

The introduction or translocation of beavers for the purpose of habitat restoration by the dam-building actions of these animals is proposed here.

2.1.2.10 Reduce invasive fish species' impacts to native species' habitat

On a very limited basis, the Agencies propose to address the adverse habitat impacts (reduced prey availability and access to spawning gravels) of non-native fish on habitats designated for the support of ESA-listed fish. The historical introduction of species with overlapping diets (*e.g.* lake trout, brown trout, and brook trout) and spawning habitat preferences (*e.g.* brown trout and brook trout) with those of ESA-listed species can reduce the prey base, and reduce spawning gravel availability (via competition) and suitability (via post-spawning use and disturbance by invasive species) thereby reducing habitat capability for species for which the stream restoration actions above are intended. The Agencies propose the removal of these non-native fish species in smaller tributaries to the Columbia River and upland lakes and small streams by various means, including angler bounties, targeted electrofishing, netting, and localized application of piscicides.

2.1.3 Category 3 - Invasive Plant Control and Vegetation Management

This category of action would include activities to control or eliminate non-native, invasive plant species that compete with or displace native plant communities, or to maintain habitats in an early seral condition[11]. This is a very common activity category funded by Bonneville, with over 23,000 acres treated annually (NMFS 2013), primarily in eastern Oregon, eastern Washington, and Idaho. Over, 3,000 acres of these were within riparian areas. The herbicides and adjuvants[12] that are proposed for use are listed in Section 2.1.3.2, below.

2.1.3.1 Manage Vegetation using manual and mechanical methods

These actions would include both manual and mechanical methods of vegetation management in tributary upland and riparian habitats.

Manual control includes hand pulling, and grubbing with hand tools then bagging the plants for burning or other proper disposal; mulching with organic materials; shading or covering unwanted vegetation; pruning or otherwise controlling brush using hand tools (*e.g.,* machetes), power tools (*e.g.,* chain saws), and targeted grazing by livestock (*e.g.*, goats).

Mechanical control includes techniques such as mowing, tilling, disking, or plowing. Mechanical control may be carried out over large areas or be confined to smaller areas (*e.g.,* scalping).

Specific mitigation measures for managing vegetation using manual and mechanical methods are listed in Appendix B.

2.1.3.2 Manage Vegetation Using Herbicides

Vegetation management would be conducted using chemical herbicides to recover watershed processes and functions associated with native plant communities in tributary upland and riparian habitats. Proposed treatments here would be applied to upland habitats, riparian areas, and surface water.

Herbicides would be applied in liquid or granular form using wand sprayers (applied by hand from backpack equipment containing a pressurized container with an agitation device); boom sprayers (mounted on or towed by trucks, ATVs, or UTVs); injection; hand wicking of cut surfaces; and broadcast application of granular formulas.

Aerial treatment is also included in this proposed category of action. Bonneville has received requests to fund aerial application of herbicides to control widespread infestations of invasive plants following wildfire, or to address particularly aggressive noxious weeds that have displaced entire native plant communities in upland areas. Site-specific evaluations of specific proposals would determine the types of herbicides to be used (including different formulations than are proposed here), the specific mitigation measures to be applied (e.g. width of buffers) and the level of NEPA and public engagement to be applied.

The actions proposed in this category of action would be limited to those consistent with the "Conservation Measures" specified in the Invasive Plant Control section of the most recent iteration

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[11] Bonneville provides funding for operations and maintenance for a growing network of conservation lands in the Willamette Valley where upland oak savannah, prairie, and forest habitats are maintained by mowing, burning, or prescribed grazing to maintain habitats for ESA-listed plants and the streaked horned lark.

[12] An adjuvant is a substance in a herbicide formulation, or added to the spray tank, to improve herbicidal activity or application characteristics.

of Bonneville's HIP consultation (see Section 2.1). Those measures limit the herbicides and adjuvants to be used; and their application rates, buffer widths, and application practices. The most recent iteration of that consultation is incorporated here by reference, and the current, relevant, portions of it to this section are included in Appendix C.

The Agencies propose the use of the following herbicides and adjuvants for vegetation management[13]:

1. **2,4-D Amine Formulations** – 2,4-D amine is the most commonly used and most widely studied herbicide in the United States. It is labeled for a wide range of uses and is an active ingredient in many products offered for home use. 2,4-D acts as a growth-regulating hormone on broad leaf plants, being absorbed by leaves, stems and roots, and accumulating in a plant's growing tips.
2. **Aminopyralid** – Aminopyralid is registered for use in non-crop sites including industrial sites, rights-of-way, non-irrigation ditches, rangeland, natural areas, wildlife openings, wildlife habitats, recreation areas, campgrounds, trailheads, and grazed areas in and around these sites for the control of many broadleaf invasive and noxious weeds. While mainly a post-emergence herbicide, aminopyralid also provides pre-emergence control with some residual effects. Aminopyralid is a plant growth regulator and kills the target plant by causing multiple disturbances affecting the ability of the plant to uptake and/or effectively move nutrients.
3. **Chlorsulfuron** – Chlorsulfuron is used for the control of broadleaf weeds and some annual grasses on non-crop lands. It is applied to young, actively growing weeds and works by preventing the production of an essential amino acid. This in turn inhibits cell division in root tips and shoots.
4. **Clethodim** – Clethodim is registered for use in crop and non-crop sites. It is a selective post-emergence herbicide for control of annual and perennial grasses. This herbicide will not control broadleaf weeds or sedges. It can be applied as a ground broadcast spray, or as a spot or localized spray. Clethodim kills plants by inhibiting fatty acid biosynthesis.
5. **Clopyralid** – Clopyralid is a relatively new and very selective herbicide. It is toxic to some members of only three plant families: the composites (*Compositae*), the legumes (*Fabaceae*), and the buckwheats (*Polygonaceae*). Clopyralid is very effective against knapweeds, hawkweeds, and Canada thistle at applications rates of 0.10 to 0.375 pound per acre. Clopyralid is a WSSA Group 4 herbicide. Its selectivity makes it an attractive alternate herbicide on sites with non-target species that are sensitive to other herbicides.
6. **Dicamba** – Dicamba is used to control broadleaf weeds, brush, and vines. Dicamba is absorbed by leaves and roots, and moves throughout the plant, although in some plants it may accumulate in the tips of leaves. Dicamba acts as a growth regulator. Some plants can metabolize or break down dicamba. Dicamba can be applied by ground broadcast, band treatment, basal bark treatment, cut surface treatment, spot treatment, or wiper methods.

[13] Bonneville proposes to use many of the products evaluated in risk assessments by the U.S. Forest Service. See http://www.fs.fed.us/foresthealth/pesticide/risk . Bonneville previously addressed the use and effects of the proposed herbicides in its Final Transmission System Vegetation Management EIS (Bonneville 2000).

7. **Diquat dibromide** - Diquat dibromide is an herbicide and plant growth regulator. It is a quick-acting contact herbicide, causing injury only to the parts of the plant to which it is applied. It is nonselective, meaning that it does not spare 'non-target' plants from its herbicidal effects. Diquat is referred to as a desiccant because it causes a leaf or an entire plant to dry out quickly. It is not residual, that is, it does not leave any trace of herbicide on or in plants, soil, or water. It is used to desiccate potato vines and seed crops, to control flowering of sugarcane, and for industrial and aquatic weed control.
8. **Fluazifop-p-butyl** - Fluazifop-p-butyl is a selective post-emergence phenoxy herbicide used for control of most annual and perennial grass weeds in cotton, soybeans, stone fruits, asparagus, coffee, and others. It may often be used with an oil adjuvant or nonionic surfactant to increase efficiency. It has essentially no activity on broadleaf species. Fusilade is a slightly too practically nontoxic compound in Environmental Protection Agency (EPA) toxicity class IV.
9. **Glyphosate** – Glyphosate is a non-selective, broad-spectrum herbicide that is labeled for a wide variety of uses, including home use. It is absorbed by leaves and translocated throughout the plant, and disrupts the photosynthetic process. The herbicide affects a wide variety of plants, including grasses and many broadleaf species, and has the potential to eliminate desirable as well as undesirable vegetation. Some plant selectivity can be achieved by using a wick applicator to directly apply glyphosate to the target plant, thereby avoiding desirable vegetation.
10. **Imazapic** – Imazapic is registered for weed control use in native grass establishment and other non-crop areas. It is a systemic pre- and post-emergence broad-spectrum herbicide for control of broadleaf weeds. It can be used in ground broadcast spray, spot, or localized spray applications. Imazapic kills plants by inhibiting enzyme synthesis.
11. **Imazapyr** – Imazapyr is used for pre- and post-emergence control of annual and perennial grasses and broadleaf weeds, brush, vines, and many deciduous trees. Imazapyr is absorbed by the leaves and through the root system, disrupting amino acid biosynthesis. Effects may not be seen for two weeks. Complete plant kill may take several weeks. It can be used in ground broadcast, spot and localized, cut stump, frill and girdle, and tree injection applications.
12. **Metsulfuron methyl** – Metsulfuron methyl is used for the control of brush and certain woody plants, annual and perennial broadleaf weeds, and annual grasses. Metsulfuron methyl is absorbed through the roots and foliage and inhibits cell division in the roots and shoots.
13. **Oryzalin** - Oryzalin has a low solubility in water. Oryzalin is soluble in water and it does not have a strong tendency to adsorb to soil particles. It leaches downward to a limited extent with rainfall and has a moderate potential to contaminate groundwater. Oryzalin does not appear to pose a risk to non-endangered freshwater fish. However, a Daphnia life-cycle study is needed to determine the chronic risk to freshwater invertebrates.
14. **Picloram** – Picloram is a restricted-use pesticide labeled for non-cropland forestry, rangeland, right-of-way and roadside weed control. The herbicide acts as a growth inhibitor and is used to control a variety of broadleaf weed species. It is absorbed through the leaves and roots, is easily translocated through the plant, and accumulates in new growth, causing leaves to cup and curl.

15. **Sethoxydim** – Sethoxydim is registered for use in non-crop sites including industrial sites, rights-of-way, substations, natural areas, wildlife openings, recreation areas, campgrounds, etc. It is a selective post-emergence herbicide for control of annual and perennial grasses. This herbicide will not control broadleaf weeds or sedges. It can be used in ground broadcast spray, spot, or localized spray applications.
16. **Sulfometuron methyl** – Sulfometuron methyl is a non-selective herbicide used primarily to control broadleaf weeds and grasses. Its primary use is for noxious weed control.
17. **Triclopyr** – Triclopyr is found in two formulations. Triclopyr TEA, or the acid formulation labeled as Garlon 3A/Tahoe 3A, is being proposed in this consultation. Triclopyr BEE, or the ester formulation labeled as Garlon 4, would not be used. Triclopyr acts by mimicking the activity of auxin, a natural plant growth hormone. Triclopyr is a WSSA Group 4 herbicide. Backpack (selective) foliar, hack and squirt, basal stem, and boom spray or roadside hydraulic spraying are the most common methods for applying triclopyr.
18. **Herbicide Mixes** – Combinations of herbicides may be the most appropriate treatment where several species of noxious weeds occur together, where the herbicides affect weeds differently, or where herbicide resistance is occurring. Up to a maximum of three herbicides may be combined together.
19. **Adjuvants: Marker Colorants/Dyes, Surfactants, and Drift Retardants** – Spray additives can be included in formulated herbicides, or can be added to the spray mixture to improve the effectiveness of the spray solution. Adjuvants are classified by their uses rather than their chemistry, although chemical properties determine their suitability for use with different herbicides. Adjuvants include surfactants, antifoaming agents, compatibility agents, crop oil or crop oil concentrates activators, drift retardants, and marker colorants/dyes. The intent of these adjuvants is that they would result in less herbicide being used overall.
    a) <u>Dyes</u> would usually be added to herbicides to identify areas that have been sprayed, to warn the general public, to regulate application rates, reduce drift, and reduce risk of spraying non-target species. The dyes proposed for use with herbicides are water-soluble, break down in sunlight and wash away easily with water.
    b) <u>Surfactants</u> are specialized additives, formulated to improve the emulsifying, spreading, sticking, and absorbing properties of herbicides to aid in uptake by the target plant. The type of surfactant used depends on the target plant, the selected herbicide, and environmental condition.
    c) <u>Drift-control adjuvants</u> increase the viscosity and the "tensile" strength of water and decrease the proportion of smaller drops in a spray system. Drift is primarily a function of droplet size and wind. Droplets with diameters of 100 microns (0.1 mm) or less contribute the bulk of the drift off site from the treated fields. Drift-control adjuvants increase the average drop size, resulting in fewer drops per square inch of leaf surface, but the rate of deposit of pesticide in pounds per acre remains the same.

The herbicides included in this category of action were selected due to their low to moderate aquatic toxicity to fish, including ESA-listed salmonids, and the use of chemicals to control noxious weeds would be designed to minimize the risk of adverse toxic effects on fish and wildlife and their habitats. Only ground-based application methods and spot treatment of noxious weeds, with herbicides rated low or moderate for aquatic level of concern, would be authorized for use within riparian areas. Only aquatic-labeled herbicides would be applied within wet stream channels. To prevent direct herbicide delivery to surface waters, aquatic glyphosate and aquatic Imazapyr may be applied up to the waterline using spot spray or hand selective application methods in both perennial and intermittent channels. Triclopyr TEA and 2,4-D amine may be applied up to the waterline, but only using hand selective techniques. These application methods were selected for their low risk of contaminating soils and subsequently introducing herbicides to streams. Fuel and herbicide transportation, storage, and emergency spill plans would be implemented to reduce the risk of an accidental spill of fuel or chemicals.

Specific mitigation measures for managing vegetation using herbicides are listed in Appendix B.

2.1.3.3 Juniper Removal

This category of action would remove juniper that has expanded within riparian areas and adjoining uplands in the absence of natural wildfire. The goal is to help restore plant species composition and structure that would otherwise be present under natural fire regimes. Juniper removal would occur in areas where juniper have encroached into riparian and adjoining upland habitats as a result of fire exclusion, and replaced more desired plant species such as willow, cottonwood, aspen, alder, sedge, and rush.

Juniper removal would be intended to simply kill live stems, and not necessarily physically remove all juniper biomass from a designated restoration site. Felled juniper may be left on site, or used for stream restoration actions under Category 2, above.

Equipment to remove junipers may include chainsaws, pruning shears, winch machinery, feller-bunchers, and slash-busters.

2.1.3.4 Prescribed Burning for invasive woody plant control

This category of action would involve the measured application of fire to control invasive woody plants. The technique involves the hand application of fire via drip torches or similar equipment.

2.1.3.5 Prescribed burning for managing vegetative composition

This category of action would involve prescribed burning to control unnatural vegetative conditions that have arisen in the absence of natural wildfire or as a result of land use practices. Under natural fire regimes, meadow, riparian, and upland habitats are usually more diverse and more resilient to natural fire frequencies and intensities than habitats that have developed under aggressive fire control over the past century. In some meadow habitats, natural fire prevented encroachment by adjacent forests or shrub lands, and maintained suitable conditions for herbaceous species now rare, threatened, or endangered.

The goals of this action, depending on the site, is to reduce ground fuel accumulations, set back forest or shrub encroachment into meadows, reduce tree densities, restore more diverse species composition, and increase the resilience of native plant communities to future wildfires. The technique involves the hand application of fire using drip torches or similar equipment. Though burn prescriptions may vary, most burns would occur in early spring or late fall when weather conditions allow for most effective burn control.

2.1.3.6 No-Till and Conservation Tillage Systems

The Agencies propose to fund conservation tillage systems that focus on increased crop residue during subsequent crop seeding, and the reduction or elimination of traditional tilling practices, which would benefit fish and wildlife and their habitats. This action may also include the purchase of chaff chopper/spreaders and other equipment (generally cooperatively purchased) designed to aid in no- or reduced- till operations and crop residue enhancement.

2.1.4 Category 4 - Piling Removal

This category of action would remove creosote-treated wooden pilings from waterways in the Basin.

2.1.5 Category 5 - Road and Trail Erosion Control, Maintenance, Decommissioning, and Construction

2.1.5.1 Maintain Roads and Trails

These actions would involve road and trail maintenance activities, including:

- Creating barriers to human access, *e.g.,* gates, fences, boulders, logs, tank traps, vegetative buffers, and signs
- Surface maintenance, *e.g.*, building and compacting the road/trail prism,[14] grading, and spreading rock or surfacing material
- Drainage maintenance and repair of inboard ditch lines, water bars, and sediment traps
- Removing and hauling or stabilizing pre-existing cut and fill material or slide material
- Relocating portions of roads and trails to less sensitive areas outside of riparian buffer areas

The proposal is for actions that maintain the designed drainage of the road, and modification if necessary, to improve drainage problems that were not anticipated during the design phase. Road maintenance would not be attempted when surface material is saturated with water and erosion problems could result.

2.1.5.2 Decommission Roads and Trails

These actions would involve decommissioning and obliterating (*i.e*. de-compact, re-contour, or reshape) roads that are no longer needed (*e.g.,* old or temporary logging roads). Water bars would be installed, road surfaces would be in-sloped or out-sloped, asphalt and gravel would be removed from road surfaces, culverts and bridges would be altered or removed, streambanks would be re-contoured at stream crossings, cross-drains[15] would be installed, fill or side-cast materials would be removed, the road prism would be reshaped, and sediment catch basins would be created.

[14] A road prism is the area of ground containing the road surface, the cut slope on the uphill side, and the fill slope on the downhill side.

[15] Roads channel water from their surfaces either by a roadside ditch on the uphill side that collects water from the in-sloped road surface and transports it to a culvert which then transports it under the road to the downhill side; or by installing a closely-spaced series of shallow drain ditches built across the road (cross-drains) that transports this ditchwater across the road's surface directly to natural ground below the road. Roads are also drained by out-sloping them so that surface water drains immediately across the road surface to the natural ground below the road.

2.1.5.3 Construct, Relocate, or Widen Roads or Trails

These actions would involve the construction, relocation, or widening of new or existing roads where needed to eliminate existing, or avoid new, impacts to stream courses, wetlands, floodplains, or other sensitive fish or wildlife habitats; or to eliminate erosion and sedimentation problem stretches on existing roads. Existing problematic roads or trails in riparian areas would be removed and relocated (new construction) into upland areas. The newly constructed upland roads or trails may be surfaced with asphalt, gravel, or other dust abatement or erosion control substance. This proposed category of action does not include asphalt resurfacing, widening roads, or new construction/relocation of any permanent road inside or into a riparian area except for a bridge approach.

2.1.6 Category 6 - In-Channel Nutrient Enhancement

This category of action involves the application of nutrients throughout a waterway corridor. This would include the addition of salmon carcasses, processed fish cakes, or placement of inorganic fertilizers into stream channels or lakes.

2.1.7 Category 7 – Irrigation, Water Delivery, and Water Use Actions

This category of action involves changes to irrigation and irrigation water delivery systems to increase in-stream flow and improve habitats for aquatic species. Types of action would include:

- Convert Delivery System to Drip or Sprinkler Irrigation
- Convert Water Conveyance from Open Ditch to Pipeline or Line Leaking Ditches or Canals
- Convert from Instream Diversions to Groundwater Wells for Primary Water Sources
- Install or Replace Return-Flow Cooling Systems
- Install Irrigation Water Siphon beneath Waterway
- Livestock Watering Facilities
- Install New or Upgrade/Maintain Existing Fish Exclusion Devices and Bypass Facilities
- Purchase or lease of water rights to maintain flows in streams

This category of action only includes irrigation or water delivery management actions where funded irrigation changes would directly result in actual in-stream water savings to benefit fish and wildlife species and habitats.

2.1.7.1 Convert Delivery System to Drip or Sprinkler Irrigation

Flood or other inefficient irrigation systems would be converted to drip or sprinkler irrigation. Education would be provided to irrigators on ways to make their systems more efficient. This proposed activity would include the installation of pipes (often trenched and buried in the ground), and pumps to pressurize the system.

2.1.7.2 Convert Water Conveyance from Open Ditches to Pipelines, or Seal Leaking Ditches or Canals

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

2.1.7.3 Convert from Instream Diversions to Groundwater Wells for Primary Water Sources

Wells would be drilled as an alternative water source to surface water withdrawals. Water from the wells would be pumped into ponds or troughs for livestock or used to irrigate agricultural fields. Instream diversion infrastructure would be removed or downsized, if feasible.

2.1.7.4 Install or Replace Return-Flow Cooling Systems

Above-ground pipes and open ditches that return tailwater from flood-irrigated fields back to the river would be replaced. Return-flow cooling systems would be constructed by trenching and burying a network of perforated PVC pipes that would collect irrigation tailwater below ground, eliminating pools of standing water in the fields and exposure of the water to direct solar heating. Most work would be in uplands or in riparian buffer areas that are already plowed or grazed; instream work would only be conducted when installing the drain pipe outfall.

2.1.7.5 Install Irrigation Water Siphons beneath Waterways

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

2.1.7.6 Livestock Watering Facilities

Watering facilities would consist of various low-volume pumping or gravity-feed systems to move the water to a trough or pond at an upland site. Either above-ground or underground piping would be installed between the troughs or ponds and the water source. Water sources may include springs and seeps, streams, or groundwater wells. Pipes would generally range from 0.5 to four inches but may exceed four inches in diameter. Placement of the pipes in the ground would typically involve minor trenching using a backhoe or similar equipment.

2.1.7.7 Install New or Upgrade/Maintain Existing Fish Exclusion Devices and Bypass Facilities

This category would include installing, replacing, upgrading, removing, maintaining, or operating fish exclusion screens and associated fish bypass systems to prevent fish entrapment in irrigation canals or other surface water diversions for existing legal water diversions.

Fish screen operation and maintenance actions are typically small scale in nature and may include:

- Lubricating moving parts
- Manually cleaning screen material, bypass pipes, and trash racks
- Maintaining bypass outfalls to ensure a safe landing area for fish and maintaining entrance areas to minimize false attraction flows.
- Removing material from bypass pipe to maintain safe fish return to waterway
- Inspecting and replacing screen seal material
- Adjusting weir boards and bypass orifice to maintain proper water levels for screen's submergence and debris removal

- Replacing screen material, bypass pipe, gear boxes, u-joints, bearings, and other worn-out parts
- Adjusting cleaning arms, carriages, cable, pulleys, and brushes to maintain good contact with screen for debris removal
- Removing accumulated sediment and debris by hand
- Mechanical removal of vegetation that prevents fish screens from operating properly
- Replacing batteries and other components of solar power systems
- Repairing paddlewheels and other components of paddlewheel driven power systems
- Removing sediment and debris and adjusting fish passage conditions in fishways by hand
- Annual installation or removal of fish screen and components
- Screen adjustments
- Installation of water measuring devices behind fish screens (dewatered)
- Inspecting, maintaining, or repairing headgates at the start of diversions (dewatered)
- Inspecting, maintaining, or repairing return-flow outlets

These actions would also include the construction of new structures or expansion of existing structures with construction that requires ground disturbance or in-water work. Installation of a fish screen typically involves excavation, installation of bedding material, construction of forms for pouring concrete, installation of the screen and cleaning system, and backfilling of bedding and other material.

Examples include but are not limited to:

- Installing/replacing/modifying/removing fish bypass
- Installing/replacing/modifying/removing fish screens and associated pipes on gravity or pump intakes
- Installing/replacing/modifying/removing fishway
- Removing accumulated sediment and debris with heavy machinery
- Assessing and repairing concrete or steel support structures
- Repairing or replacing screens due to damage from extreme weather events
- Installing/replacing/modifying/removing headgates at the start of diversions
- Installing, replacing, or modifying structures with the intent to improve fish passage and/or flow, typically by removing or modifying a full or partial instream barrier
- Installing/replacing/modifying/removing fish exclusion barriers on ditch return-flow outlets

2.1.7.8 Water transactions to maintain flows in streams

This action would acquire temporary and permanent water rights from willing landowners through voluntary market-based water transactions (landowner agreements, leases, conservation projects, and permanent water rights transfers) to restore stream flows to key fish habitats. These acquisitions would be made primarily through Bonneville's "Columbia Basin Water Transactions

Program",[16] and would target streams where flows are a limiting factor for fish populations and where small streams are sometimes disconnected from larger tributaries. Since 2002, over 540 such transactions have been made to protect nearly 9.4 million acre feet[17] of water for instream benefits.

2.1.8 Category 8 - Fish, Hydrologic, Wildlife, and Geomorphologic Surveys

The Agencies propose to collect information in uplands, wetlands, floodplains, and streambeds regarding existing on the-ground conditions relative to identifying habitat restoration needs and the effectiveness of implemented habitat restoration projects. The information collected would include:

- Habitat type, condition, and impairment
- Fish and wildlife species presence, abundance, and habitat use
- Conservation, protection, and rehabilitation opportunities or effects

Work may entail the use of trucks, survey equipment, unmanned aerial vehicles (drones), and crews using hand tools, and would include activities such as:

- Measuring/assessing and recording physical measurements by visual estimates or with survey instruments
- Installing rebar or other markers along transects or at reference points
- Installing piezometers and staff gauges to assess hydrologic conditions
- Installing recording devices for stream flow and temperature
- Installing cameras for recording species' presence or activity
- Conducting snorkel surveys to determine species of fish in streams and observing interactions of fish with their habitats
- Excavating cultural resource shovel test probes (generally cylindrical in shape, no smaller than 30 centimeters in diameter, spaced no greater than 20 meters apart)
- Installing PIT detector arrays
- Use of Unmanned Aerial Vehicles (UAVs, or "drones") - Drones are proposed for use in upland and riparian habitats for monitoring, surveys, reconnaissance, and inspections. Other uses would also be considered as drone capabilities, and techniques for their use, develop for seeding, burning, and other delivery purposes.

2.1.9 Category 9 – Riparian and Upland Habitat Improvements and Structures

This category of action would occur in riparian areas or uplands for the benefit of terrestrial wildlife species and their habitats. Such actions may include (but would not be limited to):

- Wildlife structure installation/development
- Fence construction for livestock control

[16] The Columbia Basin Water Transactions Program was developed in 2002 in response to recommendations by the Council and a specific conservation measure in the 2000 NMFS Biological Opinion on the effects of operating the Federal Columbia River Power System.

[17] One acre-foot equals about 326,000 gallons, or enough water to cover an acre of land, about the size of a football field, one foot deep. An average household on the west coast uses between one-half and one acre-foot of water per year for indoor and outdoor use.

- Vegetation planting
- Tree removal for large wood projects
- Debris removal
- Interpretive developments
- Upland erosion and sedimentation control

2.1.9.1 Wildlife Structure Installation/Development

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

2.1.9.2 Fence construction for Livestock Control

Permanent or temporary livestock exclusion fences or cross-fences would be installed in restored riparian areas to assist in grazing management. Individual fence posts would be pounded or dug using hand tools or augers on backhoes or similar equipment. Fence posts would be set in the holes and backfilled. Fence wire would be strung or wooden rails placed. Installation may involve the removal of native or non-native vegetation along the proposed fence line. Occasionally rustic wood X-shaped fence that does not require setting posts would be used. If wire fencing is used, the configuration would be designed to be wildlife-friendly.

2.1.9.3 Vegetation Planting

Trees, shrubs, vines, grasses, and legumes would be planted to stabilize soils in areas (primarily riparian or streamside areas) with severe erosion or high erosion potential. Trees such as cottonwoods and conifers would be planted. Plants and seeds would be obtained from local sources to ensure plants are adapted to local climate and soil chemistry.

Planting sites would be prepared by cutting, digging, grubbing roots, scalping sod, de-compacting soil as needed, and removing existing vegetation. The ground would be scarified as necessary to promote seed germination. Woody debris, wood chips, or soil may be placed at select locations to alter microsites.

Plants would be fertilized, mulched, and stems wrapped to protect from rodent girdling. Buds would be capped to protect plants from herbivores. Work may entail use of heavy equipment, power tools, and/or hand tools.

Because noxious weeds, nonnative invasive plants, and aggressive weedy species can take over disturbed lands and degrade range values, vegetation would be controlled through the use of herbicide application, mechanical removal, and hand pulling as discussed in Section 2.1.3.

2.1.9.4 Tree Removal for Large Wood Projects

This activity involves manipulation, harvest, placement, or removal and stockpiling of large wood for stream restoration projects. For this activity, live conifers and other trees can be felled or pulled/pushed over for in-channel large wood placement. These trees would come from areas fully stocked by conifers and other trees. "Danger trees[18]" and trees killed through fire, insects, disease, blow-down, and other means can be felled and used for in-channel placement regardless of live-tree stocking levels. Trees may be removed by cable, ground-based equipment, or helicopter. Trees may be felled or pushed/pulled directly into a stream or floodplain. Trees may be stockpiled for future instream restoration projects. Preferential sources of trees for projects requiring large wood would be from sites or unconnected projects where the requirements of NEPA, ESA, and NHPA concerning tree removal have already been met. Site-specific evaluations of specific proposals would determine if additional NEPA analysis would be needed and the mitigation measures necessary for the specific action.

2.1.9.5 Debris Removal

This action would remove items such as trash, old buildings, and abandoned supplies or equipment from water or land. Debris removed in these actions would not result in adverse effects to historic properties and other cultural resources.

2.1.9.6 Interpretive Developments

These activities include the design, construction, operation, and management of interpretive developments and other user-enhancement facilities that focus on endangered species, habitat loss and restoration, biological diversity, and lifestyle practices and connections to waterways, floodplains, and upland habitats. This would include installation and maintenance of signs, kiosks, information boards, access roads, trails, road closures, and parking areas.

Interpretive developments are also a component of many plans for addressing adverse effects to cultural resources and historic properties. These would often provide information about the area's history.

2.1.9.7 Erosion and Sedimentation Control

This work would routinely occur in and along riparian areas, but would also occur in upland habitats above the range of fish distribution. Actions may include the installation of water bars, gully plugs, culverts, and culvert outlets, grassed waterways, grade stabilization structures, sediment catchment ponds/basins, regrading or terracing, and removal of drainage pipes and other blockages specifically to prevent erosion, sediment slumps, or landslides.

Specific design criteria and mitigation measures for this action would be the same as those for actions under Category 1 (Fish Passage Restoration) and Category 5 (Road and Trail Erosion Control, Maintenance, and Decommissioning), found in Appendix A.

2.1.10 Category 10 - Artificial Pond Development and Operation

This category would include construction, management, and maintenance of ponds and their surrounding habitats. Sediment control ponds are not included in this action. Pond development may involve the installation of a water control structure or excavation.

Constructed ponds would be used for a variety of mitigation purposes, including:

- Providing habitat for resident fish, waterfowl, or wildlife

[18] "Danger Trees" are trees (alive or dead) standing near human infrastructure such as roads, buildings, structures, that pose a hazard to that infrastructure should they fall.

- Providing water sources for terrestrial wildlife, or for livestock when removing their use from riparian areas
- As restoration components within floodplain or riparian area restoration projects

Though not their purpose, the ponds would also provide opportunity for recreational or subsistence fishing and would likely be close to roads and have a limited amount of trails and structures (toilets, day-use sites, etc.) as necessary to protect vegetative and riparian resources from recreational-use impacts.

Acclimation ponds for the release of hatchery-reared fish are not included here.

2.2 Implementation of the Proposed Action

2.2.1 Project Selection

2.2.1.1 Bonneville Project Selection

Bonneville's action is implementing tributary habitat restoration projects by providing funding to other entities. Projects are submitted to Bonneville for consideration for funding from various sponsors such as Indian tribes, conservation districts, state departments of fish and wildlife, other state and federal agencies, and conservation organizations. Many projects receive local review and prioritization by a team of people representing the various types of sponsors listed above from the area where the project is proposed. And most major projects are evaluated and recommended by the Council either individually or as part of a category of similarly situated projects before Bonneville funds them.

Some few projects may be proposed for Bonneville funding that do not receive Council review, and no law requires that Bonneville wait for Council review of every mitigation project before making a funding decision.[19] These kinds of projects would typically (but not exclusively) be (1) in response to natural events such as fire or flood where resource damage is occurring or has the potential to occur; (2) where the action is part of a larger program that has already undergone review and recommendation; for example, the Columbia Basin Water Transaction Project; or (3) the action is part of a larger agreement between Bonneville and the sponsor. The timing need for such actions may preclude the Council's review process, though internal Bonneville review for consistency with the Council's fish and wildlife program and this analysis and its requirements would be conducted (see Section 1.5.1).

2.2.1.2 Reclamation Project Selection

Reclamation's action, through its Tributary Habitat Program, is to provide technical assistance, directly or through grant funding, for habitat project development, design, and technical services. These projects would occur in the John Day, Grande Ronde, Upper Salmon and Upper Columbia River subbasins. Most of these projects would be implemented in coordination with Bonneville and

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[19] The project review provisions of the Northwest Power Act apply to the Council and require review of only "a sufficient number of projects to adequately ensure that the list of prioritized projects recommended [to Bonneville for funding] is consistent with the Council's program." 16 U.S.C. § 839b(h)(10)(D)(iv). Bonneville is not required to submit every project it proposes to fund to the Council for review, Nevertheless, Bonneville typically helps facilitate the Council's review and recommendation of most projects to help ensure the agency's mitigation efforts are consistent with the Council's program and reflect regional priorities.

represent an overall tributary habitat restoration program; some projects, however, may be funded through other Reclamation partners.

2.2.2 Project Design and Environmental Reviews

Bonneville is routinely engaged in the final design of most of the structures and larger restoration projects it funds. Bonneville's influence in the design of river, stream, floodplain, and restoration projects is required by the review requirements of the HIP ESA consultation process; and Bonneville engineers routinely evaluate designs for culvert installation, bridges, and other actions outside of the HIP consultation process to ensure the action's consistency with the Agencies' purposes and needs as described in Section 1.2 and 1.3. Review of project designs would usually begin at the earliest phases, with Bonneville interacting with the sponsor at multiple design stages to develop an effective project that meets Bonneville's purposes, applies the mitigation measures listed in this Programmatic EA, and minimizes short-term effects while maximizing long-term benefits to the resource.

Reclamation is engaged in all steps of the design process, from concept to final design; and works with the project sponsors and other interested parties to form design teams to help guide project development. Reclamation provides funding to project sponsors and other key project partners to participate in the design team process as the designs are developed and reviewed. Design that utilizes Bonneville funding for implementation also follow the HIP ESA consultation process as the project is developed. When Reclamation serves as the Engineer of Record, it follows applicable state licensing rules and standards regarding oversight and quality assurance of design work.

Many small actions, however, have no specific design or formalized review process, but would be guided in their design by the mitigation measures and design requirements in Appendix B. Piling removal, fencing, planting, and invasive plant control are examples of the kinds of funded actions for which design review is not relevant. Livestock watering developments and wildlife structure installations are examples where designs are reviewed, but not generally overseen, or require approval, by Bonneville. Site-specific review of these actions by tiered NEPA documents to this Programmatic EA would identify needs for design review, if any.

All actions would also be reviewed to ensure compliance with all applicable laws and regulations — including, but not limited to ESA, NHPA, Clean Water Act, and the Migratory Bird Treaty Act.

Public notification or involvement would be conducted, as appropriate, for specific actions with potential effects that may differ in scope, scale, or potential level of interest or concern to tribes, landowners, local governments, or interest groups, from actions routinely implemented. This outreach would inform these potential stakeholders of proposed actions, help determine the appropriate level of NEPA analysis to be conducted, and identify issues to be addressed.

Consultations under ESA and NHPA would be conducted as appropriate prior to implementation for all actions under this EA. Conservation or mitigation measures identified through those consultations would be applied alongside the mitigation measures applicable from Appendices A and B.

2.2.3 Tiering Future Analyses to this NEPA Document

Individual projects would be evaluated to determine the level of NEPA analysis required, and whether the project proposal could be tiered to this programmatic assessment. The extent of project-specific NEPA analyses would be commensurate with the size, scope and potential environmental impacts of the specific restoration proposal. For both agencies, site-specific NEPA analyses could be documented in a categorical exclusion, an EA, or an EIS, as appropriate for the specific proposal. Bonneville may use supplement analyses tiered to this EA. All of these documents could incorporate by reference or tier to the analysis in this Programmatic EA. Reclamation may use a similar process when appropriate to tier to this EA when a CE, EA, or an EIS is not warranted.

Mitigation measures identified through this Programmatic EA would be used, as applicable, to help lessen potential impacts of site-specific actions. Additional mitigation measures identified through site-specific analysis, public comment, or consultation may also be applied.

2.3 No Action Alternative

The No Action Alternative would not use a programmatic EA to help evaluate the effects of tributary habitat actions that would be implemented, funded, or technically supported by Bonneville and Reclamation. The No Action Alternative would maintain the current case-by-case NEPA analysis on specific project actions. Currently, the Agencies evaluate habitat improvement projects as they are advanced by different sponsors or proponents at different times. These projects are rarely packaged or timed in a manner that facilitates coordinated review under NEPA. The No Action Alternative continues this practice.

2.4 Mitigation Measures and Design Criteria

As discussed in Section 2.1, "*Proposed Action*", each specific action would be designed and constrained by implementation of the action-specific "*Design Criteria and Mitigation Measures Specific to Project Actions*" detailed in Appendix A, and by the "*General Conservation Measures Applicable to All Actions*" in Appendix B. Mitigations measures for the application of herbicides are included in Appendix C. Additionally, a specific list of mitigation measures, which may include additional measures and site-specific refinements of the measures in Appendices A, B, or C, would be identified for each project and would be based on the site-specific analyses, consultations, and public feedback (as applicable) identified during compliance with the various environmental laws and regulations identified in Chapter 4. A typical list of commonly applied mitigation measures is displayed in the table below.

Table 1 Typical Mitigation Measures for Restoration Projects

Resource	Mitigation Measure
All	• The design criteria and conservation measures from ESA consultation shall be followed for all project actions and when applying the mitigation measures below.
Water Resources	• The project sponsor would ensure that applicable permitting under Section 401 and 404 of the Clean Water Act is in place prior to ground-disturbing activities. • Use sediment barriers such as fences, weed-free straw matting/bales, or fiber wattles, as necessary, in all work areas to intercept any surface flow that might transport sediment to the water bodies. • Stage construction equipment in staging areas identified and approved in construction plans (over 150 feet from streams). • Operate construction equipment, to the extent feasible, from the top of the bank along adjacent uplands and in previously cleared areas. • Develop a Stormwater Pollution Prevention Plan to minimize stormwater runoff and erosion from construction areas; include directions for hazardous material handling and disposal. • Store construction fuel offsite and refuel equipment within temporary secondary containment in designed staging areas, no closer than 150 feet from water bodies. • Operate refueling areas using BMPs and equip these areas with appropriate spill containment systems constructed to contain 110% of the volume of fuel stored within the fuel tanks. • Use water trucks to apply water to the construction area as needed for dust control. • Wash all equipment that may work below the ordinary high water mark (OHWM) elevation before it is delivered to the job site.

	• Inspect equipment to remove vegetation and soil that may contain noxious weed seeds. • Inspect machinery daily to identify and resolve fuel or lubricant leaks. • Cover and stockpile excess excavated materials away from water bodies and flank with sediment fencing to minimize opportunity for fine sediment to be transported into water bodies. • Protect existing riparian/wetland vegetation, to the extent possible.
Fish and Aquatic Species	• Minimize the amount of stream and riparian area impacted during construction. • Conduct excavation for project features in the dry season (late summer or early fall) to the extent possible. • Operate machinery for below-OHWM construction from the top of the streambank along adjacent upland areas, to the extent possible. • Retrofit hydraulically-operated equipment that may work below the OHWM with hydraulic fluids non-toxic to aquatic organisms. • For projects requiring with in-stream construction work, isolate work areas according to the conservation measures for "Work Area Isolation & Fish Salvage" from Appendix B. The procedures outlined in the National Marine Fisheries Service's "Guidelines for Electrofishing Waters Containing Salmonids Listed under the Endangered Species Act" (NMFS 2000) would also be followed. Conduct work below the OHWM during designated instream work windows. • Conduct work below the OHWM during designated instream work windows (generally mid-July through August 31) as approved by the appropriate states' fish and wildlife agency. • No instream or riparian construction activities would occur during nighttime hours and prior to 30 minutes after dawn or continue any later than 30 minutes before dusk. • Protect existing riparian/wetland vegetation, to the extent possible.
Vegetation	• Wash all construction equipment prior to entering into and leaving the site to prevent the spread of noxious weeds. • Pull noxious weeds by hand or treat with herbicide approved for application in wetlands. • Reseed and plant native herbaceous plants, shrubs, and trees appropriate to riparian or upland sites following construction. • Apply weed control measures following construction.
Wetlands and Floodplains	• Mark wetlands designated for protection as "avoidance areas" on construction drawings, and flag them on the ground as "no-work areas" prior to construction
Wildlife	• Seasonal restrictions and spatial buffers would be implemented around known raptor nests during construction to minimize impacts to nesting raptors.
	• Use wildlife-friendly fence design wherever wire fencing is proposed for livestock exclusion
Geology and Soils	• Use sediment barriers such as silt fences and curtains, weed-free straw matting/bales, or fiber wattles, in all work areas to minimize soil loss. • Use water trucks to apply water as needed to the construction area to minimize air-borne soil loss. • Reseed and plant disturbed areas with appropriate native species effective for erosion control following construction.
Transportation	• Ensure awareness of, and coordination with, county and state roads and highways agencies of construction actions along major roads and highways. • Place signs and use flaggers on highways and roads to alert motorists of construction work along these travel ways.
Visual Resources	• Retain, when possible, existing vegetation that visually screens construction activities. • Reseed and plant disturbed areas with appropriate native species.
Air, Noise, and Public Health and Safety	• Reduce the speeds of construction vehicles on access roads to minimize dust. • Maintain and replace defective mufflers on all construction equipment. • Operate construction equipment only during daylight hours when actions are within 0.25 miles of residences. • Signage and other routine safeguards for worker and public safety would be applied when heavy equipment is operating on, nearby, or traveling along public highways and roadways. • Use state-licensed applicators to apply approved herbicides according to manufacturers' labels. • Dispose of non-hazardous wastes in approved landfills. • Dispose of hazardous wastes according to applicable federal and state laws. • Develop and follow the protocol for dealing with hazardous substances inadvertently discovered during project activities.

Cultural Resources	• Mark known cultural resource sites as "avoidance areas" on construction drawings and flag as "no-work areas" in the field prior to construction. • When identified as needed as part of the Sec 106 compliance process, have a cultural resources monitor present on-site during construction activities that would take place in close proximity to identified avoidance areas. • Prepare a plan that addresses post-review discoveries (per 36 CFR 800.13) and inadvertent discoveries per (43 CFR 10.4), and ensure project sponsor has a copy on site during implementation and follows the protocol should a cultural resources be discovered during construction.
Indian Trust Assets	• Where effects to ITAs cannot be avoided by project design or other measures, mitigation would be proposed in a site-specific NEPA analysis.
Socioeconomics	• Use local labor and materials, to the extent practicable
Climate Change	• Regularly inspect, maintain, and replace defective emission control devices on all construction equipment.

3 Affected Environment and Environmental Consequences

This chapter provides an analysis of the potential effects of the Proposed Action and the No Action Alternative on the human environment. It includes discussions of the environment that would be affected by the actions proposed in Chapter Two.

Chapter overview

The "Environmental Consequences" discussion is presented in three sections:

1. Effects common to construction actions. This effects discussion is structured around the progression of implementation actions common to projects that include construction activities.
2. Specific effects for each category of action. This section looks at each category of action in Chapter Two and identifies effects unique to that action either in the type of effect, or the degree of effect associated with it.
3. Effects by resource type. This section includes a description of the potentially affected environment for a specific resource, and an analysis of the effects of the Proposed Action on that resource. Effects of the No Action Alternative are collectively described in section 3.5. The degree of discussion for each of these resources is informed by the effects described in the prior two sections. Effects on specific resources are characterized as "high", "moderate", "low", or "no impact". Beneficial effects are noted. Effects are also described as "short-term" or "long-term". For this analysis "short-term", or "temporary" would be considered as one construction season, usually 2 to 12 weeks in mid- to late- summer or early fall. Some large projects may require two or more construction seasons, but these are very uncommon. "Long-term" is considered to be decades or scores of years.

Not all areas or resources in the Basin are described in detail

The third section of Chapter 3 includes a discussion the "Affected Environment" for each resource. The analysis focuses on the types of locations and resources within the Basin most likely to be affected by the Proposed Action, rather than providing a detailed description of all the Basin's resources. Proposed restoration actions are not uniformly distributed across the tributaries in the Basin.

Similarly, sensitive resources are not uniformly distributed across the basin. Some listed species, for example, are only located in specific stretches of river or in specific valleys or counties. If those specific locations do not coincide with potential action areas, there would be no effects, and thus limited discussion within this chapter.

Natural Resource Effects are well understood

The effects of the actions described in this chapter are well known and understood. The Agencies and other federal agencies (*e.g.*, U.S. Forest Service (USFS) and Bureau of Land Management (BLM)) have evaluated, funded, implemented, and monitored hundreds of these types of actions throughout the western states over the past 20 years. These types of actions have been the subject of numerous site-specific NEPA analyses and consultations under ESA, and the information gained from monitoring and evaluation has been used to inform and refine the design criteria and mitigation measures that are integral to the actions proposed.

Efficiencies gained by use of this Programmatic EA

An effect common to all actions described in Chapter Two would be the increased efficiency this analysis provides in moving projects from conception to implementation. As discussed in Section

1.2, delays for detailed effects analysis and public disclosure as required by NEPA could be reduced by tiering site-specific analyses to this programmatic assessment. Assessments of routine actions with predictable impacts for each project would be efficiently tiered to this programmatic assessment, which could reduce by months or years the time it might otherwise take to implement habitat improvements. This would increase land and project managers' ability to implement more habitat actions, and within timeframes, sequences, and at a pace more conducive to achieving meaningful results for the resource. The long-term and cumulative benefits of these improvements to species and habitats would thus be able to accrue more rapidly that they might have other wise.

Short-term adverse effects to achieve long-term beneficial effects

The implementation of the Proposed Action is intended to improve habitat for the benefit of fish and wildlife over the long term. To achieve those long-term benefits, physical changes to streams, rivers, floodplains, and uplands would need to be made. The Proposed Action, therefore, would create some unavoidable, short-term, minor to moderate adverse effects such as increased stream turbidity and riparian disturbance in order to gain the more permanent habitat improvements. In general, each action would create adverse temporary effects that may last for hours, days, or weeks, to achieve the beneficial long-term effects that are expected to last for decades. These are primarily the effects discussed in this chapter with the recognition that design criteria and mitigation measures (Section 2.4 and Appendices A and B) would help reduce the scale, intensity, and duration of these effects and are therefore integral elements of the Proposed Action.

3.1 Effects Common to Construction Activities

The habitat improvement actions would have long-term beneficial effects to both aquatic and terrestrial habitats at both the project/site scale and the watershed scale. As stated above, however, many of the actions would include activities that create short-term adverse effects to fish and wildlife and their habitat. Many projects would require one or more actions related to pre-construction, site-preparation, construction, operation and maintenance, and site restoration with direct physical, chemical, visual, and auditory effects.

As discussed in Chapter 2, each project would be constrained as appropriate by the application of general mitigation measures applicable to all actions as detailed in Appendix B, and by action-specific design criteria and mitigation measures (if any) as detailed in Appendix A or as identified through various compliance processes. Mitigation measures for herbicide applications for invasive plant control are detailed in Appendix C. These measures would minimize each actions' effects. The effects discussions below, however, describe effects that are possible, and include those minimized or prevented entirely by these measures. Where effects descriptions for some actions below seem to indicate a high level of effects, statements are included about their minimization by mitigation measures and best management practices, but it should be recognized that such effect minimization would be prescribed for all actions.

3.1.1 Pre-construction

Pre-construction activity includes surveying, minor vegetation clearing, placement of stakes and flagging guides, and minor movements of machines and personnel within the action area. The effects of these actions relate to vehicular traffic and human presence, which have minimal impact on natural resources.

Vehicular traffic would introduce noise and emissions, and damage vegetation in off-road travel. Foot traffic would occur across vegetation, streambanks, and through streambeds. Minor amounts of vegetation might be disturbed or removed; aquatic and terrestrial wildlife would be disturbed and minor amounts of instream gravels, plants, and animals would be displaced or trampled. Minor amounts of sediment could be produced from foot travel in streams.

Foot and off-road vehicle travel may have potential to disturb certain kinds of sensitive cultural resources. The Section 106 consultation process, as required for compliance with NHPA (Sections 2.2.2 and 3.3.11), would identify this potential and avoid or minimize this impact.

3.1.2 Site Preparation

The next stage, site preparation, would begin the modification of the vegetation and ground surface at a project site. These existing soil and vegetative conditions provide some measure of resource function and value at a project site, though such values were likely deemed as needing improvement. Nonetheless, site preparation activities would remove vegetation and modify the ground surface would reduce or eliminate those resource and habitat values, at least for the short term (Darnell 1976, Spence *et al*. 1996).

Site preparation, typically requires development of access roads and the construction of staging and materials storage areas. These actions require earthwork to clear, excavate, fill, and shape the site for its eventual use. These site-preparation actions produce more intense effects than preconstruction. Heavy equipment use would remove vegetation (possibly including trees); displace, mix, and compact soils; and temporarily introduce higher amounts of emissions, noise, and the potential for fuel, lubricant, and hydraulic fluid spills and drips. These actions would modify terrestrial habitats and create bare-soil areas that would allow rainfall to strike bare earth, creating the potential for erosive runoff.

Heavy equipment use would compact soil, thus reducing soil permeability and infiltration by storm-water. New impervious surfaces allow for faster and increased delivery of soil and contaminants in storm-water runoff, causing impaired water quality.

Denuded areas lose organic matter and dissolved minerals, such as nitrates and phosphates. The microclimate would become drier and warmer with a corresponding increase in soil and water temperatures. Loose soil could temporarily accumulate in a construction area, and in dry weather, this soil could be dispersed as dust. In wet weather, loose soil could be transported to streams by erosion and runoff, particularly in steep areas. Loose soil in aquatic habitats could increase turbidity and sedimentation. This effect would be amplified during high-frequency and high-duration flow events.

Loss of vegetation on the project site could increase the rate of transport of water to streams during rain events, which could lead to higher peak flows. Higher stream flows would increase stream energy that scours stream bottoms and transport greater sediment loads farther downstream than would otherwise occur. Sediments in the water column would reduce light penetration, increase water temperature, and modify water chemistry. Once deposited, sediments could alter the distribution and abundance of important instream habitats, such as pool and riffle areas. During dry weather, the physical effects of increased runoff would appear as reduced ground water storage, lowered stream flows, and lowered wetland water levels.

Removal of vegetation may also have negative impacts to cultural resources, especially if it is done with heavy equipment that tears up the roots of trees and shrubs. This could reduce the integrity of archaeological resources that lie within the area where the removal is being conducted. Furthermore, traditionally important plants including shrubs like willow, serviceberry, chokecherry, and other species, may contribute to the integrity of cultural resources that have traditional cultural value. Removal of plants that have traditional uses may minimize the ability of Native Americans to utilize these areas in a traditional manner. Consultations with tribes, as required for compliance with Section 106 of the NHPA (Section 2.2.2 and 3.3.11), would identify this potential and likely minimize this impact.

General mitigation measures are included as part of the Proposed Action (Appendix B) that would reduce the degree and extent of these effects.

3.1.3 Construction

The direct effects of construction activities include those described above for pre-construction, but involve substantially greater use of heavy equipment for vegetation removal and earthwork. During construction, there would be a greater extent and higher degree of soil displacement. Construction equipment would be used to entirely reshape and realign stream beds and banks, and to regrade floodplains; some construction actions are limited to the placement footprints of large wood or other structure placements.

The combination of soil compaction, erosion, and mineral loss from heavy equipment operation can reduce soil quality and site fertility in upland and riparian areas. There would be a greater potential for the mixing of soil horizons as well, mitigation measures would minimize this by requiring the segregation, storage, and protection of topsoil for post-construction restoration purposes (Appendix B).

It is also likely that some degree of in-stream work would be required to complete some activities (*e.g.,* fish passage restoration; river and stream restoration, etc.). In-stream work could compact or dislodge channel sediments, thus increasing turbidity and allowing currents to transport sediment downstream where it is eventually redeposited.

Discharge of construction water used for vehicle washing, concrete washout, pumping for work area isolation, and other purposes could carry sediments and a variety of contaminants to the riparian area and stream.

3.1.3.1 De-Watering for In-Stream Work

The most impactful action with the most lethal biological effects to aquatic species would likely be caused by the in-stream work necessary for many stream restoration projects. For many such actions, the in-stream work area is isolated from the stream's flow using instream barriers to route the stream's flow around it. For some major restoration projects, however, the stream itself must be temporarily relocated from the existing degraded channel so that a properly-functioning channel can be created and then receive back the stream's flows.

To accomplish this, a temporary bypass channel would be constructed (using a ditch or a culvert) with sufficient dimensions to route the river or stream's flows around the construction area. This would produce all the effects from heavy equipment operation described above. Temporary dams are erected upstream (to divert flow into the bypass), and downstream (to keep water from flowing into the work area) which produces the in-stream work effects discussed above.

Prior to dewatering, fish would be removed (termed "fish salvage") from the work area to be dewatered and relocated up or downstream as safely as possible[20]. This process may result in injury or death to individual fish, though Appendix B includes specific mitigation measures to minimize harm to fish during any dewatering process. The work area would then be dewatered using natural flow and then kept dewatered by pumping throughout the work period.

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[20] Appendix A includes specific measures to be rigorously followed to minimize harm to fish during any dewatering process.

Once dewatered, construction activities commence within the now-dry stream bed, often using heavy equipment. The dewatering and earthmoving that occurs in these former stream beds may be lethal to all organisms not able to relocate or be relocated prior to the construction activity.

Following instream restoration construction actions, water would be gradually reintroduced into the dewatered work area. Because of the heavy equipment operations in this work area, the stream bed would have loose soils in the bed and along the banks that would be subject to erosion with the newly reintroduced flows. There would be a pulse of sedimentation into the stream or river upon re-watering. Mitigation measures require that re-watering would be gradual by stages, with close monitoring of erosion and turbidity effects to minimize this impact as much as possible. The degree of this effect and its duration is highly variable, being dependent on the type of substrate in the stream bed and the characteristics of the flow being reintroduced.

Though highly impactful, the isolation of in-water work areas minimizes lethal and sub-lethal effects that would otherwise be greater without it. In-water work-area isolation is itself a mitigation measure intended to reduce the adverse effects of construction activities within a stream course (See Appendix B).

3.1.3.2 Concrete work

Concrete structures are a common feature in restoration actions, be they for new bridges, irrigation diversions, fish screens, etc. Many structures are precast, and placed on site using heavy equipment. Some structures, however, require the forming[21] and pouring of concrete on site.

Fresh concrete and cement-related mortars are toxic to fish and the aquatic environment. The lime found in cement and concrete products easily dissolves in water. It is alkaline, and water that comes into contact with concrete slurry, cement, or uncured concrete becomes strongly alkaline, and deadly to aquatic organisms, including fish. Mitigation measures, however, would minimize this potential for this effect. They require that concrete must be sufficiently cured or dried (48-72 hours depending on temperature) before coming into contact with stream flow to minimize the potential for this effect to water quality and the toxic effect on fish. The mitigation measures also require that concrete wash water be contained and not allowed to enter flowing or standing waters (Appendix B).

The degree of potential effects from construction actions for restoration projects differs based on the purpose and location (in relation to a waterway) of each activity, as discussed in Section 3.2 below.

3.1.4 Site Restoration

The final stage of project activity is site restoration; this stage involves the restoration of ecological function and habitat-forming processes to maintain or launch the site along a trajectory toward conditions that support functional aquatic, riparian, wetland, and terrestrial habitats. For projects that only installed, modified, relocated, or removed artificial structures, this stage may simply be the final shaping and revegetation of land surfaces. For other projects, this site restoration phase would entail the reshaping of stream courses, stream beds, and banks, or placement of instream structures to restore natural function and processes after problematic stream or floodplain conditions were addressed in the construction phase.

The physical and chemical effects of post-construction site restoration included as part of the proposed activities are essentially the reverse of the construction activities that go before it. Site

[21] "Forming" is the erection of wooden structures designed to shape poured concrete into its intended form.

restoration may include the reshaping of streambanks as necessary for successful hydrologic function and revegetation. Additional actions require bioengineered solutions that include vegetation and large wood as the major structural elements to increase bank strength and erosion resistance to restore riparian function and allow habitat to develop, and allow the banks to respond more favorably to hydraulic disturbance than conventional approaches that used hard, inflexible, engineered structures. This streambank work would routinely require heavy equipment use, and though the effects and risks of this use is the same as described above, this shaping and construction work is designed to establish an effective foundation for natural hydraulic action to restore the stream course and banks; and for plantings that provide for vegetative recovery.

Bare earth would be re-vegetated by seeding, planting woody shrubs and trees, hydroseeding, and mulching with certified weed-free materials. This is often handwork, with minimal effects to resources. Hydroseeding is accomplished using a truck-mounted tank/pump/hose system, however, and the truck may travel off road to reach application sites; off-road travel would compact soils and damage existing vegetation.

3.1.5 Construction Activity Effects Summary

The risk of the impacts discussed above concerning site preparation, preconstruction, construction, and restoration would exist throughout the project area until project completion and final designed restoration features have been put in place. This time period is routinely less than one year and most often during the dry, low-flow, months with completion before winter and the following years' high flows. Projects that require more than one construction season would have protection measures in place to protect resources during fall, winter, and spring rains and increased flows. Implementation of mitigation measures in Section 2.4 and Appendices A and B, would reduce, but likely not eliminate, the risk of soil erosion and increased sediment inputs to streams during this period.

3.2 Effects Specific to Categories of Action

The short-term construction-related effects as described above would be applicable to nearly all the categories of action discussed here. This section will describe the long-term beneficial effects likely, and intended, by the funding and ultimate implementation of actions with in the categories of actions displayed in Chapter Two. Short-term adverse effects unique to actions within these categories that were not addressed in the general construction effects discussion above will be disclosed here.

3.2.1 Effects of Fish Passage Restoration (Category 1)

This activity category is divided into two sections: transportation infrastructure and profile discontinuities[22]. Under transportation infrastructure, the Agencies propose to fund activities to improve fish passage, prevent bank erosion, and facilitate natural sediment and wood movement. Included activities are bridge and culvert removal or replacement, bridge and culvert maintenance, and the installation of fords. The effects related to general pre-construction and construction actions described above would apply here.

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[22] A stream's "profile" is the gradient of a stream channel. A "discontinuity" in that profile refers to a break in the smooth slope of that profile, such as a headcut, small waterfall, or gap between the end of a culvert and the stream bed below.

In addition, the periodic maintenance of culverts and ditches would ensure fish passage and floodplain connectivity; allow for dynamic flow conditions; and maintain access to spawning, rearing and resting habitats for aquatic species, including ESA-listed trout, salmon, and steelhead.

The installation of properly designed culverts and bridges would increase the fluvial transport of sediment that is needed to form diverse habitats. The bridges and properly sized culverts would enable additional recruitment of wood to downstream reaches compared to current conditions. The new culverts would reduce the probability of catastrophic damage to aquatic habitats that is often associated with undersized culverts during extreme high flows and large movement of wood. The installation of new culverts should also increase the stability of the streambed.

Fish passage restoration activities that address profile discontinuities include: removal of a dam, water control, or legacy structure; consolidation or replacement of existing irrigation diversions; headcut and grade stabilization; removal of trash, artificial debris dams, sediment bars or terraces that block or delay fish passage; low flow consolidation; and providing fish passage at an existing facility. These activities involve substantial in-water work, and general pre-construction and construction effects to habitat.

These activities would benefit habitat by removing impediments to passage for flow, sediment, wood, and fish. Removing barriers allows access to unoccupied spawning and rearing habitat, or allows occupancy during more flow conditions. Removing or consolidating large instream structures would facilitate the release of bedload materials as the structures are notched or removed; this would cause immediate increases in suspended sediment and turbidity, and may degrade downstream habitat for a short period of time. Long-term effects include increased access to spawning, rearing and migration habitat above the site, increased gravel recruitment for spawning downstream of the project site, and increased floodplain connectivity and channel migration capacity.

Removal of in-stream barriers would be accomplished by blasting and/or mechanical means. Blasting has the potential to harm or kill fish and other aquatic species from its concussive impacts, but mitigation measures in Appendix A would minimize this effect as much as possible. Mechanical operations in or along a live watercourse to remove in-stream barriers would have the potential to affect that water course and its surrounding riparian areas, if any, as described in Section 3.1.

Effects of fish passage restoration would be minimized and mitigated by application of design criteria and conservation measures in Appendix A and by applying any mitigation measures unique to the action as exemplified in Section 2.4. Though there would be construction-related impacts for nearly every action in this category, they would be small scale, short-term, with full restoration of functional aquatic and riparian conditions once completed. The effects of fish passage restoration actions would be low.

3.2.2 Effects of Improving River, Stream, Floodplain, and Wetland Habitat (Category 2)

The Agencies propose to fund actions that would improve secondary channels and wetland habitats; set back or remove existing berms, dikes, and levees; protect streambanks using bioengineering methods; install habitat-forming instream structures using native materials; plant riparian vegetation; and reconstruct stream/river channels. These activities would aid in the re-establishment of hydrologic regimes, increase the area available for rearing habitat for fish, improve access to rearing habitat, increase the hydrologic capacity of side channels, increase channel diversity and complexity, provide resting areas for fish at various levels of inundation, provide flood water attenuation, increase floodplain nutrient and sediment storage, and establish and augment native plant communities.

The long-term effects of this activity category would include improved habitat conditions, and habitat-forming processes. Increased vegetation and habitat complexity would improve thermal regulation, hydrologic and nutrient cycling, channel formation and sediment storage, floodplain development and energy dissipation. Streambank stabilization would be achieved using large wood and vegetation to improve bank strength and resistance to erosion (Mitsch 1996, WDFW *et al*. 2003).

Bioengineered bank treatments would be applied that develop root systems that are flexible and regenerative, and respond more favorably to hydraulic disturbance than conventional hard alternatives. This type of bank treatment and the installation of instream wood structures promote channel complexity, through pool formation, gravel and organic material retention, velocity disruption, and cover (Carlson *et al*. 1990, Bilby and Ward 1989, Beechie and Sibley 1997). Instream structures dissipate stream energy, thus reducing the erosive force of the stream on vulnerable banks, and provide areas for pools and gravel bars to form.

Excavating new channels or reconnecting historical stream channels have a risk of failure during high flows; they could be filled with sediment, or supporting large wood structures could be washed downstream. The risk of channel avulsion would be greatest during the first year after channel construction, and would decrease as riparian vegetation becomes established and floodplain roughness[23] increases. However, mitigation measures and ESA consultation design reviews[24] are prescribed to minimize or eliminate these risks. These projects would be designed to achieve restoration goals and to minimize the risk of failure. Also, all projects that involve streambank excavation resulting in bare earth exposure would include erosion controls, revegetation plans, and riparian fencing if appropriate. All in-water construction would occur during the site-specific, in-water work windows[25] to minimize effects to anadromous fish spawning and migration. Despite implementation of minimization measures, these actions would likely create pulses of suspended sediment which could result in localized areas of increased turbidity and, ultimately, areas with fine sediment deposition.

Invasive species control actions to increase prey availability and functional spawning habitat would produce effects from targeted removal actions (e.g. electrofishing or sport fishing bounty programs). The long-term beneficial effect of these treatments would be an increased availability of prey species and reduced competition and redd destruction on spawning gravels. There would also be the desired effects of reduced predation on, and reduced genetic dilution of, ESA-listed species.

Angler bounty programs that encourage the targeted removal of non-native species through sport fishing could increase fishing pressure in targeted waters. This increased pressure would result in more fish caught: both the non-native target fish and native non-target fish caught while pursuing target fish. Fishing techniques (tackle, technique, and timing) are specific to the species sought, so the catch of non-target species would be anticipated to be minimal. There would also likely be increased boat traffic and human presence in target locations, but these would be anticipated to create only minor impacts on the aquatic and shoreline environments.

[23] Floodplain roughness is a term used to describe the presence of vegetation, logs, rocks, or other structures or vegetative debris on a floodplain's surface that serves to slow the flow of flood waters allowing the deposition of sediments and the infiltration of water into the ground.

[24] The programmatic ESA consultation process under HIP IV requires design reviews by Bonneville, NMFS, and USFWS engineers and biologists for high and medium risk projects.

[25] In-water work windows are periods of time designated by state fish biologists when instream work would be least likely to harm ESA-listed fish species.

Improved streams, floodplains, and wetlands would also improve scenic values by restoring streams to more natural configurations and expanding riparian vegetation cover. Restored floodplain function and stream migration allows people to witness how watersheds behave, and allows people to view and interact with the rivers in ways that have not been possible in hundreds of years. For Native Americans, this opportunity may be valued as part of their connection to their ancestral lands.

Effects of actions improving river, stream, floodplain, and wetland habitat would be minimized and mitigated by application of design criteria and conservation measures in Appendix A and by applying any mitigation measures unique to the action as exemplified in Section 2.4. There would be construction-related impacts for nearly every action in this category, and some could potentially impact up to 100 acres or more and span two or more construction seasons. These impacts, however, are comparatively short term (normally one construction season, late summer to early fall, and would be addressing adverse effects that have been in place for many decades) and there would be full restoration of functional aquatic and riparian conditions once completed. A very few projects may extend over one to three years, but mitigation measures call for protection against erosion and sedimentation and would protect resources during winter months. The effects of improving river, stream, floodplain, and wetland habitat actions would be low to moderate.

3.2.3 Effects of Invasive Plant Control and Vegetation Management (Category 3)

3.2.3.1 Effects of Managing Vegetation using Physical Control

Manual and mechanical treatments would likely to result in short-term restoration construction effects (Section 3.1). Hand pulling of emergent vegetation would likely result in localized turbidity and mobilization of fine sediments. Treatment of knotweed and other streamside invasive species with heavy machinery would likely to result in short-term increases in fine sediment deposition or turbidity when treatment of locally extensive streamside monocultures occurs. Thus, these treatments would be likely to affect a definite, broad area, and produce at least minor damage to riparian soil and vegetation. In some cases, this would decrease stream shade, increase suspended sediment and temperature in the water column, reduce organic inputs (*e.g.*, insects, leaves, woody material), and alter streambanks and the composition of stream substrates. However, these circumstances would be likely to occur only in rare circumstances, such as treatment of an invasive plant monoculture that encompasses a small stream channel. This effect would vary depending on site aspect, elevation, and amount of topographic shading, but would be likely to decrease over time at all sites as shade from native vegetation is reestablished.

3.2.3.1 Effects of Managing Vegetation using Herbicides

When an herbicide is used to control weeds, some of the compound ends up in the environment, whether it is in the soil, water, atmosphere, or in the decomposing species that was targeted (Kudsk and Streibig 2003). Due to the widespread use of these chemicals over the years, there has been an accumulation of these residues in the environment, which is causing alarming contaminations in the ecosystems (Parsons *et al*. 1988)] and negative damages to the biota. Herbicides are designed to be highly toxic to target species, but they can also be toxic, at different levels, to non-target species (Bolognesi and Merlo 2011)

The Agencies' proposed use of chemicals to control non-native plants is structured so as to minimize the risk of adverse effects on non-target species and aquatic habitats. Mitigation measures guide chemical and fuel transport and storage; and emergency spill plans would be implemented to reduce the risk of an accidental spill of chemicals or fuel. A catastrophic spill, however, could have the potential for substantial adverse effects to water quality, aquatic species, and their habitat. No spills have occurred on Agency funded projects since at least 2003[26], and the risk of an accidental spill is judged to be low as long as the mitigation measures are followed strictly (NMFS 2013).

Bonneville prepared an environmental fate and risk assessment for herbicide use to disclose the scope and effects of the proposed noxious weed control at the project, watershed, and subbasin level for its HIP consultation under ESA (see Footnote 2, Section 2.1). In addition, NMFS analyzed the effects of the proposed activities using similar active ingredients and mitigation measures that were proposed for BLM and Forest Service invasive plant control programs (NMFS 2010, NMFS 2012). Those risk assessments and analyses are incorporated here by reference, and the effects presented here and in Section 3.3.1.2.2.3, below, are summarized from those past analyses.

3.2.3.1.1 Herbicide applications and terrestrial species

The primary potential impacts from herbicide use would be to non-target terrestrial plants and animals as a result of intended herbicide application, and any unintended direct application or spray drift. Unintended direct spray could result in an exposure level equivalent to the application rate, and it is plausible that some non-target plants within and adjacent to an application site could be sprayed directly. Unintended direct spray at a full application rate would result in mortality to plants sprayed. Herbicide may also be transported off-site by percolation, runoff, or by wind erosion of soil and contact with other plant species thereby. Effects to vegetation (both "target" and "non-target") directly sprayed would likely be high, since the killing of vegetation is the purpose for this action, but application of the prescribed mitigation measures would minimize exposure of non-target species outside of any treatment area such that effects there would be low to moderate.

Direct exposure of terrestrial wildlife to applied herbicides can occur when mammals and birds contact chemical residues with their skin or eyes or when they inhale vapors or particulates. Small resident mammals such as mice would likely be present when herbicide is applied and could receive direct contact; medium and large-sized mammals (such as coyotes and deer) would likely flee the site before any direct contact with spray. Indirect exposure to mammals and birds can occur through dermal contact with contaminated vegetation, grooming activities, or ingestion of contaminated vegetation, prey species, or water. A wide range of exposures can be anticipated from the consumption of contaminated vegetation with the highest exposures immediately after application. Such exposures, however, are unlikely to be lethal because the herbicides and application rates proposed in this action are structured to be less than known levels of toxicity; and chronic exposure over a long period of time is unlikely given the short, singular, annual seasons of application and the naturally short life-span of small animals likely to receive direct exposure. Effects on wildlife would be moderate.

Use of herbicides may have an impact on Native American traditional plant foods and medicine gathering. Native peoples have been known to stop harvesting in areas where herbicides have been applied, and have expressed concerns about the impacts on health from chemical toxicity. They have also reported that medicinal plants that have been gathered from herbicide treated areas are less effective.

3.2.3.1.2 Herbicide applications and contamination of aquatic habitats

Many herbicides and pesticides are detected frequently in freshwater habitats within the four western states where ESA-listed Pacific salmonids are distributed (NMFS 2011b). In general, when herbicides contaminate the aquatic ecosystem, they can cause deleterious effects on the organisms in that environment; and organisms that live in regions impacted by these substances, whose

[26] The year 2003 was the beginning of formal monitoring of these actions under the HIP consultation.

breeding period coincides with the application period of the herbicides, suffer serious risks of development and survival of their offspring (Marin-Morales *et al*. 2013). Herbicide applications would be conducted according to the mitigation measures in Appendix C and any conservation measures prescribed from ESA consultations, so all applications would be timed and conducted to minimize the impacts discussed in the following paragraphs to ESA-listed fish, and thereby, most other species.

NMFS (2011b) identified three scenarios by which herbicide can come into contact with, and affect, aquatic habitats and species: (1) Runoff from riparian application; (2) application within perennial stream channels; and (3) runoff from intermittent stream channels and ditches. This s*surface water contamination* with herbicides can occur when herbicides are applied intentionally or accidentally into ditches, irrigation channels or other bodies of water, or when soil-applied herbicides are carried away in runoff to surface waters. Direct application into water sources is generally used for control of aquatic species. Accidental contamination of surface waters can occur when irrigation ditches are sprayed with herbicides or when buffer zones around water sources are not wide enough. In these situations, use of hand application methods would greatly reduce the risk of surface water contamination.

The level of contamination from runoff would vary depending on site and application variables, although the highest pollutant concentrations generally occur early in storm-runoff periods when the greatest amount of herbicide is available for dissolution (Stenstrom and Kayhanian 2005, Wood 2001). Lower exposures are likely when herbicide is applied to smaller areas, when intermittent stream channel or ditches are not completely treated, or when rainfall occurs more than 24 hours after application. Under the Proposed Action, some formulas of herbicide could be applied within the bankfull elevation of streams, in some cases up to the water's edge. Any juvenile fish in the margins of those streams would likely be exposed to herbicides as a result of overspray, inundation of treatment sites, percolation, surface runoff, or a combination of these factors. Overspray and inundation would be minimized through the use of dyes or colorants.

Spray and vapor drift are additional pathways for herbicide entry into aquatic habitats. Several factors influence herbicide drift, including spray droplet size; wind and air stability; humidity and temperature; physical properties of herbicides and their formulations; and method of application. For example, increases in wind velocity increases the amount of herbicide transported from the target area and increases the distance the herbicide moves. Under inversion conditions, when cool air is near the ground and beneath a layer of warm air, little vertical mixing of air occurs and spray drift can be severe, since small spray droplets would fall slowly and move to adjoining areas even with very little wind. Low relative humidity and high temperature cause more rapid volatilization of spray droplets between sprayer and target which reduces droplet size, increasing the potential for spray drift.

The formulation and volatility of the compound also affect the potential for vapor drift, with the potential being highest with ester formulations at high air temperatures with low humidity. Even after application, ester-based phenoxytype herbicides can still release vapor from the leaf surface of sprayed plants (DiTomaso *et al.* 2006). Even a few days after spraying, when temperatures go above 75°F, 2,4-D ester chemicals can evaporate and drift as vapor.

Herbicide droplet size, and the distance it must travel from applicator to target plant are also key variables in vapor drift. When herbicides are applied with a sprayer, nozzle height controls the distance a droplet must fall before reaching the weeds or soil. Less distance means less travel time and less drift. Wind velocity often increases as height above ground increases, so droplets from nozzles close to the ground would be exposed to lower wind speed. The higher that an application is made above the ground, the more likely it is to be above an inversion layer that would prevent herbicides from mixing with lower air layers and thus increase long-distance drift.

Several proposed mitigation measures address these drift variables by requiring that herbicide treatments be applied using ground equipment or by hand, under calm conditions, and preferably when humidity is high and temperatures are relatively low. Ground equipment reduces the risk of drift, and hand equipment nearly eliminates it.

Groundwater contamination is another important pathway to aquatic species contact. Most herbicide groundwater contamination is caused by “point sources,” such as spills or leaks at storage and handling facilities; improperly discarded containers; and rinses of equipment in loading and handling areas, often into adjacent drainage ditches. Point sources are discrete, identifiable locations that discharge relatively high local concentrations. Proposed mitigation measures minimize these concerns by ensuing proper calibration, mixing, and cleaning of equipment. Non-point source groundwater contamination of herbicides is relatively uncommon but can occur when an herbicide that can be mobile in the environment is applied in areas with a shallow water table. Proposed mitigation measures minimize this risk by restricting the formulas used, and the time, place and manner of their application to minimize offsite movement.

Further discussion of effects of herbicide application on aquatic species and their habitat is found at Section 3.3.1.2.2.3.

As with the terrestrial species, the effect of herbicide applications (including strict adherence to the mitigation measures) on non-target species in wetland or aquatic environments would be moderate.

3.2.3.1.3 Herbicide applications and human exposures

Application of herbicides as proposed here, with full application of mitigation measures, would not result in spray hitting local residents, water sources, gardens, etc. Human behavior, however, cannot be controlled, and even with proper application there is potential for humans to come in contact with the compounds. It is possible people may walk into a treatment area during or after application even if adequate signage and other measures are taken to prevent such exposure. Workers that handle and apply the herbicides would likely be exposed but would be protected by appropriate personal protective equipment. However, careful application of the mitigation measures would prevent or minimize exposures, and if exposure did occur, the concentration and toxicities would be low such that effects on humans would be low.

3.2.3.2 Effects of Juniper Removal

Juniper removal entails the cutting or girdling of juniper to reduce the density of juniper across a landscape or just along a stream corridor. The killed juniper may sometimes be removed or burned, but more often it would be retained where it was felled. Short-term adverse effects include the noise and disturbance of chainsaw use; and the soil and vegetation disturbance from falling trees. There could be a loss of streamside shade if activity occurs along stream courses; and the loss of nesting and roosting habitat for birds and cover for wildlife. If trees are hauled away, then there would be the soil and vegetation disturbance from off-road vehicle travel and from dragging and loading the felled trees. If juniper removal was accomplished by burning then the effects from burning activities (discussed below) would be realized. All of these affects would be short-term until intended vegetative conditions are restored. The purpose of this treatment is to increase soil moisture, thereby improving conditions for a plant species composition and structure that would be expected under natural fire regimes.

Long-term effects from juniper removal stem from the increase in moisture available for other plant species. Removal of juniper can increase soil moisture levels and thereby provide conditions that could increase densities of native grasses and shrubs; and provide for a more diverse plant community. In riparian areas, a riparian vegetation community could be restored. This habitat modification would provide more habitats for migratory birds and an increased carrying capacity for big game on winter ranges.

Increased vegetative ground cover would be anticipated within just a few years which would increase water infiltration rates, decrease overland flow, and thus decrease the site's erosion potential. Increased infiltration rates, and reduced evapotranspiration losses (from a reduced density of trees) would increase water available for streams, increasing their flow during dry summer months.

A reduction in the density of juniper across a landscape and along a riparian corridor where such densities are high, would reduce also the potential for high-intensity, stand-replacing wildfires.

In areas proposed for juniper removal, all trees exhibiting old growth characteristics would be retained for birds and other wildlife benefit (Appendix A). Wildlife benefits of old-growth juniper include thermal cover and low quality forage for ungulates. Juniper is typically used for forage when nothing else is available. Western juniper berries provide an important source of food for Townsend's solitaires, American robins, mountain bluebirds, Cedar waxwings, Stellar's jays, and scrub jays (Lederer 1977, Solomonson and Balda 1977, Poddar and Lederer 1982). Cavity nesters also make use of juniper cavities.

3.2.3.3 Effects of Prescribed Burning

The direct short-term effects of prescribed burning include the disturbance, displacement, and mortality of wildlife, the destruction of live vegetation, and the consumption of dry vegetative material such as forest litter, downed logs, and standing snags. There would be the creation and distribution of smoke. Though prescribed burning (including that for disposal of slash after juniper removal) would utilize only low and moderate severity fire, some small sites might experience a high intensity burn such as where a downed, dry, log would have been consumed. Such sites would likely experience a loss of soil productivity from the damage to the organic layer in the soil where soil organisms are killed and organic material is fully consumed.

There would be a loss of ground cover, and the risk of erosion would be increased in the first year or two following the burn. This erosion could deliver sediment to streams with turbidity and sedimentation impacts likely. The degree of this effect would be dependent on the scale of the burn, the fire's intensity, the topography of the site, the nature of the storm event, the type and condition of the surrounding soils, and the nature of the stream and its fish habitat and use. This reduction of ground cover would also facilitate the identification of previously unrecorded cultural resources, the incorporation of cultural resources survey following prescribed burns could increase awareness of these resources and inform future project and management actions.

Professionally-developed prescribed-burn plans are required for each treatment with the intention of applying practices that would keep the fires at low to moderate intensity and minimize the risk for adverse effects as described here.

Properly conducted prescribed burns would leave site productivity intact and vegetation would be expected to start returning with the first rainfall, usually in the fall. There would be a flush of nutrients available to support plant growth in the following spring and summer, when a more diverse and productive plant community would be expected to develop.

3.2.3.4 Effects of No-Till and Conservation Tillage Systems

One of the main objectives of conservation tillage systems is to maintain crop residue on the soil, which ensures that organic matter accumulates near the soil surface. The soil surface is not tilled, so there are fewer compaction and horizon-mixing impacts to the soil. Water infiltration, runoff, and erosion are among the main reasons for adopting conservation tillage systems. Generally, this practice increases water infiltration, reduces soil sheet erosion and non-point pollution, thereby reducing turbidity concerns in nearby streams and other waterways. Soil quality is also improved by the retention of organic matter and the increase in microbial activity near the soils surface where plants can benefit. The accumulation of organic matter increases soil microbial activity by providing the microbes with a source of energy in the form of carbon compounds.

3.2.3.5 Summary of Effects of Invasive Plant Control and Vegetation Management Actions

Most invasive plant control and vegetation management actions would have no ground-disturbing activity. Herbicides would be sprayed, fire would be applied, cut vegetation would be retained, but no soil would be turned and no heavy equipment would be operated. Juniper removal would be the exception, but even there, the impacts would be on a very small scale – mostly around each tree. Herbicide effects would be minimized by application of the mitigation measures in Appendix C. Fire effects would be minimized by the development and application of an appropriate burn plan and prescription. Thus, the effects of invasive plant control and vegetation management would be low.

3.2.4 Effects of Piling Removal (Category 4)

Piles are removed using a vibratory hammer, direct pull, clam shell grab, or cutting/breaking the pile below the mudline. Vibratory pile removal causes sediments to slough off at the mudline, resulting in some suspension of sediments and, possibly, contaminants. Old and brittle piles may break under the vibrations and require use of another method. The direct pull method involves placing a choker around the pile and pulling upward with a crane or other equipment. When the piling is pulled from the substrate, sediments clinging to the piling slough off as it is raised through the water column, producing a plume of turbidity, contaminants, or both. The use of a clamshell may suspend additional sediment if it penetrates the substrate while grabbing the piling. If a piling breaks, the stub is often removed with a clam shell and crane. Sometimes, pilings are cut, broken, or driven below the mudline, and the buried section left in place. This may suspend small amounts of sediment, providing the stub is left in place and little digging is required to reach the pile. Direct pull or use of a clamshell to remove broken piles is likely to suspend more sediment and contaminants.

Piling removal would re-suspend sediments that are inevitably pulled up with, or attached to, the piles. If sediment in the vicinity of a pile is contaminated, or if the pile is creosote-treated, those contaminants would be included in the re-suspended sediments, especially if a creosote-treated pile is damaged during removal, or if debris from a broken pile is allowed to re-enter or remain in the water. Turbidity generated during piling removal would be temporary and would likely only extend a few meters downstream, depending on water flow and characteristics of the streambed material. If sediment in the vicinity of a piling is contaminated, or if the piling had been treated with creosote, polycyclic aromatic hydrocarbon would be released during removal, particularly if the piling breaks. To minimize the potential for adverse effects, mitigation measures, such as the use floating surface booms to collect debris, and operating during low water or low flow periods, would be applied that would limit the extent of sediment plumes or surface debris and contaminant exposure.

The effects of piling removal are likely to include reduction of resting areas for piscivorous birds, hiding habitat for aquatic predators (*e.g.,* large and smallmouth bass) and, in the case of creosote piles, a chronic source of creosote and polycyclic aromatic hydrocarbon pollution.

The potential long-term benefits of piling removal include reduced predation from piscivorous birds and fish; reduced ongoing contamination from treated pilings; and increased area for benthic production and juvenile salmon rearing. The effects of piling removal would be low.

3.2.5 Effects of Road and Trail Erosion Control, Maintenance, and Decommissioning (Category 5)

The effects of actions in this activity category are adequately described in the above Sections 3.1.2 and 3.1.3 where the following potential effects associated with road maintenance and decommissioning activities are addressed:

1) Vegetation removal
2) Erosion and sedimentation
3) Compaction, displacement, and mixing of soil and disturbance of streambeds resulting in sedimentation, increased water turbidity, and increased flows and stream energy
4) Contamination from fuel spills or use of heavy equipment in water or riparian areas
5) Sedimentation and contamination from discharge of construction water
6) Stress to fish from capture and release from coffered areas during isolation of instream work areas; and noise, with resulting avoidance behavior by listed species
7) Changes in flows

Roads and their associated drainage systems can cause accelerated runoff of sediment and contaminated water. However, with the incorporation of the proposed mitigation measures, such as prompt cleaning of ditches and culverts and minimizing disturbance to vegetation in ditches and at stream crossings, the amount of sediment that enters a stream is expected to be small, infrequent, and of short duration. Substrate quality would not be expected to decrease over time. Additional biological effects can include accelerating the introduction of alien plant and animal species by disturbing native vegetation, which can make ecological recovery more uncertain (Gucinski *et al*. 2001). When roads or trails are relocated, riparian shrubs and trees may be cut and excavated to access each site. This stream-shading vegetation removal would have negligible or localized effects on water temperature because of the small amount of vegetation involved.

Asphalt used during resurfacing can leach out hydrocarbons, which can influence pH in water bodies. Because routine maintenance would consist of small road segment patches applied during dry conditions, hydrocarbon leaching would likely not reach water bodies and not be a concern to water quality. Extensive asphalt laying during wet periods would pose a greater risk but would be minimized by mitigation measures in Appendix A.

Dust abatement materials can pose a risk to water quality if not properly applied. The most common dust abatement materials are calcium chloride, magnesium chloride, and lignin sulfonates. Usually, applying calcium chloride or magnesium chloride would not injure fish or degrade water quality beyond background levels of calcium or magnesium. Even where dust abatement materials wash into ditches and streams, effects to water quality would typically not last more than a few hours. Martin (1989) found that contamination from using dust abatement compounds could be reduced by restricting their use within 25 feet of a water body and in areas with shallow groundwater. Using unscreened intake pumps to pump water from streams to use in dust suppression can directly injure fish. Pumping too much water from the stream at once can dewater a section of stream and strand fish. Mitigation measures in Section 2.4 and Appendix B would require screened pumps and prohibit dewatering.

If roads in riparian areas are decommissioned, mitigation measures would ensure that actions such as the removal of culverts or cross-drains, would minimize the potential for sediment movement to aquatic habitat during those construction actions; and be designed to protect aquatic habitats and organisms from possible future sediment movement to streams.

Beneficial effects occur where road maintenance reduces the potential for catastrophic erosion and delivery of large amounts of sediment to stream channels. Severe erosion is almost inevitable if roads are not regularly maintained, and thus regular maintenance is a high priority. Effects of proper road maintenance activities also include the reduction of human disturbance on unstable or sensitive sites.

Road obliteration and decommissioning would be even more beneficial than road and culvert upgrades, in that all or nearly all of the hydrologic and sediment-regime effects of the roads would be removed. Long-term beneficial effects would result from these activities, including rehabilitation of hydrologic functions, reduced risk of washouts and landslides, and reduction of sediment delivery to streams. In the long term, these projects would tend to rehabilitate habitat substrate by reducing the risk of sediment delivery to streams and would restore fish passage by correcting fish barriers caused by roads. Road decommissioning actions would also tend to rehabilitate hydrology by reducing peak flows and reducing the drainage network. Watershed conditions also would be improved as road densities are reduced and riparian reserves are rehabilitated. These actions may also potentially improve floodplain connectivity.

Additional effects of road decommissioning activities include reconnecting natural habitats and excluding human disturbance. Decommissioning a road allows for the recolonization of native flora and fauna, thus increasing the total amount of space available for fish and wildlife, and decreasing the amount of human traffic originally responsible for habitat disturbances. Consequently, native plant communities can reestablish and move towards more properly functioning habitats for fish.

Road and trail erosion control, maintenance, and decommissioning actions would require the use of heavy equipment. This equipment use, however, would be almost entirely within a previously-disturbed road prism with comparatively little native soil and vegetation disturbed; and the effects would be minimized and mitigated by application of design criteria and mitigation measures in Appendix A and by applying any mitigation measures unique to the action as exemplified in Section 2.4. Though there would be construction-related impacts for nearly every action in this category, they would be small scale, short-term, with vegetation restoration and long-term improvement of hydrologic function of the site once completed. The effects of road and trail erosion control, maintenance, and decommissioning actions would be low.

3.2.6 Effects of Nutrient Enhancement (Category 6)

The goal of this activity is to replace, in some measure, the delivery of marine-derived nutrients to upstream tributaries throughout the Columbia River Basin that has been lost along with the reduction of anadromous fish populations. These nutrients have been measured in present-day trees, soils, and sediment substrates in lakes, demonstrating the widespread ecological influence these historical nutrient inputs had on the larger ecosystem in both aquatic and upland habitats.

The immediate goal is to enhance primary and secondary production in streams and lakes (for sockeye salmon rearing); thus, enhancing the prey base for ESA-listed fish, and thereby their growth, survival, and reproduction. A beneficial impact of in-channel nutrient supplementation includes the delivery of marine-derived nutrients into freshwater tributaries which may be important to better growth, increased survival, and increases in salmon populations as well as other animal and plant species. See Section 3.3.1.2.2.6.

Effects due to the use of nutrient supplementation may potentially include the introduction into native streams of fish diseases and chemicals specifically used to control those diseases. According to an Environmental Protection Agency peer-reviewed publication (Compton *et al*. 2006), supplementing nutrients may introduce an excess of nutrients, disease, and toxic substances to streams. It is also a risk that spawning adults taken from one watershed could be redistributed as carcasses into another watershed. Or, carcasses would be stored and distributed at times when the benefiting fish species are unable to utilize the nutrients. Potential adverse effects to a downstream reach could occur if nutrients are transported downstream and result in adversely altering ecosystems currently in equilibrium (*e.g.*, algal blooms in a lake). There is also the potential that nutrients may be added to eutrophic or naturally oligotrophic waterways.

Because the effects of these nutrient additions, particularly carcass additions, have not been studied in detail (Compton *et al*. 2006), the Agencies propose specific mitigation measures to reduce the risk of disease transmission in conjunction with this activity type. Fish carcasses would be certified as disease-free by a qualified biologist and would follow the process and guidance in the publication: *"Washington Department of Fish and Wildlife Habitat Technical Assistance: Nutrient Supplementation"* (2004). Following these steps would minimize the chance of introducing disease-causing pathogens through carcass supplementation. These measures also ensure

Mitigation measures in Appendix A would prevent placement of carcasses in naturally oligotrophic systems where nutrient levels would be naturally low, and they would not add nutrients to eutrophic systems where nutrient levels are unnaturally elevated to prevent creating nutrient balance conditions inconsistent with what would likely have been in place under historical fish-run levels. These measures also require treatments to be applied at a time consistent with historical spawning timing and abundance for each particular stream to ensure that fish intended to be benefitted could utilize the nutrients. The effects of nutrient enhancement actions would be low.

3.2.7 Effects of Irrigation and Water Delivery/Management Actions (Category 7)

3.2.7.1 Irrigation and Water Delivery Modifications

These proposed activities would increase the amount of instream flow for fish and restore or improve aquatic and riparian function in affected streams. This increased flow would be accomplished by promoting irrigation efficiencies, reducing water losses from evaporation and transpiration, and reducing diversions of water to allocated water rights (or less, if not needed).

The long-term effect of these efficiencies and upgrades, however, would be the conservation of water instream. Much less water would be needed to irrigate crops via drip or sprinkler irrigation than via flood irrigation because less water is lost through evaporation, and because the application is more precise. The delivery of the water can be controlled to meet the needs of the plants without waste. Drip irrigation technology can also incorporate agricultural wastewater and water from retention/detention basins, serving to further reduce the amount of water that must be withdrawn from streams (Trooien *et al*. 2000). The application of water via drip and sprinkler irrigation can also substantially reduce the amount of soil erosion and nutrient and pesticide runoff that is normally associated with furrow irrigation systems (Ebbert and Kim 1998). This reduced water use, however, is dependent on the irrigators not expanding the acreage being irrigated, nor shifting to more water-intensive crops. Such changes could actually increase consumptive water use (Upendram and Peterson 2007).

In addition, there would be less water loss from water conveyance (leakage) by delivering irrigation water via pipelines or lined ditches and canals than by unlined open ditches or canals. Pipelines also eliminate water losses from evaporation. The replacement of canals with pipelines would substantially reduce the amount of herbicides and fertilizers entering streams, as these substances can easily drain into streams through open ditch networks in agricultural fields (Louchart *et al*. 2001).

Construction and installation of these systems would require in-stream work and thus generate the following potential effects to aquatic species and habitat as addressed in the general construction section:

- Exposure of bare soil and compromised slope and bank stability
- Compaction, displacement, and mixing of soil and disturbance of streambed resulting in sedimentation
- Contamination from fuel spills or use of heavy equipment in streambed
- Stress to fish from: capture and release from coffered areas during isolation of instream work areas; and noise, with resulting avoidance behavior by listed species
- Changes in flows
- Destabilization of the stream bed and banks
- Disruption of the natural streambed

3.2.7.2 Livestock Watering Facilities

Livestock watering facilities would be constructed to relocate cattle watering sites from within riparian areas to upland areas. This would relocate cattle activity away from riparian habitats and would reduce trampling and grazing damage to riparian vegetation, stream banks, and instream habitats. It would also reduce direct and potentially excessive nutrient input (cattle urine and feces) into streams. This would allow for the restoration of damaged riparian areas and provide long-term protection to those sensitive and valuable habitats.

3.2.7.3 State Programs for Fish Screens

The Agencies propose to fund/implement State-sponsored fish screen programs. These programs provide immediate and long-term protection for anadromous and resident fish species by ensuring proper operation and maintenance of protection and passage devices on diversions and dam structures. Proper operation and maintenance is critical to fish survival, and would ensure that fish protection is adequate as per NMFS Criteria (NMFS 2011a) for such screens. These facilities reduce or eliminate fish loss associated with water withdrawals and passage barriers.

Currently the ODFW Fish Screen Program is the largest and consists of three screen shops located at The Dalles, Enterprise, and John Day. This fish screen program is the largest because it includes operation and maintenance (O&M) of fish screens with numerous private landowners. Fish screen programs in other states (Idaho and Washington) are typically engaged with federal partners and would have much less fish screen maintenance, though the actions themselves may be larger and include new construction.

The ODFW Fish Screen Program has nearly 1,400 locations where O&M actions may be necessary across the Hood River, Deschutes, Grande Ronde, Imnaha, John Day, Umatilla, and Walla Walla, Willamette River, and other Columbia River subbasins. Each year approximately 700 fish screens and fishways are maintained. This activity is segmented into actions that require some form of construction activity (Table 2) and routine actions requiring no construction action (Table 3).

Construction would generate the potential effects to aquatic species and habitats addressed in the general construction section (Section 3.1.3, above) and would require instream work. Instream work may require dewatering of waterways, with the attendant effects described in Section 3.1.3.1, above.

Because these fish screens and fishways need year-around maintenance, these activities may occur outside the in-water work window. In most cases, work would occur in the dry, but O&M activities may also require instream work and would have the potential to generate turbidity and sedimentation; and temporarily disturb and displace fish and other aquatic organisms.

Table 2 Summary of fish screen maintenance requiring construction activity

Activity	Description	Location	In-water Work
Assess and repair concrete or steel support structures	Use heavy equipment to repair concrete or steel support structures	Ditch or stream	Yes
Repair or replace screen due to damage from extreme weather event	Use heavy equipment to repair or replace screen	Ditch or stream	Yes
Remove accumulated sediment and debris	Use hand tools or heavy equipment to remove accumulated sediment and debris within structures and within several feet above and below structure. Construction/replacement/maintenance actions on streambank screens are closer to a fish bearing waterway resulting in greater risk to waterway than working in an off channel ditch.	Ditch or stream	Yes
Headgate adjustments	Install or replace headgate to protect screening and passage structures from debris	Ditch or stream	Yes/No

Table 3 Summary of routine fish screen O&M activities

Activity	Description	Location	In-water work
Lubricate moving parts	Lubricate bearings, some may be underwater but most points above Water.	Ditch or stream	Yes/No
Manually clean screen material, bypass pipes, and trash racks	Activities include using hand tools to clean screens, bypass pipes and trash racks. Accumulated debris can restrict the open area of the screen, causing high velocities at the screen surface if not removed. It can also clog the bypass. Both of these situations create a dangerous condition for fish.	Ditch or stream	Yes
Ensure safe landing area at bypass outfall in waterway and minimize false attraction	Bypass outfalls typically terminate in a fish bearing stream at a location with sufficient water and clear of boulders/logs to provide a safe landing area. Activities include excavating or removing accumulated debris	Stream	Yes
Remove material from bypass pipe to maintain safe fish return to waterway.	Bypass pipe terminates in a fish bearing stream. Pipe must remain clear of debris to function properly for fish protection. Activities include removing accumulated debris.	Stream	Yes
Inspect and replace screen seal material	Seals prevent gaps around the screen that fish can slip through. Seals do wear over time and must be replaced.	Ditch or stream	No

Adjust weir boards and/or bypass orifice to maintain proper water levels for screens submergence and debris removal	Adjustments made within a screen box.	Ditch or stream	No
Replace screen material, bypass pipe, gear boxes, u-joints, bearings, and other worn out parts	All screen components are subject to a harsh work environment experiencing extreme cold, heat, water, sediment, and other damaging factors. Inspection and maintenance/replacement of these components is necessary to continue providing for fish protection and reliable flow of water for the operator.	Ditch or stream	Yes/No
Adjust cleaning arms, carriages, cable, pulleys, and brushes to maintain good contact with screen for debris removal	Adjustment of screen parts.	Ditch or stream	No
Trim or remove vegetation that prevents fish screens from operating properly	Mechanical removal of vegetation	Ditch, adjacent area	Yes
Replace batteries and other components of solar power systems	Replace batteries and components of solar power systems	Ditch/land	No
Repair paddlewheels and other components of paddlewheel driven power systems	Use hand tools to repair paddlewheels and other components of those systems	Ditch	No
Remove sediment and debris and/or adjust fish passage conditions in fishways	Debris removal may be by hand or with heavy equipment.	Stream	Yes
Annual installation or removal of fish screen and components	Activities involve using hand tools to install screens and components	Ditch or stream	Yes
Screen Adjustments	Use hand tools to adjust screens to maintain appropriate clearance and operation	Ditch or stream	No
Electricity	Electricity to operate screens.	Ditch, stream, or adjacent area	No
Walkways and handrails	Install or replace walkway and/or handrails to allow for safe operation and maintenance of the system.	Ditch or stream	No

3.2.7.4 Water transactions to maintain flows in streams

This action would prevent the withdrawal of some water from flowing streams and rivers that might otherwise be withdrawn for other uses. The beneficial effects of this action would only be realized during periods when water might otherwise be withdrawn: the irrigation season. It would not contribute to high flows in spring or early summer. In some cases, these maintained flows could prevent some watercourses from going completely dry; in others it may be sufficient to meet minimum flow requirement for the needs of aquatic organisms. This flow may be needed for fish passage, or for just basic habitat availability needs for aquatic species.

These flow purchases would be from willing sellers of water rights, and therefore would not likely adversely impact the irrigation needs of those sellers.

3.2.7.5 Summary of Effects of Irrigation and Water Delivery/Management Actions

Irrigation and water delivery/management actions are varied in type and scale, and other than water transactions, would all require heavy equipment use for temporary, short-term periods of time. The ground disturbed, however, would mostly be agricultural land, or other associated sites with previously disturbed soils. Very little would be on native soils or would disturb native vegetation. Impacts of all actions, however, would be minimized and mitigated by application of design criteria and mitigation measures in Appendix A and by applying any mitigation measures unique to the action as exemplified in Section 2.4. Though there would be construction-related impacts for nearly every action in this category, they would be small scale, short-term, generally on previously disturbed soil, and be restored to a vegetated condition (either native vegetation or agricultural plantings) once completed. The effects of irrigation and water delivery/management actions would be low.

3.2.8 Effects of Fish, Hydrologic, Wildlife, and Geomorphologic Surveys (Category 8)

These actions have minimal effect on the environment. No site preparation or construction activities are included here. Vehicular use, human presence and foot traffic, and the placement of measurement or recording devices are the most impactful actions in this category. Some vegetation may be crushed under foot or vehicle, and some wildlife or aquatic organisms may be temporarily disturbed or displaced.

While there is potential for trampling a negligible amount of vegetation during upland and floodplain surveys, the vegetation would be expected to recover. Excavated material from cultural resource testing conducted near streams may contribute sediment to streams and increase turbidity. The amount of soil disturbed would be negligible and would have a minimal effect on instream turbidity.

Use of drones for surveys, monitoring, mapping, etc. would have no ground-disturbance effects, but could have an effect on wildlife since they pose very similar kinds of effects as other human disturbances such as people presence, cars, and conventional aircraft. One difference, however, is the drones' capability to intrude into occupied wildlife habitats not previously available to the above mentioned disturbance types. Close proximity to cliff or tree nesters; and surveys up rivers or streams near the water surface as such examples.

When animals come into contact with drones, they may experience physiological changes such as an increased heart rate, behavioral responses such as running or flying away, or even suffer stress that could disrupt their reproductive process. The degree of disturbance would be dependent on the frequency and intensity of the animals' contact with a drone, and the animal's sensitivity would vary by species and individual. Frequent intense contact (as evidenced by the animal's behavioral response) could result in nest or habitat abandonment, but they could also eventually become used to the drones. At worst, if drones fly too close to animals, collisions or attacks may cause wounds or death. Also, not all animal species or individuals react to drones in the same way, and they may be more vulnerable in certain situations such as breeding season, or in areas without protection or escape routes.

There would be no ground-disturbing or habitat-altering actions with the proposed fish, hydrologic, wildlife, and geomorphic surveys. While there may be some wildlife or fish disturbance from these actions, the impacts are very short-term and the effects would be low.

3.2.9 Effects of Actions for Riparian and Upland Habitat Improvements and Structures (Category 9)

These actions generally require construction activities on a small scale. The effects of such actions described in Section 3.1 above, are applicable here but generally at a smaller scale and with direct effects of lower impact due to their implementation in upland and riparian sites rather than wetland or aquatic sites.

Wildlife structure developments as described in Section 2.1.9.1 is only by handwork and power tools, with no mechanized equipment or construction activity effects. Short-term adverse effects would be low, but may include wildlife disturbance and some modification or trampling of soils and vegetation.

Fencing for livestock control would be constrained by the mitigation measure requiring wildlife–friendly design. Nonetheless, pronghorn, deer, elk or other animals may still occasionally become entangled and suffer injury or death. Fence construction may also use tractors or other small power equipment to dig holes for posts, deliver materials, etc. These construction-related direct effects would be very low. Long term beneficial effects would include the accelerated vegetative and streambank restoration of protected areas.

Vegetation planting, like fencing, would be accomplished primarily by hand, but some small power equipment could be used to plant or transplant willow clumps or small trees. Site impacts at planting sites (soil disturbance) would be small and scattered over large areas. These impacts would most frequently occur within and along streams and their associated riparian areas. The short-term adverse effects would be low; the long-term beneficial effects include restored riparian habitats, improved shade and cover for instream aquatic species; and increased food and nutrient inputs into stream courses.

Tree removal would create the most impactful short-term direct effects. These actions require the use of heavy equipment to fell, yard, load, and transport logs to restoration sites. All the site-preparation effects described above (Section 3.1.2) could be realized in these actions. As described in Section 2.1.9.4, the activities that provide trees for restoration actions are usually separate from the restoration actions in which the trees would be used. They are often part of larger construction, restoration, or development actions, the effects of which (if a Federal action) are analyzed specifically and independently from this EA.

Pond development would require the use of heavy equipment to dig a pond, shape its banks, and disperse the spoils. The short-term adverse effects associated with site-preparation and construction as described above would be typical of the actions taken in pond development. Ponds, however, provide many long-term benefits for fish, wildlife, and numerous species that would find habitats in the aquatic and riparian conditions associated with successful natural-functioning pond developments. Ponds are also attractive for human recreation and can add an aesthetic feature to the visual landscape.

Interpretive site development would create the short-term adverse effects consistent with that described for site-preparation Section 3.1.2. And the site would generally not be restored to desirable wildlife habitat conditions, but rather to that of a recreation site.

Upland erosion and sedimentation control would reduce sediment inputs from roads and disturbed sites into streams high in small watersheds above the range of fish distribution as well as from roads upslope of fish-bearing streams. The use of backhoes and other equipment to modify road surfaces, stream crossings, and other sites to achieve long-term erosion reductions would produce short-term minor to moderate soil disturbance. The application of best management practices for timing, erosion control, and equipment operation would minimize any potential for sedimentation or contamination from oil or fluid drips or spills.

Category 9 effects summary: Ground disturbance is minimal for actions under Category 9, and mitigation measures would minimize even those. Effects would be short-term, with long term improvement of habitat conditions for most actions (but not at interpretive site developments). Overall effects would be low.

3.2.10 Effects of Artificial Pond Development and Management (Category 10)

Pond development would have the effects of all phases of construction and restoration activities described in Section 3.1 above. The primary effect unique to this category of action would be the permanent conversion of habitat from an upland or riparian vegetation type to a pond with an open-water surface and a narrow riparian habitat zone along its shores. Such conversions create habitat for fish, other aquatic species, waterfowl, and other species that occupy shoreline riparian habitats (e.g. invertebrates, amphibians, some birds), but eliminate habitat for terrestrial species that may have occupied the upland forest, shrub or grassland habitat there initially.

Pond development would also likely provide for increased human access to a site by roads, trails, or recreational facilities. Increased human activity could affect habitat use by larger vertebrate wildlife species that may be disturbed and displaced from this locale and its immediate surrounding habitats.

Many ponds are constructed with inlets and outlets connected to existing streams. This is, in effect, a diversion of water from that stream for the reach between the diversion serving the inlet, and the confluence with the pond's outflow. It is anticipated that design criteria for such construction would minimize or avoid adverse effects of flow reduction in this reach, but some reduction would be unavoidable. The outflow from the pond could also potentially introduce an increased level of nutrients or pollutants into the stream than would otherwise be in that stream. The water quality effects would be dependent on the size of the pond, the human and fish/wildlife activity it supports, vegetative conditions in and around the pond, and numerous other physical and biological factors. Such factors would be a consideration in the design and function of ponds (Appendix A) with connected inflows and outflows.

Effects of pond development would be minimized and mitigated by application of mitigation measures unique to the action as exemplified in Section 2.4. Though there would be construction-related impacts for these actions, they would be small scale, short-term, with full restoration of functional aquatic and riparian conditions once completed. In many cases, pond development would result in a diversification of wildlife habitat, though its utility would be mostly for small mammals and birds for those sites with long-term human activity. The effects of pond development actions would be low.

3.2.11 Summary of Effects by Categories of Action

Table 4 Summary Display of Adverse and Beneficial Effects

Summary of Effects by Proposed Categories of Action	Short-term adverse effects*								Long-term beneficial effects									
	Handling, disturbance of fish or wildlife	Dewatering, entire stream or partial	Stream flow alteration	Stream bed modifications/impacts	Soil compaction, displacement, mixing	Chemical contamination potential/drips/spills	Aquatic and riparian vegetation loss	Sedimentation and turbidity	Restore or improve hydrologic flows & function	Improve floodplain connectivity and function	Improve fish habitat connectivity/fish passage	Reduce water temperatures	Improve sediment and LWD movement	Provide LWD or improve recruitment of LWD	Improve streambed grade and stability	Increase instream habitat complexity	Improve riparian and wetland habitats	Eliminate adverse impact source
Category 1 - Fish Passage Restoration																		
Dams, Water Control, or Legacy Structure Removal	x	x	x	x	x	x	x	x	x	x	x	x	x				x	x
Consolidate or Replace Existing Irrigation Diversions	x		x		x	x	x	x	x		x	x	x				x	x
Headcut and Grade Stabilization	x	x	x	x	x	x	x	x	x		x		x		x		x	x
Low Flow Consolidation	x	x	x		x	x	x	x	x	x	x	x	x			x	x	x
Providing Fish Passage at an Existing Facility				x	x	x	x	x			x							x
Bridge and Culvert Removal or Replacement	x	x	x	x	x	x	x	x			x		x					x
Bridge and Culvert Maintenance							x	x			x		x					x
Installation of Fords				x	x	x	x	x			x		x					x
Removal of Natural or Man-Made instream barriers		x	x	x		x		x	x		x					x		
Category 2 - Improving River, Stream, Floodplain, and Wetland Habitat																		
Improve Secondary Channel and Floodplain Connectivity			x		x	x	x	x	x	x						x		
Set-back or Removal of Existing, Berms, Dikes, and Levees			x		x	x	x	x	x	x			x			x		
Protect Streambanks Using Bioengineering Methods					x	x	x	x				x	x	x		x		
Install Habitat-Forming Natural Material Instream Structures (Large Wood, Small Wood & Boulders)			x	x	x	x	x	x				x		x	x	x	x	
Riparian Vegetation Planting												x		x			x	
Channel Reconstruction	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Install Habitat-Forming Natural Material Instream Structures (Sediment and Gravel)			x	x				x	x	x			x		x	x		
Category 3 - Invasive Plant Control and Vegetation Management																		

Manage Vegetation using Physical Controls							x										x	
Manage Vegetation using Herbicides (Riverine)						x	x										x	
Juniper Removal					x	x											x	
Prescribed Burning for Invasive Woody Plant Control																	x	x
Prescribed Burning for Managing Vegetative Composition							x	x	x								x	
No-Till and Conservation Tillage Systems																		x
Category 4 - Piling Removal																		
Piling Removal						x											x	x
Category 5 - Road and Trail Erosion Control, Maintenance, and Decommissioning																		
Maintain Roads					x	x												x
Decommission Roads					x	x												x
Category 6 - In-Channel Nutrient Enhancement																		
Nutrient Enhancement						x										x		
Category 7 - Irrigation and Water Delivery/Management Actions																		
Convert Delivery System to Drip or Sprinkler Irrigation			x		x	x	x	x	x		x	x		x				x
Convert Water Conveyance from Open Ditch to Pipeline or Line Leaking Ditches or Canals					x	x	x											x
Convert from Instream Diversions to Groundwater Wells for Primary Water Sources			x	x	x	x	x	x	x		x	x						x
Install or Replace Return-Flow Cooling Systems					x	x	x					x						x
Install Irrigation Water Siphon beneath Waterway	x		x	x	x	x	x	x				x						x
Livestock Watering Facilities					x	x											x	x
Install New or Upgrade/Maintain Existing Fish Screens					x	x	x											x
Category 8 - Habitat, Hydrologic, and Geomorphologic Surveys																		
Habitat, Hydrologic, and Geomorphologic Surveys	x				x			x	x	x	x	x	x	x	x	x	x	x
Category 9 - Actions for Riparian and Upland Habitat Improvements and Structures																		
Wildlife Structure Installation/Development					x	x												
Fence Construction for Livestock Control																	x	x
Upland Vegetation Planting												x					x	
Tree Removal for Large Wood Projects						x								x				
Pond Development					x	x	x										x	
Interpretive Developments					x	x												
Upland Erosion and Sedimentation Control					x	x												x
Category 10 - Artificial Pond Development and Management			x		x	x		x								x	x	
* See Table 9, Section 3.3.3.2, for details on the typical extent/scale of these impacts																		

3.3 Affected Environment and Effects to Resources by Resource Type

This section of the EA focuses on the resources within the Basin. A description of the affected environment is provided for each, followed by a discussion of the effects of the Proposed Action. For each resource, a generalized description of that resource within the Basin is provided, followed by a focused discussion of the specific elements of that resource that would likely be affected by the Proposed Action, as discussed at the beginning of Chapter 3.

3.3.1 Fish and Aquatic Species

3.3.1.1 Affected Environment

3.3.1.1.1 __Aquatic Habitat Conditions__

The quality and quantity of freshwater habitat in much of the Basin have declined dramatically in the last 150 years as many stream, estuarine and riparian areas have been degraded by the effects of land and water use, including agriculture, grazing, road construction, forest management, mining, urbanization, and water development. Each of these economic activities has contributed to the decline of salmon, steelhead, and non-ESA-listed fish and aquatic species. Among the most vital of these degraded habitat conditions are changes in stream channel morphology, degradation of spawning substrates, reduced instream roughness and cover, loss and degradation of estuarine rearing habitats, loss of wetlands, loss and degradation of riparian areas, water quality (*e.g.*, temperature, sediment, dissolved oxygen, contaminants) degradation, blocked fish passage, impacts to fish, and loss of habitat refugia.

Land ownership has also played its part in the Basin's habitat and land-use changes. Federally-managed public lands, which compose approximately 50% of the Basin, are generally forested and situated in upstream portions of the watersheds. While there is substantial habitat degradation across all land ownerships, habitat in many headwater stream sections is, in general, in better condition than in the largely privately-owned lands in the lower portions of tributaries (Doppelt *et al*. 1993, Frissell 1993, Henjum *et al*. 1994, Quigley and Arbelbide 1997). In the past, valley bottoms were among the most productive fish habitats in the basin (Stanford and Ward 1992, Spence *et al*. 1996, ISG 1996). Today, agricultural and urban land development and water withdrawals have substantially altered the habitat for fish and wildlife in these valley bottoms. Streams in these areas typically have high water temperatures, sedimentation problems, low flows, simplified stream channels, and reduced riparian vegetation.

The water quality and quantity conditions in the Basin (see Section 3.3.2.1) are also adversely impacting fish and other aquatic species' habitat.

On the landscape scale, human activities have affected the timing and amount of peak water runoff from rain and snowmelt. Forest and range management practices have changed vegetation types and density that, in turn, affect runoff timing and duration. Many riparian areas, flood plains, and wetlands that once stored water during periods of high runoff have been destroyed by development that compacts, paves, or displaces soil—thus increasing runoff and altering natural hydrograph patterns.

The development of hydropower and water storage projects within the Basin have resulted in the inundation of many mainstem spawning and shallow-water rearing areas (loss of spawning gravels and access to spawning and rearing areas); altered water quality (reduced spring turbidity levels), water quantity (seasonal changes in flows and consumptive losses resulting from use of stored water for agricultural, industrial, or municipal purposes), water temperature (including generally warmer minimum winter temperatures and cooler maximum summer temperatures), water velocity (reduced spring flows and increased cross-sectional areas of the river channel), food (alteration of food webs, including the type and availability of prey species), and safe passage (increased mortality rates of migrating juveniles) (Williams *et al*. 2005; Ferguson *et al*. 2005).

Within the Basin, anadromous salmonids have been affected by the development and operation of dams. Floodplains have been reduced, off-channel habitat features have been eliminated or disconnected from the main channel, and the amount of large wood in rivers has been greatly reduced. Remaining habitats often are affected by flow fluctuations associated with reservoir water management for power peaking, flood control, and other operations.

Dams without adequate fish passage systems have extirpated anadromous fish from their spawning and rearing habitats, and though effective fish passage has been restored at many dams, the reservoirs behind dams have altered the river environment and adversely affected fish passage through increased temperatures and the alteration of natural hydrographs. Habitats for native aquatic species downstream of dams are also adversely affected. Anadromous fish passage has been completely blocked by dams on the following rivers:

- Columbia River, by the Chief Joseph Dam in north central Washington State, which renders all of northeastern Washington State and large portions of southeastern British Columbia inaccessible to salmon.
- Snake River, by the Hells Canyon Dam, which renders all of southwestern Idaho and large portions of southeastern Oregon inaccessible to salmon.
- North Fork Clearwater River, by Dworshak Dam near the river's mouth, which renders essentially all of that river basin in north central Idaho inaccessible to salmon.

Though some dams prevent access to anadromous salmonids, natural water falls also prevent anadromous fish passage to large portions of the Columbia Basin. The following areas are naturally blocked to anadromous fish:

- The majority of the Columbia Plateau in east central Washington State; blocked by elevation differences between the plateau and the deeply incised canyon through which the Columbia River flows.
- The panhandle of Idaho and all of the Basin in northwestern Montana; blocked by Albeni Falls in northern Idaho, and Monroe St. /Upper Falls in Spokane, Washington.
- All of the Basin in southeastern Idaho; blocked by Shoshone Falls on the Snake River and the natural cascading waterfall barrier on the Malad River, a tributary to the Snake River downstream of Shoshone Falls.
- The Upper Deschutes River basin in Central Oregon; blocked by Big Falls six miles north of Redmond, Oregon.

Past and Ongoing Habitat Restoration Actions

Aquatic habitat restoration in the basin has been underway, however, for the past few decades. Federal, state, tribal, and private entities have—singly and in partnership—begun restoration efforts to help slow and, eventually, reverse the decline of ESA-listed fish populations. Notable efforts in the Columbia Basin include the Council's Fish and Wildlife Program, Basin-wide Salmon Recovery Strategy, the Northwest Forest Plan, PACFISH, the Washington Wild Stock Restoration Initiative, the Washington Wild Salmonid Policy, and the Oregon Plan for Salmon and Watersheds. Full discussions of these efforts can be found on the websites for ODFW, WDFW, the USFS, Reclamation, and Bonneville; and in the Federal Columbia River Power System biological opinions (NMFS 2008, NMFS 2020).

From the mid-1990s to the present, Bonneville has funded, and the Reclamation has implemented habitat restoration actions from all the categories of action described in Section 2.1 across the basin. The U.S. Army Corps of Engineers and Federal Highway Administration have completed numerous transportation projects, primarily bridge and culvert replacements. The USDA Forest Service and USDOI Bureau of Land Management have completed restoration and natural resource management projects throughout the basin, which, implemented in conjunction with these agencies' aquatic conservation strategies, are designed to avoid or minimize effects on fish and wildlife and their habitat; or to restore natural stream habitat-forming processes. Reclamation has completed a few large tributary water-management projects such as the Umatilla Project and Deschutes Project which are now being operated in a manner consistent with the recovery of ESA-listed salmonids.

Despite these efforts, however, there remains work to be done to restore habitat for aquatic species in the Basin, as the biological needs of ESA-listed fish are generally not being met (USFWS 2013).

3.3.1.1.2 __Aquatic Species__

3.3.1.1.2.1 ESA-listed Anadromous Fish

Numerous anadromous fish occupy the basin's waterways that are federally listed as threatened or endangered and have designated critical habitat (specific geographic locations critical to their existence) under the ESA (Table 5).

Table 5 ESA-listed anadromous fish and their listing status

Species	Federal Status	Critical Habitat Status
Chinook salmon (*Oncorhynchus tshawytscha)*		
Snake River spring/summer	Threatened 70 Federal Register (FR) 37160	Designated 58 FR 68543
Snake River fall	Threatened 70 FR 37160	Designated 58 FR 68543
Upper Columbia River spring	Endangered 70 FR 37160	Designated 70 FR 52685
Lower Columbia River	Threatened 70 FR 37160	Designated 70 FR 52685
Upper Willamette River	Threatened 70 FR 37160	Designated 70 FR 52685
Steelhead (*O. mykiss*)		
Snake River	Threatened 70 FR 37160	Designated 70 FR 52685
Upper Columbia River	Threatened 74FR 42605	Designated 70 FR 52685
Middle Columbia River	Threatened 57 FR 14517	Designated 70 FR 52685
Estuary	Threatened 62 FR 43937	Designated 70 FR 52685
Upper Willamette River	Threatened 62 FR 43937	Designated 70 FR 52685
Chum Salmon (*O. keta*)		
Columbia River	Threatened 70 FR 37160	Designated 70 FR 52685
Sockeye Salmon (*O. nerka*)		
Snake River	Endangered 70 FR 37160	Designated 58 FR 68543
Coho Salmon (*O. kisutch*)		
Estuary	Threatened 70 FR 37160	Designated 81 FR 9251
Pacific eulachon (*Thaleichthys pacificus*)	Threatened 75 FR 13012	Designated 76 FR 65323
Southern Distinct Population Segment (DPS	Threatened 75 FR 13012	Designated 76 FR 65324
Green sturgeon (*Acipenser medirostris*)		
Southern DPS	Threatened 71 FR 17757	Designated 73 FR 52088

Species	Federal Status	Critical Habitat Status
White Sturgeon (*Acipenser transmontanus*)		
Kootenai River population	Endangered 59 FR 45989 46002	Designated 73 FR 39506 39523
Bull Trout (*Salvelinus confluentis*)		
Columbia River DPS	Threatened 63 FR 31647	Designated 75 FR 63898

3.3.1.1.2.2 Non-Anadromous Fish

Approximately 60 species of non-anadromous fish live in the Columbia River and its tributaries. About one-half are native species primarily of the families *Salmonidae* (trout), *Catastomidae* (suckers), *Cyprinidae* (carps and minnows), and *Cottidae* (sculpins). The Basin also supports at least 42 introduced species, primarily representing the taxonomic families *Percidae* (perch and walleye), *Centrarchidae* (bass, crappie, sunfish), and *Ictaluridae* (catfish) (see list in Appendix F). The following table displays likely interactions between these fish and ESA-listed salmonids.

Table 6 Interactions between native fish and ESA-listed salmonids in the Columbia River Basin

Species	Range in Columbia River Basin	Federal/State Listing Status*	Type of Interaction with ESA-listed fish
Pacific, river, and brook lamprey (*Entosphenus tridentatus, Lampetra fluviatilis,* and *L. planeri*)	All accessible reaches in the Basin	Not listed under the federal ESA. Pacific lamprey and river lamprey are Federal Species of Concern; river lamprey is a Washington State species of concern; Pacific lamprey is an Oregon State sensitive species and an Idaho State imperiled species	Freshwater predator species of Chinook salmon
White sturgeon (*Acipenser transmontanus*)	All accessible reaches in the Basin	Not listed under the federal ESA; Idaho Species of Greatest Conservation Need - Tier One	May compete with Chinook salmon for food
Margined, reticulate, and riffle sculpin (*Cottus marginatus, C. perplexus,* and *C. gulosus*)	All accessible reaches in the Columbia River basin	Not listed under the federal ESA; Washington State Sensitive (margined sculpin only)	Predators of salmon eggs and fry
Leopard dace (*Rhinichthys falcatus*)	Columbia River basin	Not listed under the federal ESA, Washington State Candidate Species	Freshwater prey of Chinook salmon
Mountain sucker (*Catostomus platyrhynchus*)	Middle-Columbia and Upper Columbia River watersheds	Not listed under the federal ESA; Washington State Candidate Species	Occurs in similar freshwater habitats, but is a bottom feeder and has a different ecological niche
Northern Pikeminnow (*Ptychocheilus oregonensis*)	Throughout the Columbia River basin	Not listed	Freshwater predator species
Smallmouth bass (*Micropterus dolomieu*)	Throughout the Columbia River basin	Not listed	Freshwater predator species
Walleye (*Sander vitreus*)	Throughout the Columbia River basin	Not listed	Freshwater predator species
Channel catfish (*Ictalurus punctatus*)	Throughout the Columbia River	Not listed	Freshwater predator species

Species	Range in Columbia River Basin	Federal/State Listing Status*	Type of Interaction with ESA-listed fish
	basin		
Pygmy whitefish (*Prosopium coulterii*)	Cle Elum and Kachess Lakes in Yakima basin; Priest	Federal Species of Concern; Washington State Sensitive Species	Freshwater prey of Chinook salmon
Inland redband trout (*Oncorhynchus mykiss gairdneri*)	Throughout the Columbia River basin	Not listed	May feed on hatchery-released Chinook salmon
Umatilla dace (*Rhinichthys umatilla*)	Columbia, Kootenay, Slocan, and Snake Rivers	Not listed under the federal ESA, Washington State Candidate Species	Freshwater prey of salmon and steelhead
Westslope cutthroat trout (*Oncorhynchus clarki lewisi*)	Upper Columbia River basin and Snake River	Federal Species of Concern, Idaho State Vulnerable Species	May feed on hatchery-released Chinook salmon

Sources: Beamish 1980; Finger 1982; Horner 1978; IDFG 2005; Krohn 1968; Maret *et al.* 1997; Polacek *et al.* 2006; WDFW 2020.
* Federal and state listing status definitions are as follows:
"**Federal Species of Concern**" is an informal term that refers to those species which NMFS and USFWS believe might be in need of concentrated conservation actions.
"**Oregon State Sensitive Species**" are defined as having small or declining populations, are at-risk, and/or are of management concern. Implementation of appropriate conservation measures to address existing or potential threats may prevent them from declining to the point of qualifying for threatened or endangered status.
"**Species of Concern in Washington**" include those species listed as State Endangered, State Threatened, State Sensitive, or State Candidate, as well as species listed or proposed for listing by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service.
"**Washington State Sensitive Species**" is defined in WAC 232-12-297, Section 2.6, to include "any wildlife species native to the state of Washington that is vulnerable or declining and is likely to become endangered or threatened throughout a significant portion of its range within the state without cooperative management or removal of threats."
"**Washington State Candidate Species**" is defined in WDFW Policy M-6001 to include fish and wildlife species that the Department will review for possible listing as State Endangered, Threatened, or Sensitive. A species would be considered for designation as a State Candidate if sufficient evidence suggests that its status may meet the listing criteria defined for State Endangered, Threatened, or Sensitive (WDFW 1995).
Idaho State "Species of Greatest Conservation Need-Tier One" are species in Idaho with the most critical conservation needs, i.e., an early-warning list of taxa that may be heading toward extirpation.
Idaho State "**Vulnerable Species**" are those species at moderate risk because of restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors that make it vulnerable to range-wide extinction or extirpation.

3.3.1.1.2.3 Other (non-fish) Aquatic Species

Other aquatic species (besides fish) have the potential to be affected by restoration actions in the Basin's tributaries. Amphibian, bird, and mammalian species closely associated with aquatic habitats are discussed in Section 3.3.5 and listed in Appendix E, but a very large number of invertebrate species, such as insects, mollusks, crustaceans, and worms would also likely be affected. The number of these species is so large such that a species-specific discussion is precluded, so they are discussed here by the ecological function they fulfill.

Detritivores, which feed on dead and decaying biomass and are critical for nutrient cycling in aquatic systems, comprise a large number of species from viruses, bacteria, fungi, nematodes, mollusks (aquatic snails) and arthropods (aquatic insects and crustaceans). Crayfish (*Pacifastacus leniusculus*), caddisflies (such as *Heteroplectron spp.),* and stoneflies (such as *Zapada spp.)* are well-recognizable examples. Collectors filter and collect small particles of organic matter found in the water columns and bottom sediments and gravels, and the Basin's freshwater mussels (such as the *Margaritifera falcate)* and some aquatic beetles are examples of such species that serve this function. Herbivores, which feed on aquatic vegetation, be it algae or leafy plants, are best exemplified by mollusks (aquatic snails) and insects such as, again, the caddisfly. Dragonfly (*Anisopetera*) and damselfly larvae (*Zygoptera*), are good examples of species filling the predator function in the Basin's aquatic systems.

These species live all or most of their lives in the Basin's water bodies. Some live in the streams' gravels or bottom sediments, some live on, or under, submerged rocks, boulders, and plants, while others live exclusively at the water's surface or in the water column. All would be affected by temporary, short-term construction actions that impact their habitats.

3.3.1.2 Environmental Consequences for Fish and Aquatic Species – Proposed Action

All of the actions listed under the ten categories detailed in Chapter Two are intended to improve environmental conditions for fish and aquatic species for the long term. Most of them are designed specifically to benefit fish, but as discussed in Section 3.1 and 3.2 nearly all of them would have short-term adverse effects in the course of providing for those long-term benefits.

3.3.1.2.1 Short-Term Effects to Fish and Aquatic Species from Construction Activities

The construction actions described in Section 3.1 would have adverse effects on fish and aquatic species.

In the short term, small aquatic organisms (*e.g.* aquatic insects) not removed by fish salvage efforts (Section 3.1.3.1) could be disturbed, injured, and killed through inadvertent crushing by heavy equipment during implementation of instream, side-channel, and floodplain restoration; and passage barrier removal actions. The noise and vibrations from heavy equipment operations may temporarily disturb aquatic species residing in the immediate area, and they may be temporarily displaced upstream or downstream by equipment operations or a pulse of turbidity. Blasting for the removal of passage barriers could injure or kill fish and other aquatic organisms. In addition, use of heavy equipment creates the opportunity for accidental spills of fuel, lubricants, hydraulic fluid and similar contaminants into the riparian zone or water, where they can injure or kill aquatic organisms. Fishes exposed to petroleum-based contaminants, such as fuel, oil, and some hydraulic fluids, are likely to be killed or suffer acute and chronic sub-lethal effects. Acute sub-lethal effects could range from disturbance to minor irritation of skin or membranes, chronic sub-lethal effects could cause gill damage, with resultant respiratory difficulties or illness which would affect growth, and make fish more prone to predation.

Discharge of contaminated water used for vehicle washing, concrete washout, pumping for work area isolation, and other purposes can carry sediments and a variety of contaminants into a riparian area and stream. For example, cement is highly alkaline (commonly exceeding pH of 10) and can result in lethal and sub-lethal effects to aquatic life if not properly maintained on-site or treated prior to discharge. High pH effects on fish include death, damage to gills, eyes and skin; and inability to dispose of metabolic wastes (NMFS 2013).

Aquatic species could also be harmed by the isolation and dewatering of in-water work areas in a stream segment. Though most actions would provide downstream passage in a bypass channel, these actions would nonetheless displace fish and limit their movement during implementation. Fish could also be stranded in pools and pockets of water within the dewatered reach, though fish salvage would be conducted to reduce potential for stranding. Small vertebrate and invertebrate aquatic species could be overlooked, or simply not salvaged, due to their size and location, and could become desiccated and die during the dewatering. Some species occupying habitat below the streambed surface may survive during the construction period if there is enough interstitial water and flow available, and streambed disturbance is minimal (Bo *et al.* 2007).

The most lethal biological effects of the proposed activities on fish would be caused by their handling and removal from dewatered water work areas through fish salvage activities. All aspects of fish handling, such as electroshocking, dip netting, time out of water, and data collection (measurements and tissue collections) are stressful and can lead to immediate or delayed mortality (Murphy and Willis 1996). Stress approaching or exceeding the physiological tolerance limits of individual fish can impair reproductive success, growth, resistance to infectious diseases, and survival (Wedemeyer *et al*. 1990). Electrofishing causes physiological stress and can cause physical injury or death, including cardiac or respiratory failure (Snyder 2003). The primary contributing factors to stress and death from handling are differences in water temperatures (between the river and wherever the fish are held), dissolved oxygen conditions, the amount of time that fish are held out of the water, and physical trauma. Stress on salmonids increases rapidly from handling if the water temperature exceeds 18° C (64° F) or if dissolved oxygen is below saturation. Bull trout are even less tolerant of increased temperatures than other salmonids, with effects seen at 15° C (59° F). Fish that are transferred to holding tanks can experience trauma if care is not taken in the transfer process, and fish can experience stress, injury and predation from overcrowding in traps, if the traps are not emptied on a regular basis. Debris buildup at traps can also kill or injure fish if the traps are not monitored and cleared on a regular basis.

There is also potential that some fish would be missed or stranded in substrate interstices after a site is dewatered. Although some fish may die during dewatering and relocation, fish would only be exposed to the stress caused by these activities once, and the procedure is only expected to last a few hours. As discussed in Section 3.1.3.1, however, work area isolation is itself a mitigation measure intended to reduce the adverse effects to aquatic species from construction impacts. If construction took place without work area isolation, even more fish could be injured or killed (NMFS 2013).

The Agencies propose several mitigation measures to limit stress and mortality during work area isolation and fish relocation; and limiting nearly all in-water work activities to in-water work periods would greatly reduce the chance of affecting adult fish, as these periods are designated to avoid times when most adult fish are present.

Completed construction activities can be expected to redirect flows in streams in a designed manner that would likely cause sediment and rock to aggrade the stream channel and alter the hydrologic regime. In the new construction's initial exposure to higher flows, there may be disturbance to gravel in fish redds that can agitate or dislodge developing young, causing their damage or loss. Depending on site conditions, these re-directed flows could also mobilize sediment, creating a turbidity pulse that may last a few hours.

Construction-related activities that expose, displace, reconfigure, or compact earth through the use of heavy equipment in, or beside, streams or other water bodies may create conditions where sediment is released once flows are restored. This sediment might then be delivered downstream to reaches where ESA-listed salmonids may be present. Suspended sediment reduces light penetration and scatters light in a manner that creates turbidity. Suspended sediment can also affect fish through a variety of direct pathways: abrasion (Servizi and Martens 1991), gill trauma (Bash *et al*. 2001), behavioral effects such as gill flaring, coughing, and avoidance (Berg and Northcote 1985; Bisson and Bilby 1982; Servizi and Martens 1992; Sigler *et al*. 1984), interference with olfaction and chemosensory ability (Wenger and McCormick 2013); and changes in plasma glucose levels (Servizi and Martens 1987). These effects of suspended sediment on salmonids generally decrease with particle size and increase with particle concentration and duration of exposure (Bisson and Bilby 1982; Gregory and Northcote 1993; Servizi and Martens 1987; Newcombe and Jensen 1996). The severity of sediment effects is also affected by physical factors such as particle hardness and shape, water velocity, and effects on visibility (Bash *et al*. 2001).

Although increased amounts of suspended sediment cause numerous adverse effects on fish and their environment, salmonids are relatively tolerant of low to moderate levels of suspended sediment. Gregory and Northcote (1993) have shown that moderate levels of turbidity, 35 to 150 NTU[27], can accelerate foraging rates among juvenile Chinook salmon, likely because of reduced vulnerability to predators (camouflaging effect).

Application of the turbidity monitoring protocol (Appendix D) during restoration actions would maintain turbidity levels below those harmful to fish. Although fish would be exposed to elevated turbidity and suspended sediment, and thereby experience negative effects commensurate with the severity of the suspended sediment, the anticipated level of exposure is not anticipated to cause harm at durations expected to be typical (less than 12 hours). Turbidity from in-water work may persist for 8-12 hours per day to accommodate a typical work day, as proposed in the mitigation measures.

3.3.1.2.2 Effects to Fish and Aquatic Organisms unique to the Categories of Action

Though individuals would be adversely impacted by the direct effects of construction activities in the short term, the population would be expected to benefit in the long term. The comparatively small scale of an action's disturbance in relation to the overall distribution of the species, and species' diverse life history, is anticipated to sustain the population over the short term, with long-term benefit as the habitat improves because of the action.

The long-term beneficial effects for fish and aquatic organisms include:

- Restoration of access to historical habitats through removal of impassable barriers
- Creation of more complex habitats through the addition of wood and boulder structures to streams and floodplains
- Increased stream length, floodplain connectivity, and riparian vegetation corridors through channel reconstruction, reconnection of side channels and removal of berms, dikes, and levees
- Reduction or elimination of nonnative fish that compete with native species

The following sections discuss the effects to fish and other aquatic organisms that might be unique to specific categories of action.

3.3.1.2.2.1 Fish Passage Restoration (Category 1)

Barrier removal and culvert replacements on fish-bearing streams with stream simulation designs would directly and immediately (hours to days) improve habitat connectivity for aquatic species, restore access to currently inaccessible habitats, increase population ranges, and allow unrestricted movement throughout stream reaches during seasonal changes in water levels (Hoffman and Dunham 2007). Improved passage for both anadromous and resident fish would result in additional available spawning and rearing habitat, which would result in increased population abundance, productivity, and genetic diversity (Wofford *et al*. 2005). Fish populations that are well-distributed spatially with unobstructed passage throughout their range are at a lower risk of detrimental effects from stochastic events. Increased access can lead to increased spawning and rearing success and can increase numbers and health of individual fish and populations (NMFS 2001).

Actions that would replace undersized culverts with larger culverts would reduce stream velocities and eliminate both physical and velocity barriers to upstream fish movement. In the short- and

[27] The acronym "NTU" refers to "Nephelometric Turbidity Units", which is s a measure of turbidity in water, taken with an instrument called a nephelometer. NTU's are the measurements called for in Appendix D, "*Turbidity Monitoring Protocol*".

long-term (1–2 months to 50 years), culvert replacement actions would reduce sediment introduction into fish habitat by decreasing the risk for road failures at stream crossings. Replacing deteriorating or undersized culverts would prevent road failures, and reduce the potential for those failures to introduce large amounts of fine sediment to the system network and fish habitat.

In some passage barrier-removal actions, grade-control structures would be added downstream of the removed barrier. In these cases, the end result would ensure that substrates would remain stable, with no potential for headcutting upstream of the action. Grade control structures would reduce stream velocities, capture gravel and fine substrate, and facilitate uninhibited passage for all life stages of fish and amphibian species.

The installation of properly designed culverts would increase the fluvial transport of sediment that is important in the formation of diverse habitats. Such culverts would enable additional recruitment of debris to downstream reaches when compared to prior conditions. Allowance for debris passage through culverts (including plant material and substrate) also encourages recruitment of large wood into the habitat, and natural fluvial deposition at downstream locations. These processes create rearing and spawning habitat that is essential to listed species. Additionally, the use of properly designed culverts would reduce the probability of catastrophic damage to aquatic habitats that is often associated with undersized culverts and their failures during extreme storm or other natural events. The installation of such culverts would also increase the stability of the streambed.

Barrier removal actions may remove a few trees within the work site, but adverse effects to adjacent aquatic habitats from this degree of tree removal would be minimal. In most cases, it would occur in such a limited area, and the action would incorporate design features to reestablish vegetation in those disturbed areas.

Blasting for the removal of passage barriers could injure or kill fish and other aquatic organisms, but mitigation measures, such as timing restrictions, use of dewatering, fish salvage, and bypass techniques, and blast timing delays would minimize this effect as much as possible (Timothy 2013, FERC 2007).

Removing large instream structures where stream bypass would not be feasible, would likely release large amounts of bedload materials (boulders, cobbles, gravels, sand, and silt) as the structures are notched or removed, which would cause immediate increases in sedimentation and turbidity, as well as debris input into the stream channel below. For actions where stream bypass would be feasible, the stream may be dewatered using an upstream berm and then pumping or piping water around the site. Pumping and piping water would often not provide for fish movement up or downstream. Though most actions would provide downstream passage in a bypass channel, these actions would none-the-less displace native fish and limit their movement during implementation.

The proposed activities would also include installing ladders or otherwise providing means for upstream fish passage at existing facilities (*e.g.* water control and irrigation structures). These would be designed to meet NMFS fish passage criteria (NMFS 2011a or the most recent version), and to the extent possible, would also be designed to facilitate Pacific lamprey passage (Pacific Lamprey Technical Workgroup 2017). Installation of a fish ladder and its subsequent operation would increase the number of individual fish that are able to move upstream. This, in turn, would increase the number of fish that populate areas upstream, either because the fish continue to reside in the newly available habitat or because they reproduce in formerly unutilized spawning habitat. In some instances, providing passage would provide connectivity and genetic exchange between fragmented subpopulations that were isolated from one another. This connectivity of populations and habitats are important to the recovery of ESA-listed fish. Restoration of passage by constructing a ladder would improve the spatial structure of a population and possibly increase abundance and productivity if additional spawning habitats are made available.

In summary, improvements in fish passage throughout the basin would contribute to increased survival and recovery of ESA-listed species, and provide a net long-term beneficial effect to many aquatic species. Improved fish passage would provide greater access to spawning and rearing habitat, less energy expenditure in movement, and greater access to diverse habitats that fosters the development and maintenance of locally-adapted populations. The improvement in passage conditions for salmonids provides an immediate benefit that is likely to increase the numbers of fish moving upstream and downstream from portions of streams that previously were inaccessible. Adverse effects would be those related to construction activities and would be short-term and are not anticipated to adversely affect populations. The overall effect of this proposed activity category would be low, with improvements expected to aquatic species' productivity, survival, spatial structure, and diversity at the population scale where projects are implemented.

3.3.1.2.2.2 River, Stream, Floodplain, and Wetland Restoration and Channel Reconstruction (Category 2)

Channel reconstruction, relocation, and off- and side-channel habitat restoration activities (Sections 2.1.2.1 and 2.1.2.6) would improve or restore stream reaches by reconnecting side-channel habitats and floodplains that were previously inaccessible to aquatic organisms, removing accumulated sediment within those habitats that contributed to habitat degradation, and clearing obstructions to aquatic species movement. Reconnecting channels with floodplains would provide periodic delivery of water, nutrients, and sediment to floodplains. It would also provide flood attenuation and reduced stream energy. Together, these results would produce more functional fish habitat. In addition, the placement of large wood and boulders as part of these actions would increase habitat structure and complexity, thereby creating or restoring shade zones, resting pools, spawning grounds, rearing habitat, and refugia; which are all important components of aquatic species' habitats.

The stabilization of headcuts, a frequent component of projects in this category of action, would have a long-term positive affect for aquatic species and habitat by removing passage barriers, preventing further headcutting and channel incision, which would otherwise disconnect a stream from its floodplains, and degrade fish habitat.

Bank stabilization activities (Section 2.1.2.3) utilizing bioengineering methods such as placement of large woody debris and riparian plantings, would increase aquatic habitat by providing overhead thermal and predator cover for fish, and reduce sediment inputs that degrade aquatic habitat. The stabilization of streambanks would enhance stream complexity over time by providing overhanging banks and in-channel root systems. As the roots of vegetation along streambanks increase, the velocity of the stream and erosion decreases (Comfort 2005), and overhanging streambanks and vegetation provide shade to the stream system and thermal cover, which moderate water temperatures. Streambank stabilization actions would minimize, or prevent, streambank erosion, and provide stable locations for native plants and shrubs to establish.

The placement of boulders, large wood, and plant material (*e.g.*, dormant willow cuttings and other plants that root easily), in a structural way to reinforce and stabilize eroding streambanks (Section 2.1.2.4) would decrease streambank shear stress by increasing the surface area of the substrate it flows over and reduce stream velocity (Washington State Aquatic Habitat Guidelines Program 2003). Reduced stream velocity would lead to beneficial sediment deposition and the creation of refugia for aquatic organisms (Washington State Aquatic Habitat Guidelines Program 2003).

Instream habitat structure and complexity would be increased by the placement of large wood and boulder structures in stream reaches deficient in these habitat elements. They provide effective pool-forming agents in smaller streams or during low flows by focusing flow and flow velocity in ways that create scour and pools that are valuable to fish habitat (Bisson *et al*. 1987). These structures would create localized areas with reductions in water velocity at high flows (Beschta and Platts 1987), which would result in sorting and increased deposition of smaller bedload materials (Bilby and Ward 1989, McHenry *et al*. 2007) in the form of sand, gravel, and cobble that would improve or create spawning areas for fish (McHenry *et al*. 2007). In low-gradient reaches they would improve and promote gravel deposition, decrease flow velocities, and increase low-flow pool volume, which would then provide additional spawning, rearing, and resting habitat for fish, increasing their survival and productivity.

The placement of instream structures would also tend to shift the force of the flowing water to other parts of the channel and change the existing pattern of erosion and deposition. Stream channels naturally meander back and forth across the valley bottom and have alternating periods of aggradation and degradation, which are driven by episodic disturbance events (*e.g.*, fires, floods, and windstorms) followed by periods having no disturbance events. Providing more channel structure encourages these natural processes to develop again, creating channel complexity, and a variety of stream habitat conditions often lacking in a simplified channel. Adding structure and channel complexity would result in better overwintering habitat for salmonids, improved summer pool habitat, and abundant spawning gravels, which would increase the quantity of available spawning habitat for salmonids, Pacific lamprey, and other native fish.

Adding wood to newly constructed side channels, or to restored historical side channels would increase the amount and quality of these habitats, and may thereby increase juvenile salmonid numbers, particularly those of Coho salmon (Roni *et al*. 2006, Roni and Quinn 2001, Rosenfeld *et al*. 2008). The proposed large wood and boulder placement would provide valuable habitat structures for macroinvertebrates and fish, improving rearing conditions for fish and increased juvenile salmonid abundance (Roni *et al*. 2006, Roni and Quinn 2001). Studies in Washington have shown that juvenile Coho densities were 1.8–3.2 times higher in stream reaches with large wood than without wood (Roni 2001). Wood also provides cover from predators during summer low flow periods, and improve the distribution and amount of hiding cover for adult salmonids as they migrate upstream.

Instream structures would provide benefits to fish during the first fall/winter increased flow conditions and continue to develop more complex habitat each winter. Studies have shown that overwinter survival of salmon, steelhead, and cutthroat trout increased in stream reaches that were treated with wood (Solazzi *et al*. 2000).

Placement of wood and boulder structures would entail the full suite of construction activity effects described in Section 3.1. Instream work would disturb or disrupt juvenile salmonids, and other resident fish species, from their normal feeding and resting behavior; and may cause the direct mortality of individual fish, though the probability or number would be difficult to quantify. Adult fish would be expected to move away from ongoing construction activities, but then readily occupy the improved or newly created habitats and resume normal behaviors upon completion of the project. Seasonal restrictions imposed by in-water work periods would prevent heavy equipment from smothering or crushing salmonid eggs.

Impacts to aquatic macroinvertebrates would result from construction actions that would likely increase fine sediment up to a few hundred feet below construction sites. The effects from this, however, are anticipated to be low, short term (hours), and localized (tens to hundreds of feet downstream).

Aquatic habitat restoration actions include vegetation planting to (Section 2.1.2.5) to restore native riparian plant communities and structure. Diverse, healthy vegetation has a major influence on stream channel shape and size. Under the Proposed Action, riparian vegetation treatments, including the planting of native trees and shrubs, would occur as stand-alone actions, or as an action to stabilize disturbed areas. These actions would affect riparian vegetation and would increase the health and diversity of riparian areas, which in turn would provide a large variety of habitat features for fish and aquatic organisms, including food sources, shade, and future large wood. Well-vegetated streams tend to be narrow and deep due to the binding nature of plants and their root systems (Comfort 2005). Planting riparian vegetation would decrease areas of bare soil and provide a sediment-filtering buffer, which would reduce or minimize sediment delivery to fish habitat. As planted riparian vegetation matures, the width-to-depth ratios of disturbed channels and fine sediment delivery would decrease, thus improving the nearby aquatic habitats.

Healthy riparian plant communities provide primary and secondary productivity that drive the food base that juvenile salmonids consume when rearing and migrating to the ocean. A healthy riparian plant community increases the prey base for juvenile salmon and steelhead by increasing the amount of terrestrial insects that drop into the stream. Riparian vegetation also provides organic material directly to the stream, which makes up about 50% of the stream's nutrient energy supply for the food chain (Cummins 1974 cited in Platts 1991). This introduced organic material provides an important food source for salmonids' prey items, such as aquatic insects.

Research by Beechie *et al*. (2000) shows that aquatic habitat is maintained and improved over the long term as the result of increased large wood production resulting from riparian tree plantings. It is anticipated that healthy riparian vegetation can improve the survival of juvenile fish by providing appropriate substrate for pre-emergent fry, and cover from predators and high flows. Properly functioning riparian habitats increase the availability of pools, spawning substrate, cover, and holding/resting areas that would enhance growth and survival for fish through improved conditions for food sources, and improved reproductive success for adult salmonids.

Habitat forming materials would be placed where a documented deficit of these materials is hindering natural fish production (Section 2.1.2.7). Gravel would be placed to provide spawning substrate for salmonids as part of a larger restoration action or as a stand-alone action below reservoirs where gravels are frequently deficit. In many cases, such deposits would be dependent on the stream or river to move and place this material in a natural configuration attractive to spawning fish. Spawning areas for migrating salmon and steelhead would thereby be increased, providing the potential for increased production of wild salmonids.

3.3.1.2.2.3 Invasive Plant Control and Vegetation Management (Category 3)

Invasive plant control and vegetation management would not create construction-related effects to aquatic species' habitats, but there could be effects from the ultimate loss of vegetation, and from the toxicity effects of herbicide application.

The removal of some invasive plants could produce minor changes in stream shade/cover, and thereby, water temperatures or dissolved oxygen levels, all of which are critical to fish. Substantial shade loss, however, would be rare, likely occurring only where treating streamside knotweed and blackberry monocultures, and possibly from cutting streamside woody species (tree of heaven, scotch broom, etc.). Most riparian invasive plants are understory species of streamside vegetation that do not provide the majority of streamside shade, and would, in time, be replaced by planted native vegetation or persistent native vegetation. Shade recovery may take one to several years, depending on the success of invasive plant treatment, stream size and location, topography, growing conditions for the replacement plants, and the density and height of the invasive plants when treated.

The mitigation measures that specifically dictate herbicides, adjuvants, carriers, handling procedures, application methods, drift minimization measures, and riparian buffers, would greatly reduce the likelihood that substantial amounts of herbicide would be transported to aquatic habitats, and the application of herbicides in accordance with EPA label instructions and applicable mitigation measures would not be expected to result in mortality to ESA-listed fish. As discussed in Section 3.2.3, there are mechanisms that transport appropriately-applied herbicides into aquatic habitats and expose aquatic species to their toxicity. There is no certainty that no chemicals would reach streams with aquatic species or ESA-listed fish, and though the exposure amounts are expected to be very low, there may be some sub-lethal effects.

NMFS analyzed the effects of herbicide application programs using the active ingredients and conservation measures similar to what is proposed here (NMFS 2010, NMFS 2012). In their analysis, NMFS identified a number of pathways by which aquatic species could be affected by herbicide applications as displayed in the table below.

Table 7 Pathways of effects to aquatic species from herbicide application

Treatment Methods	Pathways of Affect							
	Disturbance*	Chemical toxicity	Dissolved oxygen and nutrients	Water temperature (shade loss)	Fine sediment and turbidity	Instream habitat structure	Forage	Riparian and emergent vegetation
Manual	X					X	X	X
Mechanical	X			X	X		X	X
Biological				X	X			
Herbicides		X	X	X	X	X	X	X

*Stepping on redds, displacing fish, interrupting fish feeding, or disturbing banks.

Short-term toxicity effects to aquatic habitats could include a reduction in oxygen, an increase in carbon dioxide, a lowering of the pH, an increase in bacterial populations, and a change in the nutrient status of the water and in plant communities. Long-term ecological effects depend on the degree of animal and vegetation loss, the persistence of the herbicide (which suppresses new plant growth), and the suitability of any colonizing or non-susceptible plant species to provide for the habitat needs of the fauna affected. The degree of these aquatic habitat effects from the application of herbicides as prescribed in this Proposed Action would be very low.

Herbicide effects on aquatic species are dependent on the level of toxicity to which the organism becomes exposed, which is determined by the herbicide, its concentration in the water at the point of contact, the environmental conditions (water temperature, flow rates/time of exposure), and sensitivity of the species exposed. Though most of the potential sub-lethal effects from the herbicides and adjuvants proposed for use have not been investigated in regards to toxicological endpoints that are generally considered important to the overall health and fitnes s of salmonids and other fish, the consequences could be the loss of physiological or behavioral functions that could adversely affect the survival, reproductive success, or migratory behavior of individual fish. Some individual fish may be negatively impacted as a consequence of that exposure. Some herbicides, when at low concentrations, cannot cause immediate detectable effects in the organisms, but, in the long term can reduce their lifespan longevity (Nehls and Segner 2001). The degree of these effects to aquatic species from the application of herbicides as prescribed in this Proposed Action would be very low.

Additional information on the effects analysis, environmental fate and transport, aquatic toxicity and risk assessment modeling of these herbicides on fish and aquatic habitats can be found in Appendix C.

3.3.1.2.2.4 Piling Removal (Category 4)

As discussed in Section 3.2.4, piling removal would re-suspend sediments and perhaps release polycyclic aromatic hydrocarbon into the water column. These would be detrimental to fish and aquatic species, but the effect would be of limited intensity, limited extent, and very limited duration. The removals however, would eliminate a chronic source of creosote and pollution.

Piling removal would eliminate resting areas for piscivorous birds and hiding habitat for aquatic predators (*e.g.,* large and smallmouth bass) and would thus be a benefit to juvenile ESA-listed salmonids, but detrimental to their aerial and aquatic predators. These piles also provided surface area for the life-history needs of some aquatic invertebrates, and this habitat would be lost. The absence of these piles, however, would provide increased area for benthic production and juvenile salmon rearing.

3.3.1.2.2.5 Road and Trail Maintenance and Decommissioning (Category 5)

Poorly functioning roads and trails in need of maintenance or decommissioning are a chronic source of sedimentation to aquatic habitats with the attendant adverse effects to aquatic species. Minimizing or eliminating chronic sediment sources through road and trail maintenance or decommissioning would maintain or increase the amount of interstitial cover (i.e., the space between gravel and cobble which is often lost through sedimentation). This would help increase the diversity and density of aquatic macroinvertebrates; reduce or eliminate suffocation and entombment of organisms living in the gravels, including fish pre-emergent fry; and improve fish feeding abilities through increased light penetration.

Runoff from roads can increase fine-sediment composition in stream gravel, which can lead to "decreased fry emergence, decreased juvenile densities, loss of winter carrying capacity, and increased predation of fishes and can reduce benthic organism populations and algal production" (Gucinski et al. 2001).

Road and trail maintenance and upgrades would benefit aquatic species and habitats by minimizing the risk of catastrophic road failure and mass wasting of soil into stream channels; and by minimizing the risk of more frequent erosion and sediment delivery during annual weather events. Severe erosion is almost inevitable if roads are not regularly maintained.

Replacing old or undersized culverts or adding additional cross-drains would prevent road failures, which are sources of fine sediment, averting the potential for those failures to introduce large amounts of fine sediment to aquatic habitat, potentially causing stress and mortality to juvenile and adult fish in fish habitat downstream. Culvert upgrades would reduce the risk of catastrophic road failure and subsequent impacts of increased sediment input to fish habitat and direct effects of increased turbidity to fish. Replacing undersized culverts would also improve woody debris movement downstream and restore fish passage.

Road obliteration and decommissioning should be even more beneficial than road and culvert maintenance and upgrade. Decommissioning roads and removing stream culverts reduces the long-term sediment risk of stream diversions and culvert failures (Madej 2001). It would permanently reduce the sediment inputs from human disturbance in these unstable or sensitive sites and essentially eliminate hydrologic impacts of these poorly located or unnecessary roads. Under the Proposed Action, decommissioning non-essential roads within riparian areas would decrease channel constriction and allow establishment of riparian vegetation.

Non-fish-bearing culvert and cross-drain actions on roads in close proximity to streams would decrease or minimize the short- and long-term (months to decades) introduction of fine sediment from roads into downstream connected aquatic habitat during precipitation events, and remove channel obstructions.

New road construction and relocations would be outside of riparian habitats, so these construction actions would have minimal potential to affect aquatic species providing the sediment controlling mitigation measures are effectively applied.

3.3.1.2.2.6 In-Channel Nutrient Enhancement (Category 6)

The immediate goal is to enhance primary and secondary production in streams, thus enhancing the prey base for ESA-listed fish. If successful, the consequence would be increased growth and survival, which contribute to increase productivity for these fish populations. A beneficial impact of in-channel nutrient supplementation includes the delivery of marine nutrients into freshwater which may be crucial to better growth, increased survival, and a growth in population of salmon, which may contribute positively to the recovery of depleted salmon stocks. The addition of nutrients can increase primary productivity and result in more food for juvenile salmonids (summarized in Reeves *et al*. 1991). The organisms in the base of the food chain that rely on those inputs are ultimately the food base that juvenile salmonids consume when rearing and migrating to the ocean. Studies conducted in British Columbia have shown that addition of inorganic fertilizers can increase salmonid production in oligotrophic streams (Slaney and Ward 1993 & Wilson *et al*. 2003).

Carcass additions would occur during normal spawning periods, so some spawning activities could be temporarily interrupted by the addition activities. These interruptions would last for a maximum of a few hours, would only happen once a year, and would not be likely to cause a measurable decrease in spawning success.

Potential negative effects include the introduction of piscine diseases into streams as well as the chemicals applied that are used to control those diseases. In-channel nutrient enhancement may also introduce too many nutrients to stream channels causing algal blooms or other eutrophication problems downstream (Compton *et al*. 2006). These adverse effects are not reasonably likely to occur because the mitigation measures prevent adding nutrients to water bodies with nutrient load concerns.

3.3.1.2.2.7 Irrigation, Water Delivery, and Water Use Actions (Category 7)

The irrigation changes proposed by the Proposed Acton would provide more instream flow for streams and rivers that are used by, or have potential for use by fish. In some cases, the water savings or water rights purchases would prevent complete dewatering of stream reaches, and thus provide habitat or access to upstream or downstream habitats at critical times of the year.

The installation of structures such as cooling systems and siphons are intended to rectify fish habitat impacts from existing practices and would provide access and habitats for fish that otherwise would not be available or survivable. The effects on fish can be similar to those described for fish passage restoration in Section 3.3.1.2.2.1.

Increased flows in streams and rivers from diversion improvements/consolidations or purchases of water rights would also provide for more natural hydrological function of streams and rivers which would provide for cooler summer temperatures through reaches that otherwise might be thermal barriers to fish movement. This hydrological function could also result in the support of year-round functional riparian plant communities which benefit aquatic species by providing cover, food production areas, and thermal regulation.

Some irrigation conversions remove water diversions which functioned as physical barriers to fish movement with beneficial effects as those for removal of culverts and dams.

The installation of watering facilities for livestock would remove the impacts of livestock trampling and grazing on streamside vegetation which would immediately improve streambank stability and riparian vegetation which provides habitat benefits for aquatic species.

The installation of fish screens would reduce the numbers of fish being lethally trapped in irrigation canals and other water delivery structures.

3.3.1.2.2.8 Fish, Hydrologic, Wildlife, and Geomorphic surveys (Category 8)

These actions would have no immediate benefit to aquatic species or their habitats; their value is in the resource information gathered to support plans and designs for other actions proposed here.

The adverse effects to aquatic species of such surveys are generally limited to the short-term disturbances caused by foot traffic or the installation of recording devises and the minimal turbidity or stream bed, bank, or riparian habitats such actions would create.

3.3.1.2.2.9 Actions for Riparian and Upland Habitat Improvements and Structures (Category 9)

These actions are primarily in habitats that would have no direct adverse impacts on riparian or aquatic habitats or species. Many, however, are designed to protect riparian and aquatic habitats from being impacted. Fencing, to control cattle grazing and keep them from riparian areas would, for example, remove the impacts of livestock trampling and grazing on streamside vegetation which would immediately improve streambank stability and riparian vegetation which provides habitat benefits for aquatic species.

3.3.1.2.2.10 Artificial Pond Development (Category 10)

Pond development may have adverse construction impacts on existing aquatic habitats if connections from the newly-constructed pond to existing streams or rivers are included, but those would be minor and short-term, in the course of creating a new pond which would be a beneficial addition to aquatic habitat in the landscape benefitting fish and other species, both aquatic and terrestrial.

3.3.1.3 Effects Conclusion for the Proposed Action on Fish and Aquatic Species

The short-term effects from tributary restoration actions on fish and aquatic species may be moderate, though reduced by the implementation of mitigation measures; but the long term benefits to fish and aquatic species from the improved habitat conditions would be high, which would balance the short-term and long-term overall effects on fish and aquatic species to be low.

3.3.2 Water Resources

3.3.2.1 Affected Environment

<u>3.3.2.1.1 Water Quantity</u>

The Basin provides drainage for hundreds of rivers, creeks, and streams, covering an area of more than 260,000 square miles. It is the fourth-largest river by volume in North America, and the second largest river in the U.S. in volume of water flow, behind only the Mississippi. Of the tributaries feeding the Columbia River, the largest is the Snake, the drainage of which constitutes half of the

Basin in the U.S. and flows over 1,100 miles from its headwaters in the Grand Tetons in Wyoming to its confluence with the Columbia in southeastern Washington (Figure 3).

Figure 3 The Columbia River and its major tributaries

The hydrology of the basin is dominated by the cycle of winter snowfall and spring snowmelt, which are by-products of large winter snow accumulations in the Rocky and Canadian Mountain Ranges. This cycle stores large quantities of winter precipitation in mountain snows through the late spring. Nearly 60% of the Columbia River's runoff first accumulates as snow, and nearly 33% of the river's runoff originates from the Canadian Rockies (Payne and Lettenmaier 2002); and despite water withdrawal for irrigation along its path, the Columbia River's average discharge is over 7,500 cubic meters per second at its mouth (Kammerer 1990) and forms a 370 mile-long fresh water plume into the Pacific Ocean in the spring (Payne and Lettenmaier 2002)[28]. The Columbia's highest recorded flow, measured at The Dalles, was approximately 1,240,000 cubic feet per second (35,000 m3/s) in June 1894, before the river was dammed (USGS 2019)[29].

More than six million acres of the Basin are irrigated agricultural land (GAO 2018), and though some of the water withdrawn for irrigation eventually returns as agricultural runoff or groundwater recharge, such diversions utilize a large portion of the Columbia River's flow.

These agricultural withdrawals also affect seasonal flow patterns of tributary streams throughout the basin by removing water from them in the summer (mostly May through September). These water quantity reductions are a substantial cause of habitat degradation and reduced fish production. Withdrawing water for irrigation, urban consumption, and other uses increases temperatures, smolt travel time, and sedimentation. Return water from irrigated fields can introduce nutrients and pesticides into streams and rivers.

Deficiencies in water quantity have been a problem for salmon populations in many subbasins that have seen major agricultural development over the last century (USFWS 2013). Water withdrawals (primarily for irrigation) have lowered summer flows in nearly every stream in the basin and thereby profoundly decreased the amount and quality of salmonid rearing habitat. In 1993, fish and wildlife agency, tribal, and conservation group experts estimated that 80% of 153 Oregon tributaries had low-flow problems, two-thirds of which were caused (at least in part) by irrigation withdrawals (OWRD 1993). The Council found similar problems in many Idaho and Washington tributaries as well.

3.3.2.1.2 Water Quality

As required in Clean Water Act Section 303(d), states and tribes identify those waters which do not meet water quality standards for beneficial uses. Where data is available, states and tribes also identify specific water quality limitations and impairments for the State's waters. The summary report is commonly referred to as the 303(d) list and is used to identify where improvements to water quality are needed to meet state and national standards. Under Section 303(d), states have identified more than 2,500 tributary streams, lakes, and segments of the Columbia River and its estuary as not meeting Federally-approved, state, and/or tribal water quality standards (NMFS 2013). Three categories of water quality are of concern for fish and wildlife habitats: toxic pollutants, temperature, and sedimentation.

Toxic Pollutants

Major sources of impairment to water quality include pollutant run-off from agricultural activities and storm-water on impermeable surfaces (e.g., paved parking lots and roads); legacy toxic contaminants, such as mercury and PCBs; and contaminants of emerging concern, such as discarded pharmaceuticals. In addition, EPA Superfund sites[30] are located throughout the Basin and may have negatively impacted water quality in locations such as Portland Harbor in Oregon, the Hanford Site in Washington, and the Upper Columbia River at Lake Roosevelt in Washington (GAO 2018).

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[28] Flow rates on the Columbia are affected by many large upstream reservoirs, many diversions for irrigation, and reverse flow from ocean tides on the lower stretches below Bonneville Dam.

[29] The Dalles is about 190 miles from the mouth; the river at this point drains 91 percent of the total watershed (USGS 2019), but flow measurements below this point, at that time, were affected by flows from ocean tides.

[30] An EPA Superfund site is a place that has been contaminated by hazardous waste and identified by EPA as requiring a long-term clean-up response. "Superfund" is the common name given to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 which authorizes funding and reimbursements for cleanups.

A 2009 EPA report noted that substantial levels of toxic chemicals were found in fish and the Columbia River waters they inhabit, including toxics banned from use since the 1970s, such as DDT and PCBs[31], as well as emerging contaminants, such as chemicals used for flame retardants (EPA 2009). This led states to periodically issue fish, and in some cases shellfish, advisories throughout the Basin warning the public not to consume more than specified quantities of contaminated aquatic species or, in some cases, at all. Since then, various entities, including federal and state agencies and tribes, implemented restoration efforts to improve water quality in the Basin (GAO 2018), and in 2016, Congress passed the Columbia River Basin Restoration Act (CRBRA) as part of the Water Infrastructure Improvements for the Nation (WIIN) Act of 2016. The legislation focuses on the U.S. portion of the Basin and created a new section of the Clean Water Act (CWA), Section 123, which directs EPA to establish a Columbia River Basin Restoration Program. It is the first legislation to officially designate the national importance of Basin water quality restoration (EPA 2019a).

Under this legislation, working groups and partnerships have been formed; certification and pollution prevention programs have been developed; safer chemical alternatives have been promoted; and regulatory and clean-up actions have been taken (EPA 2019a). Agricultural Best Management Practices, coordinated monitoring, and green infrastructure initiatives have been identified as near-future needs.

Temperature

While toxic chemical pollution is being addressed, all or parts of the Columbia River and the lower Snake River are not meeting temperature standards established by Idaho, Oregon, Washington, the Confederated Tribes of the Colville Reservation, and the Spokane Tribe of Indians (EPA 2019b). Water temperatures in the Columbia and Lower Snake Rivers sometimes approach the upper limits of temperature tolerance for cold water fishes, including salmon.

Another source of elevated water temperatures in the Columbia and Snake Rivers is the warm water delivered to them by their tributaries.

Sedimentation

Sediment is the loose sand, clay, silt and other soil particles that settle at the bottom of a body of water. Sediment can come from soil erosion or from the decomposition of plants and animals. Wind, water and ice help carry these particles to rivers, lakes and streams. Natural erosion and human activities both contribute sediment into river systems making it one of the most common pollutants in rivers, lakes, and streams.

The timing and size distribution of sediment transport in rivers can be a key determinant in riverine ecology, affecting plant and animal distribution and population dynamics, and the storage or flow of this sediment is influenced greatly by the condition of streams and their connections to their floodplains.

The mean particle size carried on the bed of the Columbia River increases downstream. The Snake River and other tributaries contribute mostly fine sediment derived from metamorphic, plutonic and sedimentary rocks, and is carried in suspension. Many downstream tributaries contribute coarser sediment derived from the erosion of andesitic volcanic rocks, and is carried largely in the bedload. Large migrating sand waves form the top surface of the Columbia River's bed (Whetten *et al*. 1969).

[31] DDT is an abbreviation for dichlorodiphenyltrichloroethane; PCB is an abbreviation for polychlorinated biphenyl.

The Snake, Yakima, Deschutes, and Willamette Rivers contributed most of the sediment load discharged to the Columbia River (USGS 2007). During water year 2000, an average streamflow year in the Pacific Northwest, the Columbia River discharged about 14,000 tons per day of suspended sediment to the Pacific Ocean (USGS 2007), yet the amount of sediment transported by the Columbia River system during a single flood may exceed that which is transported during an entire 'average" year (Whetten *et al*. 1969).

The distribution of sediment on some of the reservoir floors changes throughout the year. Sediment deposited during low discharges may be scoured from the reservoirs during periods of high discharge and transported downstream through the dams. The mineral and chemical composition of Columbia River sediment obtained from reservoir floors suggests that the sediment particles have undergone relatively little chemical weathering (Whetten *et al*. 1969).

3.3.2.2 Environmental Consequences for Water Resources – Proposed Action

3.3.2.2.1 <u>Water Quantity</u>

Most project actions change stream channels and the conditions of the bed, bank, and floodplain through which water may flow through a stream reach; but most do not affect the amount of water flowing through that stream reach. One category of action, however (Category 7, Irrigation, Water Delivery, and Water Use Actions), is intended to increase in-stream flow and thereby improve habitats for aquatic species, (Section 2.1.7). In many cases, the consolidation of irrigation diversions or the modifications of them, from small in-stream barriers to metered diversions or wells, would serve to limit withdrawal of water to that amount actually authorized by water rights where historically much more may have been withdrawn, in some cases to the point of de-watering.

The reductions in water withdrawals would also frequently be accompanied by changes in irrigation systems (e.g. from flood irrigation systems to sprinkler systems) that would reduce the amount of water necessary for productive farming. Other water savings come from improvements in water delivery systems, such as replacing ineffective ditches with pipelines, or lining leaking ditches.

Many of these actions in small tributaries higher in the subbasins could increase in-stream flows considerably, depending on the size of stream from which water had been diverted. Section 3.3.1.2.2.7 describes how in some cases, the water savings would prevent complete dewatering of some stream reaches.

3.3.2.2.2 <u>Water Quality</u>

Construction activities would be the primary factor affecting water quality, with sedimentation, turbidity, and temperature being the primary variables of concern. Another concern would be the potential fuel and fluid leaks from heavy equipment, but the probability of such an event is low, and the extent of the problem would likely be small given the mitigation in place for these actions (see Section 2.4 and Appendix B).

3.3.2.2.2.1 Sedimentation and Turbidity

Many of the proposed activities are designed and would be implemented to restore more natural watershed processes that influence the production, transport, and deposition of sediments throughout watersheds and their stream and river networks. Though restoration activities would have short term adverse effects on water quality, the combination of multiple restoration activities across the Basin with ongoing natural recovery and passive restoration are expected to improve stream sediment and turbidity conditions overall.

Within the restoration actions proposed, those with construction activities involving heavy machinery and earth moving create the greatest potential for sediment and turbidity concerns. Actions in Categories 1 (Fish passage restoration), 2 (River, stream, floodplain, and wetland restoration), 5 (Road and trail decommissioning, maintenance, etc.) and 7 (Irrigation, water delivery, and water use actions), would be those most likely to produce sedimentation and turbidity impacts of short-term consequence. Actions in other categories have minor, if any, construction components.

Category 1, fish passage restoration, would require the removal of instream structures such as culverts, dams, weirs, water control structures, or natural features. These actions would require the use of heavy equipment or other earth-moving tool or technique within the stream course which would mobilize or introduce sediment into the stream and create turbidity. The degree of the impact would vary project-by-project and would depend on the scale of barrier being removed and the extent of activity within the stream bed.

Removing large instream structures would facilitate the release of bedload materials stored behind the structure. As the structures are notched or removed, an immediate increase in suspended sediment and turbidity would be expected. Downstream habitats would likely be degraded for a short period of time.

The removal of passage barriers that had also restricted natural hydrologic flows would restore a more natural and functional hydrologic condition, which would be expected to increase the fluvial transport of sediment thereby providing for more diverse habitat formation downstream.

Category 2 river, stream, floodplain, and wetland restorations also routinely require heavy, earth-moving, equipment operations within stream channels. Short-term inputs of sediment would result from instream structure placement, opening of side channels, stream reconstruction, and other activities that occur inside the bankfull channel.

Channel reconstruction, relocation, and side-channel restoration projects would expose tens to hundreds of feet of channels to flow for the first time in decades. Exposing, or reactivating existing off- or side-channels by removing fill plugs, would mobilize site or stream-reach sediment and increase turbidity either during initial water flows or during the first high flows. The scale and scope of the sediment transport and turbidity created would depend upon multiple factors such as project location, channel size, and stream grade. Resulting sediment plumes would be most concentrated within, and immediately downstream of, the immediate action area during construction activities. For most actions, these plumes would extend no more than a few hundred feet, though a few very large projects in large rivers may produce plumes extending beyond that. The duration of most plumes could be measured in hours or days, though large projects may continue to produce turbidity, (though gradually declining) for weeks. Some additional intermittent erosion and sedimentation would be possible during high flows for up to a couple years after some activities (*e.g.*, stream channel reconstruction), as streams adjust to newly established site conditions. However, with proper design of channel capacity, form, gradient, and grade control structures, and the establishment of vegetation, would limit the amount of erosion and turbidity created as the project's stream reach seeks equilibrium with the channel network over one or more years. Reactivating existing, vegetated side channels that are morphologically suited to their environment would generate less sediment than turning flow into a recently constructed side channel that would need time to reach equilibrium with the stream.

Instream log and boulder placements require the use of heavy equipment in riparian areas and stream channels. Direct sediment delivery to streams would occur when excavators disturb stream banks as they travel access routes between existing roads where materials are staged and the channels where the materials are placed. Excavator tracks push soil into streams, and dragging and pushing logs and boulders moves soil into channels. The movement and placement of materials may uproot stream-adjacent trees causing soil to enter streams. The volume of soil displaced would be small (less than two cubic yards) per access route. Options for placing more than one instream structure per access route would occur, if space and materials permit, limiting bank disturbance. Bank contouring with the excavator when it leaves the placement site and bank planting would further minimize soil delivery.

The first few higher-flow events of the rainy season following any of the actions discussed the action would transport, sort, and deposit displaced soil remaining in channels. This volume of action-related soil or sediment transport, however, would represent a small fraction of the sediment that naturally moves through and deposits in a stream reach in any one season. Scarifying (i.e., shallow ripping of the soil surface with excavator bucket tines), seeding, and mulching access routes prior to the onset of fall and winter rains would prevent or minimize overland sediment movement to streams from this potential source.

Instream log placements, however, would increase the sediment storage capability of a stream reach. Instream structures reduce flow velocity resulting in the sorting and deposition of sediment and the creation of features (e.g. gravel spawning beds and gravel/sand/silt/clay bars) and floodplains storing shallow groundwater. Project designs typically locate structures in series along a stream reach, and it takes years for downstream structures to capture material if the stream has limited sediment to move. In the case of a debris flow entering a project's stream reach, one or more structures could capture tens to hundreds of cubic yards of sediment and wood that would otherwise be lost through the project's stream reach in the absence of placed structures.

The Proposed Action also includes the funding of no-till and conservation tillage systems (Category 3) that would maintain organic material at the soils surface to increase water infiltration into the soil and decrease the potential for sheet erosion and sediment delivery thereby into nearby waterways.

Felling conifers and other trees directly into stream channels and pulling or pushing trees into stream channels would create short-term turbidity (minutes to hours) and long-term (years to decades) benefit to sediment routing. Pulling and pushing trees would displace more bank soil and stream sediment than direct tree felling. The amount of soil displacement (less than two cubic yards) per placement site would be inconsequential to channel form and function.

The maintenance, decommissioning, and relocation of roads (Category 5) would be focused on travel-ways that produce, transport, and deliver sediment into waterways. There may be a slight increase in short-term sediment delivery by these actions if immediately adjacent to waterways, but for most actions, heavy equipment operation would be far enough from streams that catchment and other mitigation measures called for in Section 2.4 and Appendix B would be effective in preventing or greatly minimizing such impact.

Studies indicate that road decommissioning would reduce human-caused sediment to streams. Black and others (2017) noted an 80 percent reduction in sediment delivery to streams in National Forests in the Pacific Northwest, Northern, and Intermountain Forest Service Regions.

Removing culverts and their associated fill and replacing undersized culverts with culverts and bridges of sizes to accommodate high flows could mobilize sediment for deposition downstream, which would increase sediment and turbidity in the short-term (days to weeks). Undersized culverts and fill act as grade-control structures by storing sediment at their inlets and scouring away sediment at their outlets. Replacement or removal of this grade-control feature can result in upstream headcut migration, deepening of the channel, bank erosion, and other responses (Castro 2003) if design criteria and mitigation measures were not in place to prevent this action. The size of the stream and culvert being removed or replaced would correspond to the amount of sediment potentially mobilized. Larger culverts would generally produce more sediment than small culverts.

Non-fish-bearing culvert replacement and removal would also mobilize stored sediment; however, non-fish-bearing culverts are generally smaller than fish-passage culverts so the volume of material moving downstream beyond the culverts would also be smaller (i.e., a few cubic yards per pipe).

Reactivating former floodplains by removing entire road fills that have encroached on stream channels would provide a long-term sediment-routing benefit. Valley-bottom stream channels that are disconnected from floodplains by roads, and unnaturally straight and constricted by roads, tend to export sediment downstream rather than depositing it in floodplains which would otherwise serve as low-gradient depositional areas. The decommissioning or removal of such roads along with removing their associated culverts and cross-drains, paired with stream reconstruction, would benefit water quality. Such restored streams with no constraining road fill would sort and hold sediment, and at high flows, force sediment laden water over its banks onto its reconnected floodplain where that sediment can be deposited.

Irrigation and water delivery actions (Category 7) would adversely impact water quality where heavy equipment is used in and along streams in the course of removing improving or consolidating water diversions, fish screens, or other associated structures. The end result however, would frequently be less water use, with more flows remaining in the stream providing for more natural and effective instream transport of sediment.

Sediment could also be delivered from disturbed and exposed ground adjacent to stream channels created prescribed burns (Category 3) of moderate-severity. Delivery from these areas would occur during storm events, generally starting in the fall. Proper fire-use planning and close adherence to a properly designed burn plan would eliminate or minimize potential sedimentation effects and ensure water quality standards are attained.

It is anticipated that essentially all project-related sediment would be flushed out during the first high flows after project completion; and site restoration measures would be expected to prevent future project-related sediment inputs into the streams.

Sedimentation and turbidity impacts to domestic water supplies during construction activities would not be expected because design criteria that would be applied would focus on minimizing turbidity. Also, project-specific analysis and planning would identify local water supply diversion intakes and diversions and provide for minimizing impacts to water supplies.

Over the long term, implementation of proposed activities would improve conditions related to stream sediment and turbidity. Newly constructed meandering stream channels established through channel reconstruction or relocation would be more sinuous than the relatively straight streams/ditches that they replace. They would be lower in gradient, and have lower water velocity with less erosive power. Sediment entering a meandering reach would likely be sorted and stored to create stream and habitat features than would sediment entering a shorter, steeper, and more high-energy straight stream reach.

3.3.2.2.2.2 Temperature

High water temperatures adversely affect salmonid metabolism, growth rate, and disease resistance, as well as the timing of adult migrations, fry emergence, and smoltification (Bonneville 2012). The proposed action could cause short-term increases in stream temperature due to construction-related disturbance of riparian vegetation and stream channels and in some limited cases, increased stream length. However, severe short-term stream temperature impacts on aquatic life are not expected given the limited geographic scope of these activities, the limited effects within individual restoration activity areas, and the fact that individual actions would be dispersed in time and space within a watershed (NMFS 2013; USFWS 2013). This is supported by the fact that the States of Oregon and Washington routinely issue Clean Water Act Section 401 programmatic water quality certifications for these projects that conclude that these actions would protect and restore temperature sensitive aquatic life and other beneficial uses of water (NMFS 2013).

Fish passage-barrier removal actions (Category 1) may provide long-term downstream temperature benefits if sediment has been trapped upstream of the barrier, as is often the case. Morphological channel changes downstream from the deposition of sediment released by such removals can create habitat features conducive to cooler water temperatures.

River and stream restoration actions (Category 2), combined with the ongoing natural recovery and passive restoration, would be expected to have long-term beneficial effects on stream temperature by restoring riparian vegetation, channel conditions, surface-groundwater interaction, and other critical watershed processes that influence water temperature. Activities would improve streamside shade through revegetation of riparian areas; restore stream channel morphology in channels that are currently unnaturally wide and shallow, or lack pools; improve surface water-groundwater interactions and hyporheic exchange; reduce stream heating associated with small dams; and reduce unnatural channel widening and associated loss of stream shade associated with overuse of streamside recreation sites and the presence of legacy structures (*e.g.* channel-spanning weirs).

Relocation of streams into historical or newly constructed channels that are more sinuous and complex would, depending on site conditions, would expose more stream surface area to sunlight, leading to short-term temperature increases, until streambank vegetation recovers to provide shade. But planting a new channel with fast-growing willows and larger riparian plants would reduce stream surface exposure over time; and a more sinuous channel, well-connected with its floodplain, would increase hyporheic exchange and bank storage which would maintain cooler temperatures and provide temperature heterogeneity within the stream system over the long-term.

Riparian planting would increase shade on streams and rivers depending on site aspect and other factors. The amount of shade provided by streambank planting, and the effectiveness of local shade to cool the water, would be a function of channel width and flow volume at the specific action site. Past experience has shown that wider channels would be more difficult to fully shade even with mature vegetation,

Reconnecting historical side-channels with floodplains, and constructing new side channels and alcoves, would increase temperature heterogeneity; create diverse habitat by increasing channel length and stream-floodplain interaction; and supply large amounts of subsurface flow to the main channel (IMST 2004). Streams and rivers with greater flow volume, however, would be less responsive to these stream cooling processes than lower volume streams and rivers.

Heavy equipment use, necessary in these river and stream restoration actions, would damage or remove stream-shading vegetation. Placements of logs and boulders by heavy equipment would require access routes and staging areas for storage of trees, logs, and rocks for instream placement. The removal of shade-producing trees and shrubs, if necessary to facilitate this movement, storage, and placement, would have the potential to cause localized temperature increases for one or more years, or until vegetation is reestablished. Careful equipment use that avoids trees would lessen damage to existing shade-producing riparian vegetation during instream project implementation. Such care would be easier to accomplish, but more necessary, in areas with sparse vegetative cover. The loss of scattered individual trees within densely-vegetated riparian areas, however, would likely not produce a measurable increase in stream temperature.

Minimizing shade loss during project implementation and replanting project sites could reduce or eliminate stream temperature increases, and lessen the time to recovery should minor temperature increases occur. The effect of constructed in-stream log and boulder habitat structures would offset the loss of vegetative shade in the near term by providing some immediate shade; and they would have a positive effect on stream temperature in the long term by deepening pools. Logs placed over the channel would also provide some measure of shade.

Restored sediment-deposition processes, and the action of narrowing and deepening channels, would increase flows and decrease the surface area of the stream exposed to direct sunlight. In addition, streams with well-connected floodplains and deep gravels would typically be connected to groundwater and would thus have cooler water temperatures. Alluvial sediment[32] in channels and along stream banks store cold water from periods of high runoff, and release it gradually during periods of low runoff (Coutant 1999).

Groundwater stored in and along stream banks is an important component of cooler water temperatures (Winter *et al*. 1998). Simplified channels that prevent flows from connecting with their floodplains lack this cool water storage. Water moves into stream banks when streams and rivers rise; but if those streams do not overtop their banks, that water returns to the channels relatively quickly. When streams and rivers are structured properly and rise high enough to regularly inundate floodplains and overtop banks, more widespread recharge of the water table throughout the flooded areas would occur. The volume of floodwater returned to the channel via groundwater is increased, as is the time it takes for that return. Both conditions—greater return volume and greater return time—favor lower stream temperatures.

Road decommissioning (Category 5) would have a long-term stream temperature benefit. Removing road fill from stream channels and former floodplains would increase overbank flooding and bank storage, and sediment stored upstream of removed culverts would mobilize and deposit downstream creating habitat features conducive to cooler water temperatures.

Removing culverts from closed roads and installing cross-drains in closed roads (Category 5) would have a small positive effect on stream temperature. Culverts in most of these cases would be small, thus the amount of sediment trapped behind them would be limited and any stream-structuring benefit of this small amount of sediment being mobilized and deposited downstream after culvert removal would be small. Installing cross-drains would divert ditch flow directly to the forest floor where it would enter the groundwater system which cools water before delivery to a stream.

3.3.2.3 Effects Conclusion for the Proposed Action on Water Resources

Overall, the tributary restoration actions would create short-term, localized, sediment inputs from the actions of heavy equipment in and along streams (though not in amounts greater than what occurs naturally during annual, natural, high flow events); and the removal of riparian vegetation could cause small increases in water temperature in the short term (but would be offset to a degree by shade from new instream structures and deepened streams and pools). But these are short-term effects and would also be lessened by the application of mitigation measures such as phased re-watering, existing vegetation protection, minimizing areas to be impacted, and replanting. The long-term effects of these actions, however, would be a decreased potential for unnatural sediment inputs, an increased potential of the floodplain to effectively manage its sediment loads, and a reduction of stream temperatures from stream form, instream habitat structure, and increased

[32] Alluvial sediment is sediment deposited by flowing water, usually from episodes of increased flows and elevated stream stages that causes water to move from the stream into the stream banks.

riparian vegetative cover. When the short-term, temporary effects are considered in the context of the long-term benefits of the project, the overall effects on water quality would be low.

3.3.3 Vegetation

3.3.3.1 Affected Environment

The Basin is an expansive landscape running from the crest of the Rocky Mountains and Cascade Range to the Pacific Ocean, with waterways crossing alpine meadows, forests, grasslands, ranch and farm lands, sagebrush steppes, urban landscapes, and ultimately the Columbia River estuary, then into the Pacific Ocean. The potential natural vegetative types and conditions across this landscape are highly variable and a function of elevation, local climate, and natural disturbance (*e.g.* natural fire) (Kuchler, 1964). In addition to this natural variability, human-caused disturbances of this natural vegetative landscape through fire control, logging, grazing, and agriculture add additional elements of variation increasing the complexity of vegetative conditions.

3.3.3.1.1 __Basin Vegetation Types__

For the purposes of this EA, the vegetation elements of the affected environment will be discussed in only the broadest of types (*e.g.* forests, sagebrush steppe, agricultural lands, etc.) with a focus on the conditions within these vegetative types that affect the needs and proposals for aquatic and terrestrial restoration.

Alpine zone

Rocky barrens and alpine meadows in the highest elevations of the Rocky Mountains and Cascade Range characterize the vegetative conditions in the headwaters of the Basin. Though the natural vegetation here has been affected by fire suppression and intense grazing by sheep in the 19^{th} and 20^{th} centuries, there is little concern with stream or riparian conditions; and few, if any, proposals for restoration are advanced for these areas. Streams are small, many are ephemeral, watercourses are usually highly constrained by bedrock, floodplains are not formed at these elevations, and the vegetation here is primarily grasses and forbs with few low-growing shrubby species and no trees. There are few, if any, proposals for restoration work here.

Forest Zone

Columbia Basin tributaries flow down from alpine habitats into the forests cloaking the Northern Rocky Mountains and the Cascades. They flow though high-elevation spruce, fir, and lodgepole pine forests into mid-elevation hemlock, white fir, and Douglas-fir forests; then down through lower elevation Douglas-fir and Ponderosa pine forests. The riparian areas and stream courses in these forests have been heavily modified by logging, mining, grazing, fire control, and road construction; and numerous restoration projects are proposed and underway in these vegetation types.

Past logging has removed large wood input from streams and their adjacent riparian areas; it has modified the age structure of forests along rivers and streams thereby changing the long-term flow of natural large wood inputs into the waterways, and has temporally eliminated or reduced the shade-producing trees along many streams and rivers, adversely affecting stream temperatures. Road construction has confined rivers and streams to narrow channels, concentrated and channeled the flow routes of water across the landscape thereby reducing infiltration into forest soils, and provided widespread sources of unnatural sediment input to waterways.

The application of forest, road, and fire management practices aimed at preventing and recovering from these impacts on public lands (*e.g.* National Forests and lands managed by the Bureau of Land Management) has been ongoing now for over two decades, and streams on those lands are slowly recovering. These impacts, however, are widespread, and can still be seen on many private forest lands in the Columbia Basin, though application of required State forest practices is reducing these impacts.

Another impact to Columbia Basin forests has been successful fire suppression over the past century. Fire regimes in the forests of northwestern North America historically exhibited a wide variation, as did the forests in which they burned. While the Douglas fir/cedar/hemlock rain forests of coastal and western Oregon and Washington were adapted to infrequent high-intensity wildfires, forests of the interior Columbia River Basin were, for the most part, fire adapted and required periodic low-intensity fire to maintain their structure. More than a century of human fire prevention and suppression has altered these forests, allowing young trees, that otherwise would have been removed by wildfire, to grow among the mature and old growth trees, and for ground fuels to accumulate. This combination has created an unnaturally dense and continuous fuel source for wildfire, making these forests highly susceptible to stand replacement wildfire. As a result, the fire regime across the basin has been changed from one of frequent, low-severity fires to one of infrequent, high-severity fires with stand-replacement effects (Block and Conner 2016).

Sagebrush Steppe, Grasslands, and Agricultural Zones

From the forests, Columbia Basin tributaries flow down into sagebrush steppe, grasslands, or agricultural lands. Shrub-steppe is a relatively xeric habitat that is dominated by shrubs, especially sagebrush, or co-dominated by shrubs and perennial bunchgrasses. The most common shrub species in the Columbia Plateau is big sagebrush, though other types of sagebrush and other shrubs can be locally dominant. In a shrub-steppe understory, one or more perennial bunchgrass species are usually dominant. A wide array of forbs was an important herbaceous component historically, although cover of those species today has been greatly diminished by a long history of livestock grazing and invasive competitors.

The grasslands, known as the Columbia Basin Palouse Prairie, was once an extensive grassland system stretching across much eastern Washington, Oregon, and patches in west-central Idaho. It is characterized by a rolling topography of low hills and plains with cool-winter precipitation up to 30 inches per year, and historically dominated by cool-season bunchgrasses. The most productive of these lands have been converted to agricultural use, and a long history of grazing; changes to stream flows and watercourses; and invasions by introduced annual grass species have converted most of the remainder to shrub steppe. Only remnants of the original grassland community now remain in steep and rocky sites, or in small isolated patches within an agricultural landscape.

Riparian Habitats

As discussed in the sections above, and in Section 3.3.4, riparian habitats are present along stream courses in each of the major habitat types. In the forested vegetative types, these areas are generally dominated by coniferous trees (spruce, fir, lodgepole pine), but also with high percentages of aspen, alder, and cottonwood. The amount of riparian habitats in forested areas is usually limited topographically, and has likely declined very little in extent over time, though in some areas they have been confined by transportation infrastructure which artificially channels long stretches of streams. The plant community age, composition, and structure in these often-narrow riparian areas is dynamic, being frequently altered by flooding, debris flows, fire, and wind; and their condition may have been degraded or altered by past logging, mining, and grazing.

Riparian and wetland habitats within the lower elevation grassland and shrub-steppe habitats in the Basin are more extensive, with broader floodplains than those in the forested regions. These habitats are frequently dominated by willow, or other shrubs at higher elevations, and with willow, cottonwood and alder at the lower elevations. The floodplains along these streams are often broad with seasonally- or temporarily-flooded hydrologic regimes that historically supported expansive wetland meadows, riparian shrublands, woodlands, and forest communities.

Human-caused modification of waterways and riparian habitats within the grassland and sagebrush-steppe vegetative types has been extensive. Water has been diverted for agricultural use, substantially reducing flows in some small streams and eliminating flow altogether in others. Vegetated riparian areas along these streams have been reduced or lost as a result of those reduced flows. Streams have been channeled and separated from their floodplains to provide ground suitable for mechanized agricultural practices. In most of these lands, beaver have been eliminated, allowing watercourses to condense to single channels with streams frequently down-cutting and head-cutting through floodplains, lowering water tables and converting many broad riparian habitat areas to sagebrush flats. Grazing and fire exclusion in these habitats has exacerbated the losses of functional aquatic habitats and healthy riparian vegetation.

Riparian vegetative communities are those most in need of restoration. They have been heavily altered and degraded by a century of human activity. Head-cuts, down-cuts and other changes to hydrology have lowered water tables and transformed these areas from wet or moist meadow habitats into dry meadows or sagebrush communities. These areas are now readily colonized by non-native and invasive plant species such as knapweeds, Dalmatian toadflax, and the winter annual grasses such as medusa head rye, cheat grass and other annual grasses.

In some areas, conifer or juniper encroachment have changed meadow and sagebrush steppe vegetative communities to forested or woodland vegetation types as a result of changes to the hydrologic processes and the exclusion of fire. During the past 130 years, western juniper has been expanding within its geographic range at unprecedented rates compared to any other time period during the Holocene (Miller and Wigand 1994). As an example, western juniper woodlands in eastern Oregon, historically restricted by natural fire to rocky hillsides, ridges and outcrops, have increased nearly five-fold as a result of fire suppression, increasing from 456,000 acres in 1936 (Cowlin et al. 1942) to 2.2 million acres in 1988 (Gedney et al. 1999). Encroachment and expansion of trees has reduced herbaceous vegetation by reducing water infiltration, increasing runoff, and displacing sunlight-dependent grasses, forbs, and shrubs. Studies that compared cut and uncut treatments in juniper patches reported substantial increases in herbaceous cover and biomass when trees were removed (Bates and Svejkar 2000).

3.3.3.1.2 Plant Species Listed Under the Endangered Species Act

There are 17 federally-listed plant species identified within the Basin as shown in Table 8. Most of these species occupy a very narrow range of habitats and are at risk because they either have an extremely small range and are associated with a highly specific habitat condition; or their habitat association is also highly valued for agricultural or grazing uses and has been modified or lost to that use.

Table 8 ESA-listed plant species in the Columbia River Basin

Species, ESA-listing Status, and Critical Habitat designation			Where found in Columbia River Basin					Likelihood of occurrence in restoration sites*
Species	ESA Status*	Critical Habitat	ID	MT	OR	WA	Location and Habitat	
Bradshaw's desert parsley (*Lomatium bradshawii)*	E	no	-	-	x	x	southern part of Willamette Valley in isolated remnants of the native bottomland prairie	highly unlikely
Golden paintbrush (*Castilleja levisecta*)	T	no	-	-	x	-	four experimental reintroductions in Willamette Valley native grassland	highly unlikely
Howell's spectacular thelypody (*Thelypodium howellii*)	T	no	-	-	x	-	sagebrush shrublands in Baker-Powder River valley in Baker and Union Counties	unlikely
Kincaid's lupine (*Lupinus sulphureus*)	T	yes	-	-	x	x	upland prairie remnants and ecotones between grassland and forest in Willamette Valley and southern Washington	unlikely
McFarlane's Four o-clock (*Mirabilis macfarlanei*)	T	no	x	-	x	-	steep river canyon grassland habitats in Snake River, Salmon River, and Imnaha River canyons	**Likely**
Malheur wire-lettuce (*Stephanomeria malheurensis*)	E	yes	-	-	x	-	hilltop sagebrush shrublands in Malheur County south of Malheur Lake	highly unlikely
Nelson's Checker – Mallow (*Sidalcea nelsoniana*)	T	no	-	-	x	x	Seasonally saturated soils in various habitats in Willamette Valley and southern Washington	unlikely
Showy stickseed (*Hackelia venusta*)	E	no	-	-	-	x	rock/talus/scree in conifer and woodland forests in Chelan County	highly unlikely
Slickspot peppergrass (*Lepidium papilliferum*)	T	yes	x	-	-	-	Semi-arid, sagebrush-steppe habitats of the Snake River Plain and Owyhee Plateau and adjacent foothills of southern Idaho	highly unlikely
Spalding's Catchfly (*Silene spaldingii*)	T	no	x	x	x	x	Deep productive soils in bunchgrass grasslands and sagebrush-steppe in Palouse prairies	**Likely**
Umtanum desert buckwheat (*Eriogonum codium*)	T	yes	-	-	x	-	Restricted to a particular basalt flow, growing on flat or gently sloping areas near the top of steep basalt cliffs along Columbia River east of Yakima	highly unlikely

Ute Ladies' Tresses (*Spiranthes diluvialis*)	T	no	x	x	-	x	Moist to wet riparian and wetland habitats shrub or forest habitats in disturbed habitats in Columbia and Okanogan river valleys in northern Washington and around Idaho Falls in eastern Idaho.	**Likely**
Water Howelia (*Howellia aquatilis*)	T	no	x	-	x	x	Submerged in seasonally flooded pothole ponds and former oxbows in Willamette Valley, northeastern WA, and Northwestern ID.	**Likely**
Wenatchee Mountains checker-mallow (*Sidalcea oregana* var. *calva*)	E	yes	-	-	-	x	Moist meadows with surface water or saturated upper soils into early summer within varied grassland, shrublands, or forested habitats in Chelan and Kittitas Counties	**Likely**
White Bluffs bladderpod (*Lesquerella tuplashensis*)	T	yes	-	-	-	x	On a single dry, barren, vertical exposure of hard, highly alkaline and calcareous substrate atop a bluff along the Columbia River within the Hanford Reach east of Yakima	highly unlikely
Willamette daisy (*Erigeron decumbens*)	E	yes	-	-	x	-	Herbaceous wetland prairie in valley bottoms in southern end of the Willamette Valley	unlikely
Whitebark pine (*Pinus albicaulis*)	C	n/a	x	x	x	x	upper subalpine forests of many western North American mountain ranges	highly unlikely
*Likelihood of occurrence was determined by comparing species' ranges, distribution, and habitat preferences with known locations of past restoration actions and areas of focus for ongoing contracts for tributary restoration actions.								

Among these species, only five have any reasonable potential for occurrence in a site that could be proposed for restoration activities (see right column, Table 8, and individual species discussions, below). Of these, four are associated with riparian or wetland habitats commonly found within river or stream corridors. Their ranges, however, are very geographically restricted and their potential occupancy of any proposed action site is low.

McFarlane's four-o'clock

Thirteen populations of MacFarlane's four-o'clock are currently found in west-central Idaho and northeastern Oregon. Three of these are in the Snake River Canyon area (Wallowa County, Oregon and Idaho County, Idaho), seven in the Salmon River area (Idaho County, Idaho), and three in the Imnaha River area (Wallowa County, Oregon).

MacFarlane's four-o'clock grows in rockslides, canyon walls, and sandy to gravelly talus slopes in steep river canyon grassland habitats characterized by warm and dry conditions. Sites are generally open (though scattered shrubs may be present), at elevations ranging from 980 to 2,050 feet. Associated species include beardless bluebunch wheatgrass, cheatgrass brome Idaho fescue, and sweet clover.

Spalding's catchfly

Spalding's catchfly is an herbaceous perennial endemic to the Palouse region of southeast Washington and adjacent Oregon and Idaho, and has a disjunct population in northwestern Montana and British Columbia, Canada.

The species occurs in dry to moist grasslands in bunchgrass and sagebrush-steppe habitats with Idaho fescue and bluebunch wheatgrass being the dominant components. Occasionally, plants can be found in open pine habitats.

Ute Ladies'-Tresses

Ute ladies'-tresses current range includes Utah, Colorado, Idaho, Nebraska, Wyoming, Montana, and Washington; and occurred in eastern Nevada, historically (USFWS 1992). Within the Basin, its range includes a small area adjacent to the Columbia River in Chelan, Okanogan, and Douglas Counties, north of Wenatchee, Washington.

It is a rare perennial, terrestrial orchid that occupies moist soils in mesic or wet meadows near springs, lakes, wet meadows, and along perennial streams (USFWS 1992).

Water Howellia

Water howellia formerly occupied a large range throughout the northwestern United States, but is now found primarily in three population centers: Montana's Swan Valley (Lake and Missoula Counties); US Department of Defense property at Lewis-McChord, Pierce County in western Washington; and Turnbull National Wildlife Refuge (Turnbull Refuge), Spokane County in northeastern Washington (USFWS 2019c).

Water howellia can be found as a minor component of the aquatic flora in ephemeral glacial ponds and former river oxbows that fill with spring moisture and dry down throughout the growing season. The ponds are often inhabited by other aquatic plants and introduced reed canarygrass (Lichthardt and Gray, 2003). The uplands surrounding water howellia habitat typically supports deciduous and evergreen trees and shrubs including willows, cottonwood, quaking aspen, alder, Engelmann spruce, Douglas fir, and lodgepole pine.

Wenatchee Mountains Checker-mallow

The Wenatchee Mountains checker-mallow is an endemic plant found only in mid-elevation wetlands and moist meadows within Chelan County in eastern Washington. It is found in meadows with surface water or saturated soils in the spring and early summer. It is also found in open Ponderosa pine or Douglas-fir conifer stands and on the margins of shrub and hardwood thickets when the soils in these habitats are saturated well into the early summer.

3.3.3.2 Environmental Consequences for Vegetation – Proposed Action

Restoring riparian and upland vegetative communities to healthy conditions is a major element in most restoration actions proposed by the Agencies and the actions of seeding and planting native species is expected to be a part of any action that includes ground-disturbing activity. Controlling invasive plants is also a likely component of most actions. Over the long term, therefore, the effects to vegetation from such actions would be the restoration, improvement, or maintenance of native plant communities.

In the short term, however, projects with construction activity could impact plant communities rather dramatically. When heavy equipment is put to use, soil is turned and plants are uprooted, buried, torn apart, etc., but the actions vary greatly in size. Some actions impact less than a tenth of an acre while some can heavily impact hundreds (Figure 4). Most proposed actions, however, would impact an acre or less.

Figure 4 Large-scale vs small-scale impacts from construction activities on restoration projects

Other, non-construction activities would also impact plant communities, though they would do so without the intense soil disturbance associated with heavy equipment use. These activities include those that remove vegetation by applying herbicides or prescribed fire; by removing juniper; or by applying water flows (permanent or seasonal). Actions with no ground or vegetation disturbance (e.g. surveys, fish trapping and transport, etc.) would have no effect on vegetation.

Table 9 displays the mechanism and extent of vegetative disturbance by the different categories of action. As stated above, the large majority of proposed actions would impact very little ground (e.g. fencing, culvert maintenance or replacement, etc.). Actions in Category 2, however, would be those most likely to disturb tens, if not hundreds, of acres each of soil and vegetation, but, only less than twenty of those actions would be anticipated each year across the entire Columbia Basin.

Table 9 Mechanism and Extent of Short-Term Disturbance to Vegetation by Proposed Categories of Action

Categories of Action	Mechanism of Disturbance				Typical Extent of Disturbance			
	Machine/manual	Chemical	Watering/Flows	Fire	< ¼ acre	¼ to ½ acre	½ to 1 acre	> 1 acre
Category 1 - Fish Passage Restoration								
Dams, Water Control, or Legacy Structure Removal	x					x		
Consolidate or Replace Existing Irrigation Diversions	x				x			
Headcut and Grade Stabilization	x						x	
Low Flow Consolidation	x						x	x
Providing Fish Passage at an Existing Facility	x				x			
Bridge and Culvert Removal or Replacement	x						x	
Bridge and Culvert Maintenance	x					x		
Installation of Fords	x				x			
Removal of Natural or Man-Made instream barriers	x						x	
Category 2 - Improving River, Stream, Floodplain, and Wetland Habitat								
Improve Secondary Channel and Floodplain Connectivity	x		x					x

Set-back or Removal of Existing, Berms, Dikes, and Levees	x		x					x
Protect Streambanks Using Bioengineering Methods	x						x	
Install Habitat-Forming Natural Material Instream Structure (Large & Small Wood & Boulders)	x						x	
Riparian and Wetland Vegetation Planting	x				x			
Channel Reconstruction	x		x					x
Install Habitat-Forming Natural Material Instream Structures (Sediment and Gravel)	x					x		
Remove Mine Tailings	x						x	
Category 3 - Invasive Plant Control								
Manage Vegetation using Physical Controls	x							x
Manage Vegetation using Herbicides (Riverine)		x						x
Juniper Removal	x			x				x
Prescribed Burning for Invasive Woody Plant Control				x				x
Prescribed Burning for Managing Vegetative Composition				x				x
No-Till and Conservation Tillage Systems	x							x
Category 4 - Piling Removal								
Piling Removal	x				x			
Category 5 - Road and Trail Erosion Control, Maintenance, & Decommissioning								
Maintain Roads	x				x			
Decommission Roads	x							x
Construct, Relocate, or Widen Roads or Trails	x							x
Category 6 - In-Channel Nutrient Enhancement								
Nutrient Enhancement	no ground/vegetation disturbing activities							
Category 7 - Irrigation and Water Delivery/Management Actions								
Convert Delivery System to Drip or Sprinkler Irrigation	x		x		x			
Convert Water Conveyance from Open Ditch to Pipeline or Line Leaking Ditches or Canals	x						x	
Convert from Instream Diversions to Groundwater Wells for Primary Water Sources	x				x			
Install or Replace Return-Flow Cooling Systems	x				x			
Install Irrigation Water Siphon beneath Waterway	x				x			
Livestock Watering Facilities	x				x			
Install New or Upgrade/Maintain Existing Fish Screens	x					x		
Category 8 - Habitat, Hydrologic, and Geomorphologic Surveys								
Habitat, Hydrologic, and Geomorphologic Surveys	no ground/vegetation disturbing activities							
Category 9 - Actions for Riparian and Upland Habitat Improvements and Structures								
Wildlife Structure Installation/Development	x				x			
Fence Construction for Livestock Control	x						x	
Upland Vegetation Planting	x				x			
Tree Removal for Large Wood Projects	x						x	
Debris Removal								
Interpretive Developments	x				x			
Upland Erosion and Sedimentation Control	x				x			
Category 10 - Artificial Pond Development and Management	x		x				x	

Construction Actions

As discussed in Section 3.1, the effect of construction activities on soils and vegetation can be severe in the short term by actions that require the use of heavy equipment such as backhoes, bulldozers, and loaders.

Most proposed actions with construction activities would impact small, discrete sites such as culvert or bridge locations, irrigation diversions, fish screens, etc. The footprints of these ground-disturbing actions are generally small, less than one or two acres (see Table 9), and the time between short-term adverse disturbance and the completed action being in place to provide long-term beneficial restoration is usually a matter of days or weeks.

Other project components such as river, stream, floodplain, and wetland restoration actions can impact dozens of acres of riparian, floodplain, and wetland habitats at each location; though given the operating windows and extent of work conducted, generally less than 20 acres at any one site is altered in any one year. A very few restoration projects would have riparian area disturbance exceeding 50 acres in a single year, though some projects, implemented in sequence and adjacent to each other can impact a couple of hundred acres over a multi-year time frame.

While the short-term mechanical damage to plants and plant communities is an obvious effect of construction activities, a more serious effect could be the creation of bare soil sites suitable for colonization by invasive plants. Nearly all construction actions implemented or funded by the Agencies would therefore also include follow-up treatments of invasive plants on these sites (see below).

Besides the obvious impact of construction activities on vegetation, four other actions proposed here have the potential to alter vegetative communities:

- the reintroduction of seasonal flooding flows;
- invasive plant treatments;
- juniper removal; and
- prescribed burning.

Effects on vegetation from reintroduction of seasonal flooding flows

Many Category 2 projects would introduce flows into side channels or floodplains that have not experienced consistent flowing water for many decades. In the absence of frequent watering, these channels have often converted to wet meadow or upland plant communities. When the flows are applied however, the plants not suited to saturated soils for long periods of time would die out, and would be replaced by plants that are so suited. Plant communities would thereby change to riparian or wetland communities. Some changes can be dramatic, such as the conversion of upland sagebrush/steppe plant communities to riparian plant communities. Figure 5 displays an example of the degree of change possible when beaver dam analogues (Category 2) are successfully applied.

Figure 5 Plant community change from sagebrush to riparian plant community

Effects on vegetation from invasive plant treatments (Category 3)

Treatments for invasive plants (manual, biological, or chemical) are implemented for two primary purposes: first, to prevent establishment of invasive species on disturbed soils created by construction actions associated with habitat restoration projects and, second, to attempt to restore landscapes to their native plant associations that have been displaced by established populations of invasive species.

Early eradication of newly-established populations is critical for maintaining native plant communities following soil disturbance. New invasive plant infestations do not produce the same level of lingering legacy effects in soil conditions as those that are long established, and restoration of native plant communities following establishment often fails (Tekiela *et al.* 2017). The Agencies' proposed activities, therefore would routinely conduct spot treatments of restoration sites where colonizing invasive plants may be found in the years following project completion. The effect on native vegetative communities by this type of invasive plant treatment is the maintenance of tha t native community by preventing its loss to invasive plants.

Some of the acreage of invasive plant treatments, however, would be on lands where invasive plants have become well-established, and the native plant community has been lost as a result. Bonneville would fund treatment of around 3,000 acres of riparian areas and 20,000 acres of upland areas in this condition annually. In these areas, the plant community affected by the action is the invasive plant community, and it would be removed with the goal of re-establishing a native plant community in its place. This, however, is a long term, multi-year process. On these sites, invasive plants would have well-established seed banks in the soils, and the soils themselves are often modified to the disadvantage of native species (Tekiela *et al*. 2017). Treatments in these areas are therefore ongoing, long-running, annual affairs, and accompanied by seeding, planting, and fertilizing in an effort to provide competitive advantage to native species. This treatment action, though applied over large acreages, is not an indiscriminate broadcast treatment, but is rather site-specific with applications made patch-by-patch or plant-by-plant that progresses and regresses across the landscape as treatments succeed or suffer setback. Ultimately, the vegetative community would transition from one dominated by invasive plants toward one dominated by native species.

Effects on Vegetation from Juniper Removal (Category 3)

Expansion of juniper in the Basin (primarily in central and eastern Oregon, southeastern Washington, and central Idaho) has occurred as a result of reduced fire frequencies over the past century. The species has increased in density and in total area covered, and has had the effect of displacing sagebrush and perennial grassland habitats by reducing available moisture and light, and by its adverse allelopathic[33] effects. Western juniper communities are susceptible to invasion by nonnative annual herbs in all stages of succession, particularly in late succession (Miller 2005), and annual grasses such as cheatgrass and medusahead often dominate post-fire plant communities that had been dominated by juniper, and once established, they greatly increase surface fuel continuity and hence, the potential for and recurrence of wildfires (Balch *et al.* 2013, Paysen *et al.* 2000). Hillsides dominated by western juniper produce more runoff on a more regular basis from thunderstorms than hillslopes that had juniper removed (Pierson *et al.* 2003). During large thunderstorms, erosion on western juniper hillslopes can be over 15 times greater than on the hillslopes without (Miller *et al*. 2005). Prescribed fire or manual/mechanical killing of juniper are actions designed to restore sagebrush and perennial grassland habitats to areas once dominated by juniper.

Removal of juniper would also increase the amount of water available to other vegetation. There would be less juniper tree cover to intercept rainfall and lose it to evaporation, and there would be less lost to infiltration into the soil, which is greater beneath juniper tress than on sagebrush - or grassland-dominated sites (Thurow and Hester 2019). Its removal would increase the amount of light and nutrients available to native plants that would be anticipated to increase in the absence of juniper, thereby improving site biodiversity and restoring the plant community to historical potential natural vegetation. These restoration effects of simply removing junipers, however, are likely to be realized only on sites not compromised by infestations of non-native annual grasses.

In juniper-dominated areas overrun with non-native annual grasses, the action of felling and leaving juniper on site, without follow-up treatments with herbicide and seeding to native shrubs and perennial grasses, would likely simply advantage the invasive grasses and increase their dominance (Dittel *et al.* 2018). If heavy equipment is used to topple juniper trees in areas where annual grasses are present, the risk of this invasive grass spreading would be even greater. Mitigations measures (Appendices A and B) requiring herbicide treatment and subsequent seeding to native species would minimize the potential for the spread of invasive grasses.

Effects on Vegetation from Prescribed burning (Category 3)

The effects of fire on vegetation can be highly variable, with effects driven by the vegetative conditions being burned (fuel flammability, moisture content, arrangement, etc.) and the weather conditions (wind, moisture, and temperature) under which they are burned. Wildfires, as opposed to prescribed fires, burn under conditions outside of human control; they are essentially unpredictable, and their effects on the pre-existing plant community can range from highly destructive to highly beneficial. Prescribed fires, however, burn under conditions selected so that fire can be controlled to produce an intended vegetative result. The discussion of fire effects in this section is focused on the effects of prescribed fire, not wildfire.

Prescribed fires are conducted under fuel and weather conditions specified in a burning prescription designed to produce the effects that would create the vegetative outcome desired. Under prescribed fire, fire intensity would be kept low, and the severity of impacts would also thus be low. While prescribed fires can sometimes get out of control, burning prescriptions can be in error, and applicators sometimes fail to follow prescribed burning prescriptions, the effects disclosed below are those anticipated from a properly designed burn prescription that would be properly applied.

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[33] Allelopathy is a biological mechanism by which an organism produces one or more biochemicals that influence the germination, growth, survival, and reproduction of other organisms.

Within prescription and implementation of mitigation measures, a prescribed fire's adverse impact to soil (a critical variable to achieving the desired vegetative result) would be minimized. Heat is contained at the soil's surface, water loss and mortality of soil fungi, bacteria, plant roots, and seed would be minimized, as would the volatilization of plant nutrients such phosphorous and potassium. Surface organic matter may be consumed, but there would be minimal impact to organic matter within the soil with no adverse effect to the soil's structure or functional capability for water transport or retention (Neary *et al*. 1999).

Plant species differ in their sensitivity to the effects of exposure to fire: some are fire resistant while others are highly fire-sensitive and are killed outright. They also differ in their post-fire reproductive strategies. Some have none, some re-sprout from their bases, and some have developed seed dispersal or stratification strategies that require a fire's heat to be spread or germinate (Franklin *et al*. 2006).

Prescribed fire's effect on vegetation extends beyond its effect to different plant species; effects are also highly variable depending on the ecosystem within which it is applied. Sagebrush steppe would respond to fire differently than would a forest, and there are different types of forest, each with distinct plant associations that would respond to fire uniquely (Franklin *et al*. 2006).

Effects of Prescribed Fire in Sagebrush Steppe

Historical fire regimes in sagebrush ecosystems varied considerably, with fire being largely absent in some of the drier locations, to being an important disturbance component in moister locations (Keane *et al.* 2008). Historically, wildfire served to restrain juniper expansion in areas of low moisture and productivity, or to maintain a mosaic of steppe plant communities in areas of higher moisture and higher productivity. Today, because of fire suppression over the past century, juniper has expanded greatly and previously diverse native plant communities have now simplified. Prescribed fire would be used to restore more historical sagebrush steppe vegetative conditions.

In sagebrush-steppe sites with low moisture and low productivity, historical fire intervals were generally long. But even then, those infrequent fires were effective in preventing dominance by western juniper (Block and Conner 2016). In the absence of natural fire, however, juniper has expanded, and in many places now dominates the landscape. When wildfire now passes through these drier juniper-dominated landscapes, invasive annual grasses are given the advantage and can dominate the entire understory. Prescribed fire may be applied in conjunction with mechanical juniper control and chemical weed control (where necessary to control annual grasses) to restore the dominance of sage in drier sites where it had declined.

In sagebrush-steppe sites with increased precipitation levels and higher overall site productivity, historical fire intervals were shorter and fires were higher in frequency. In these more productive sagebrush steppe sites, fire maintained a mosaic of grass, forbs, and shrubs (Block and Conner 2016). In the absence of fire, sagebrush has expanded and ultimately eliminated the grass/forb/shrub mosaic. Prescribed fire would be applied in these habitats to push back the juniper on drier sites, and restore the desired mosaic.

The application of prescribed fire would be expected to successfully kill western juniper in the drier, low-productivity sagebrush steppe communities where it now dominates. Fire would also, however, kill the sage if care is not taken to constrain it to juniper-dominated patches only; and in the absence of sufficient moisture, recovery of the sagebrush community may be delayed by many years (Beck *et al*. 2009). In high-productivity (moist) sagebrush steppe habitats, prescribed fire would be expected to effectively kill much of the dominating sagebrush and provide nutrients, moisture, and growing space for grasses and forbs and thereby recreate the historical mosaics of these plant communities.

Effects of Prescribed Fire in Forested Ecosystems

Prescribed burning in forests is frequently prescribed to address concerns about natural fuel levels (combustible forest debris that can carry a fire through the forest) or forest stand conditions (forest structure and species composition). Such burning is not an action frequently funded by Bonneville or conducted by the Reclamation (though it is routine for the USFS and BLM since they manage large tracts of forested lands). It can, however, be a small component of a larger project addressing restoration needs in adjacent meadows and riparian habitats. The primary purpose of the proposed burning activities would be to restore fire-resilient conditions in riparian forests to avoid future stand-replacement[34] by wildfire and thereby maintain a supply of large streamside trees for natural input into adjacent streams.

Prescribed burning in forests would produce a number of immediate effects. Young understory trees would be killed (the number and size of which would be dependent on the intensity of the fire applied and the condition of the stand being burned). Dead wood (down and standing) would be consumed to some degree, with the extent dependent on the intensity of the fire applied and the degree of protective measures applied to such forest features. Accumulated fine forest-floor debris (tree leaves, needles, small twigs, dead forbs and grasses) would be consumed, thereby exposing bare soil. Larger shrubs and trees may be fire-damaged or killed.

These effects provide conditions for the long-term indirect effects which are usually the goals sought by the action. The reduction of understory trees increases moisture availability for the remaining trees, improving their health and vigor, and thus their fire resiliency. The exposure of bare soils, increase in light exposure (from the reduction of understory trees), and the flush of nutrients released through the ash would provide a productive site for an increase in number and diversity of grasses and herbaceous plants which would likely arise from seed already present in forest soils. Some fire-damaged plants (grasses, forbs, shrubs and trees) would re-sprout from their bases. And though some down logs and standing dead trees may be consumed, many would not (in a properly prescribed and applied burn prescription), killed trees killed by the applied fire would provide for a succession of these forest features for the future. Overall, the health of individual forest plants would be improved, plant diversity in the forest would be increased, and the fire resiliency of the forest ecosystem on the treated acres would be increased. In riparian zones, the increase in plant diversity could be dramatic, given the overall greater plant diversity usually found in these areas.

Effects of Prescribed Fire in Wetlands, Meadows, and Prairies

Along meadow fringes, fire would be applied to push back forest or shrub encroachment. In these areas, trees of all sizes and ages would be targeted for removal to provide for expansion of the meadow back to some historically evident and prescribed extent. Such treatments may be preceded by tree felling and piling to ensure full solar exposure of the site following fire application. In such treatments, water tables are often elevated by the removal of trees; bare soil would be exposed, and understory plants that are components of the meadow being expanded would likely re-sprout or reseed. The change would not be immediate, since plants alter soil conditions for their own advantage, and such changes in the soils may take time in the transition from invasive forest back to a meadow plant community.

If the action includes tree or shrub cutting and piling of those cut trees and shrubs, then the applied fire would be anticipated to burn more intensely in those pile locations and perhaps damage the

[34] "Stand-replacement" is the term used to describe a post-fire condition where a large forested area was burned and all mature and old-growth trees were killed. The stand of mature and old growth trees is thereby "replaced" with a new forest starting from seed, sprouting, or planting.

soil, reducing its capability to support desired plant life in the short term. These soil-damaged sites would also be vulnerable to invasive plant infestation if seed sources are present.

Meadows vary widely. Some are wetland meadows in low, well-watered conditions. Others may be dry prairies on ridge tops or side-slopes. Plant ecologies would differ greatly in these conditions, but the anticipated result of properly tailored prescribed fire in each would be the removal of forest or shrub cover and the successive restoration of wetland, meadow, or prairie plant communities.

Prescribed fire would also be applied to wetlands, meadows, and prairies to reduce the density of dominant plant species and reduce the accumulation of dead organic material. The suppression of natural fire in these plant communities provides conditions for dominance of some species and the reduction of plant community diversity overall. Fire suppression also provides for the accumulation of thatch that can stifle new plant growth and decrease site productivity. Prescribed fire in these systems would consume the dead leafy thatch material and, in the process, kill some of the dominant plant cover. This would make nutrients and growing space available for other species native to the site, and those species would be anticipated to quickly appear in exposed soil sites from seed stores in those soils or from vegetative reproduction from remnant plants. Such burns would be repeated frequently (*e.g.* every five to ten years) to maintain desired condition.

A safety limitation of applying prescribed fire could dampen or delay the dramatic results described above. Natural fire historically burned with low intensity under the hottest and driest conditions in July, August, and September; and plants in the Basin are adapted to burns at these times and conditions (Block and Conner 2016). Prescribed fire, however, is seldom applied in such conditions because of the high risk of losing control[35] and the undesired consequences of the wildfire that could result. In fuel conditions prone to higher intensity fires, prescribed fire is therefore often applied during normally wetter months in the spring (April, May, or June), fall (October or November), or winter[36] if conditions are relatively dry. As a result, prescribed fire would often be applied when desired plants may be more vulnerable to fire damage (in the spring) or when their reproduction capability may be limited (in the fall) (Block and Conner 2016). Prescribed fire in the spring or fall would thus achieve some degree of the desired result, but likely not to the same extent had a low-intensity summer wildfire occurred on the same area (Feller 2004).

3.3.3.3 Effects Conclusion for the Proposed Action on Vegetation

Though the effects on vegetation from construction actions may be moderate in the short term, the long-term beneficial effects of increased riparian habitats and improved vegetative conditions would be high, thus when the short- and long-term effects are considered together, the overall effects of the Proposed Action on vegetation would be moderate.

3.3.4 Wetlands and Floodplains

3.3.4.1 Affected Environment

The actions proposed in this EA would be located in a very wide variety of wetlands and floodplains. The actions could be located high in a watershed where high-gradient streams flow through alpine or forest conditions and are constrained within their courses by rock or large in-

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[35] Fuel conditions after so many years of fire suppression create conditions where fire cannot be kept at low-intensities during dry months.

[36] Wetlands and marshes are often burned in winter when conditions are dry enough to burn the tops of plants across the underlying water or ice. This could be applied to thickets of tall marsh plants such as cattail, bulrush, or reed canary grass.

stream wood in narrow v-shaped canyons. By comparison, to wetlands and floodplains further downstream (where most projects have been, and would be proposed), wetlands here may be small and few; and floodplains would be narrow and confined. The ability of streams to interact with adjacent wetlands or floodplains at these elevations are frequently limited by road or railroad fills that confine streams within rip-rapped channels, or functionally separate the channel from its floodplain entirely, or are topographically separated from nearby wetlands.

In lower reaches, the Agencies propose actions in broad valleys, where the floodplains were historically very wide and streams connected[37] with them through the actions of seasonal flooding, beaver activity, and sediment supply and movement. Streams here were historically of lower gradient and anastomosed[38], with a tendency to migrate across a floodplain over time as floods move banks and deposit sediment in adjacent floodplains; or beavers dammed channels creating sediment-accumulating ponds, which ultimately force stream flows to find alternate routes. These are the areas that first attracted trappers who removed the beavers; and then ranchers and farmers who channeled, diked, and diverted flows to meet their irrigation needs. The conditions being proposed most frequently for treatment by the Agencies currently are channelized mainstem rivers and streams, low in their watersheds, with reduced flows or now-ephemeral flows, with little riparian vegetation. The former side channels and overflows are mostly cut off from water sources (except during the highest of flood events) and the main flows no longer migrate across floodplains. Such stream migration would disrupt established pastures, irrigated fields, travel and utility infrastructure, home sites, and towns. Floodplains and wetlands are functionally disconnected from their streams flows, and the natural system of sediment transport and deposition has been disrupted.

Figure 6 Modified floodplain conditions commonly treated in the proposed actions in agricultural lands

[37] A "connected" floodplain is one where high stream flows have the capability at varying flood levels to flow onto and across adjacent floodplains where its transported sediment can be deposited as the flows spread out, slow down, and lose energy

[38] Stream anastomosis refers to the branching and interconnecting structure, or network, of main channels, side channels, and seasonal overflow channels that divide then reconnect, with the main stream flow migrating from one to another over time across a floodplain.

Streams in these lower reaches may also travel through sagebrush-steppe habitats where the historical removal of beaver and the impact of grazing and transportation infrastructure has created conditions where rivers and streams have channelized and vertically down cut (Figure 7).

Figure 7 Down-cutting by stream channel in sagebrush-steppe habitats

Streams and rivers interact with adjacent groundwaters, and as these channels down-cut, they pulled the water tables down with them. These lowered water tables de-watered the extensive wetlands and meadows that historically were supported along rivers and streams through these arid habitats. Riparian communities are now confined to incised channels (Figures 7 and 8) with extensive loss of the sub-irrigated wetland conditions that existed before. Seasonal high flows and periodic flooding, which historically might have flowed over adjacent floodplain wetlands and deposited sediment, are now confined to incised channels where erosive forces are increased and focused, thereby producing more downcutting and further lowering of the water table.

Figure 8 Stream conditions that would commonly be treated in the proposed projects in sagebrush steppe wetlands and floodplains

In both agricultural and sagebrush steppe lands, most rivers and streams in the Columbia Basin are now disconnected (see footnote #36, Section 3.3.4.1) from their floodplains, and the wetlands once supported there have been converted to irrigated agricultural uses, or have been dewatered and converted naturally to sagebrush dominated plant communities.

Executive Order 11988, Floodplain Management, requires federal agencies to evaluate and avoid, to the extent possible, potential long and short-term adverse impacts of their actions in 100-year flood hazard zones[39] as shown on Federal Emergency Management Agency flood insurance rate maps. The objective of this Executive Order was to curtail development actions that might decrease floodplain function. In the actions proposed here, however, The Agencies would be funding/implementing restoration actions designed to reverse pre-existing adverse conditions this Executive Order was intended to prevent. Agency projects would restore floodplain function where possible without placing human infrastructure at risk.

3.3.4.2 Environmental Consequences for Wetlands and Floodplains – Proposed Action

3.3.4.2.1 __Wetlands__

Wetlands would be temporarily damaged or destroyed in the short term in most of the construction actions proposed here; but would be permanently restored, expanded, or improved a few days or weeks later by that same action. Actions in Categories 1 (Fish passage restoration), 2 (River, stream, floodplain, and wetland restoration), and 7 (Irrigation, water delivery, and water use actions) would be those most likely to damage then restore, wetlands as described here, with specific actions' effects differing in scale (see Table 9). Wetlands that are connected to streams being restored could be bladed over with a tractor and then re-constructed to be larger or better connected to that stream's flows, or they could be displaced by a newly-constructed river or stream channel and moved or expanded into an adjacent location. These are restoration actions, with the end result designed to improve the wetland condition and function in the project area. Though appreciable, the short-term effects would be temporary, with full or greater restoration being the end result. Figure 9 displays the same site during and after a stream restoration action under Category 2 showing the extent of short-term impacts and the improved end result for the long term.

Figure 9 Example of degree of disruption during and after stream restoration action in same year

One technique proposed for use to restore incised stream channels is the "pond and plug" method for re-elevating ground water levels in former wetlands. With this technique, pioneered in the Sierra Nevada National Forests, the stream channel is redirected (at the upstream end of the meadow/wetland) to the former floodplain's surface elevation, either in to a newly constructed channel or a former (pre-down-cutting) channel. The incised channel is then obliterated by constructing a series of earthen plugs with material excavated from banks along the incised channel above and below the 'plugs'. When the base level of the stream is raised (by its relocation into the new channel) the wetland's water table rises and the former, now widened, incised channel areas

[39] The 100-year floodplain areas are designated on these maps as areas with a one percent or greater chance of flooding during a given year.

fill with ground water resulting in 'ponds', and the surrounding excavated area become sub-irrigated at the elevation of the former wetland meadow and floodplain. Though the short term effects from bank excavations, plug construction, and channel relocation would be dramatic, these systems ultimately recreate wetland conditions that had been lost to sagebrush and dry grassland by the stream's incision (Figure 10).

For the long term, this treatment would reduce stream bank erosion and would improve riparian and wetland vegetation conditions. By raising the stream base level to the historical floodplain elevation, the ground water table would be restored. This re-watering of the wetland meadow would result in the re-establishment of riparian herbs and woody vegetation within a couple of years, though the constructed features may take longer. By raising the stream base level to floodplain elevation, the meadow's historical function of acting as a "sponge" and reservoir for runoff would be restored.

Figure 10 "Pond and plug" treatment "before" (left photo) and "after" (right) showing effects of elevated water table

Two proposed actions that impact wetland vegetation without the disruptive soil impacts from construction activities are the application of herbicides and prescribed fire (Category 3).

The application of prescribed fire (Category 3) in wetlands would be uncommon, but most likely applied where wetland plant vigor and complexity might be suppressed from accumulations of dead and decaying vegetative material. While fire in wetlands can remove this material, there may also be impacts to wetland soils. Wetland soils are composed primarily of decayed plant matter, and if dry when fire is applied, can itself burn, and do so for an extended period of time until flooding ultimately extinguishes it. This can have the effect of reducing soil mass, lowering elevations within wetlands, and increasing the amount of time that a spot in a wetland will remain under water each year (Watts *et al*. 2015). This may not be an adverse effect, but it would be a change.

Burning in wetlands would expose soils to solar radiation, and deposit ash on those soils altering its pH and increasing nutrient availability to plants. These effects would be strongly evident immediately after a fire, but modulated over a short period by the newly stimulated vegetative growth (Kotze 2013).

Other actions with no construction activity or herbicide application (e.g. fencing, planting, surveys, etc.) would have no or inconsequential short-term adverse effects, but would provide some long-term beneficial effect.

3.3.4.2.2 <u>Floodplains</u>

As with wetlands, projects within floodplains would be intended to improve long-term function, but the associated construction activities would have short-term adverse effects.

Typically, projects within floodplains would include the construction of secondary channels, side channels, and alcoves (Category 2). They also could include floodplain roughness[40] treatments. For construction feasibility, there may also be stream bypasses, staging areas, and access roads temporarily located on the floodplain (Figure 11).

Figure 11 Short-term impacts to a floodplain during restoration project showing conditions before (upper photo) and during (lower photo).

The floodplain would be greatly modified during construction, and its function would be compromised. This would be occurring, however, at a time of year when flows are low and floodplains would naturally have no, or limited, surface connections to their associated channels. Such projects would usually be completed in phases so that a segment of floodplain would be improved and capable of improved long-term function before the next high flows. If a section required multiple seasons, then mitigation measures would be applied to protect incomplete work,

[40] Floodplain roughness treatments includes the scarification or low level reshaping of soil surfaces, the planting of vegetation, and the placement of woody debris with the intent that these actions would slow the flow of water across the floodplain surface thereby increasing the potential for sediment to be deposited.

prevent erosive or polluting impacts to the river or stream, and ensure effective flow capacity and control during high seasonal flows.

Excavating new channels or reconnecting historical stream channels (Category 2), and then diverting a live stream into it can be disruptive to the landscape. Locations and amounts of flows are changed, and the initial flows of water through a newly constructed area, though gradually introduced, would mobilize and transport some amount of sediment, and the force of flows would begin the process of molding the new floodplain features: digging pools, establishing gravel bars, moving instream gravels and large wood water, and refining banks, diversions, and confluences. Until recently, such projects were rigidly designed with the intention that flows would conform to the channels as engineered. Currently, however, these projects are designed and constructed to provide the stream or rivers opportunities for flows and woody materials to be moved and placed as the stream might dictate. The current objective is on proper floodplain function and resilience rather than control. While the design would be expected to function effectively, some degree of change can be embraced if hydrologic conditions create something different from the conditions constructed.

With these types of projects, however, there is a risk that the newly-constructed channel may fail during subsequent high flows. This is especially the case if uncommonly high flows impact a newly restored reach before design flows[41] have a season or two to refine and stabilize that reach, and before vegetation has a chance to become established. The channel could return to its pre-project channel, or channel avulsions may cut off the constructed meanders, resulting in a relatively straight channel with little habitat complexity. The former would be more likely to occur when floodplain roughness is low, which can be the case when floodplains are reshaped and temporarily devoid of vegetation or large wood. The chance of channel avulsion would be greatest during the first year after channel construction and would decrease as riparian vegetation becomes established. Liberal placement of large woody debris, wood structures, planted (or transplanted) riparian vegetation, erosion controls, and fencing would all contribute to early and effective floodplain roughness and minimize this risk of channel avulsion.

By restoring stream flow connection to historical floodplains, either through raising the stream base level to floodplain elevation, or by increasing anastomosed conditions, the floodplain's historical function of acting as a "sponge" and reservoir for runoff would be restored. When floodplain function is restored, a portion of winter and spring runoff is stored in floodplain soils where it is available for release later in the spring and summer. This restored function would result in some degree of improved flow timing, including augmentation of some seasonal flows, potentially resulting in benefits for aquatic species and downstream irrigators. The primary flow augmentation effect would typically occur in late spring as stored groundwater from winter and spring runoff flows out of floodplain soils to the stream channel. This augmentation of channel flow would often extend into summer months, but the degree of this effect would vary from site to site.

Restoration of floodplain function would result in increased transpiration of groundwater where ground cover would be converted from dry-land species like sagebrush to riparian species from which transpiration would be greater (Loheide 2005; Hammersmark 2008). Potential for evaporation of ground water would also be increased by the creation of ponded water in the "plug and pond" restoration areas. Increased post-project evapotranspiration could result in reduced base flow within the project reach during late summer, though potential reductions could likely be

[41] "Design flows" are the varying amounts and elevations of river or stream flow to which a restoration project has been designed and that are typical for the river or stream reach being restored.

offset by increased flows, and increased floodplain connection with those flows, from other project actions.

Reconnection of a stream to its floodplain would create conditions for that floodplain's flood response to be closer to historical condition by increasing water storage capacity and slowing the flow of flood waters. This could result in a flood-control benefit for downstream landowners and municipalities (Plumas N.F. 2010) since, at the project level, most projects would be expected to attenuate the peaks of flood flows. The degree of such attenuation, however, would vary based on the degree of flooding, the size of the floodplain, the degree of reconnection, and the degree of saturation of floodplain soils before the flood (saturated or not) (Hammersmark 2008).

3.3.4.3 Effects Conclusion for the Proposed Action on Wetlands and Floodplains

The short-term effects on floodplains would be high from the impacts of heavy equipment operations during Category 2 actions; and the temporary, but complete, disconnection of the stream from its floodplain while in bypass channels. The long-term beneficial effects, however, of greatly improved stream/floodplain connection; restored floodplain function; and riparian habitat improvements, even considering the short-term adverse effects, would make the overall effects on wetlands and floodplains low.

3.3.5 Wildlife

3.3.5.1 Affected Environment

3.3.5.1.1 Wildlife Habitats and Use

The Columbia River Basin supports a diverse range of habitat types in its mountains, forests, meadows, grasslands, sage-brush steppes, farmlands, river bottoms, and waterways as shown in Table 10. Those habitats however, have changed dramatically over the past 150 years. Habitat and its utility for wildlife has been lost through conversion and fragmentation by agriculture or invasive species; and much of the remaining habitat has been degraded by livestock grazing, forest management activities, mining, and alteration of historical fire regimes. As described in Section 3.3.3, "Vegetation", all major habitat types have been altered by human uses and activities. For the most part, these alterations have degraded the habitats for use by many native wildlife species. As can be concluded from the discussions in Section 3.3.2, "Water Resources", riparian and wetland habitats, found within all habitat types (forest, shrub-steppe, etc.), have also decreased in area, and have been degraded for wildlife use.

Basin wildlife's use of these habitat types is variable, with some species being dependent on very specific habitats or structures, while others are more generalist in nature, occupying territories composed of a wide range of habitats. Table 10 displays the number of species known to associate closely with specific habitat types commonly impacted by the proposed actions in the Columbia Basin (adapted from Johnson and O'Neil 2001; species lists for these habitats can be found in Appendix E).

Table 10 Number of Wildlife Species by habitat to which they are closely associated.

Wildlife-Habitat types commonly or potentially impacted by funded Agencies' restoration actions		Number of Closely Associated[1] species[2]
Forest	Montane mixed conifer Forest	35
	Eastside (interior) Mixed Conifer Forest	38
	Lodgepole Pine Forest and Woodlands	15
	Ponderosa Pine Forest and Woodlands	26
	Upland Aspen Forest	4
Alpine	Subalpine Parkland	19
	Alpine Grasslands and Shrublands	19
Grasslands, Shrub-Steppe, Agriculture	Western Juniper and Mountain Mahogany Woodlands	17
	Eastside (Interior) Canyon Shrubland	13
	Eastside (Interior) Grasslands	33
	Shrub-steppe	47
	Dwarf Shrub-steppe	23
	Desert Playa and Salt Scrub	27
	Agriculture and Pastures Mixed Environs	68
Wetlands and Riparian	Herbaceous Wetlands	105
	Montane Coniferous Wetlands	17
	Eastside (Interior) Riparian Wetlands	81

[1] The term "Closely Associated" refers to a species that is widely known to depend on a specific habitat or on specific structural conditions for part or all of its life history requirements (from Johnson *et al.* 2001).
[2] There is overlap in these numbers between similar habitat types. See Appendix E for species listing by habitat type.

The wetland and riparian habitats support more wildlife species than do other habitats. This habitat type has been impacted more than any other in the Basin by historical land uses, and it is this habitat type that the Proposed Action would primarily target in its habitat improvement efforts.

Among these habitats, the wetland and riparian types stand out as supporting more closely-associated wildlife species (see footnote, Table 10) than do other habitats. This habitat type has been impacted more than any other in the Basin by historical land uses, and it is this habitat type that the Proposed Action would primarily impact (short-term) and ultimately improve (long-term). Some species, such as beaver, muskrat, otter, mink, kingfisher, etc. are dependent on aquatic and riparian habitats, and have the most to gain from the Proposed Action. Even if not closely-associated, most species are known to forage in riparian areas at least 50 percent of the time (Kauffman et al. 2001).

Actions within riparian areas may also affect more habitat-generalist species such as deer or coyote, which have a high degree of habitat adaptability but use riparian habitats opportunistically. Restoration actions in riparian areas would also likely affect species with very large home ranges such as lynx, wolverine, or wolves. These species may use aquatic, riparian, or wetland habitat conditions incidentally as they occur within their home ranges, but they are not dependent on them for their forage, seasonal survival, or reproductive needs. Restoration actions may disturb or temporarily displace these species, but have no real consequence on their survival.

Other than the riparian habitats, the shrub-steppe habitats have been particularly hard hit by agricultural conversions, occupancy by invasive plants, expansion of western juniper, and modified fire regimes. Approximately six million hectares of shrub-steppe have been converted to wheat fields, row crops, and orchards in the interior Columbia Basin (Quigley and Arbelbide 1997). In Washington, over 50% of historical shrub-steppe has been converted to agriculture (Dobler et al. 1996). The results have been the permanent loss of native habitat and the isolation and fragmentation of the remaining shrub-steppe habitat within a landscape of multiple land uses. This large-scale displacement of one habitat type for another has substantially reduced the area available to native shrub-steppe wildlife. In a 1997 analysis of Neotropical migratory birds within the Interior Columbia Basin, most of the species identified as being of "high management concern" were shrub-steppe species (Saab and Rich 1997).

Some habitats created by agricultural development, however, have values for wildlife. Wetlands associated with agricultural development (created as part of numerous irrigation projects) provide breeding and feeding areas for species such as nesting waterfowl and marshland birds not typically associated with the grasslands and shrub-steppe converted to that use. Amphibians and small mammals also benefit from this type of habitat development.

3.3.5.1.2 <u>Wildlife Species</u>

The Basin is home to over 700 species of wildlife[42] of which approximately 5% are amphibians, 5% reptiles, 75% birds, and 15% mammals occupying the high diversity of habitats in the Basin.

Amphibians

Amphibians can be found in all habitat types in the Basin, but they are especially dependent on aquatic habitats, since nearly all amphibians found here breed in riparian zones (Johnson et al. 2001)]. These species are therefore highly sensitive to habitat changes, and are good indicators of aquatic and riparian health.

Conversions of wetlands to agriculture, and water diversion for irrigation needs, have resulted in declines of amphibian (and reptile) populations across the west, and certainly within the Basin. Ongoing stressors to these species include the application of pesticides and herbicides, by which they can be killed outright or adversely affected physiologically (Hayes, 2013); livestock grazing, which reduces streamside vegetation thereby diminishing foraging habitat; and by livestock trampling of burrows with destruction of eggs and nests (Kauffman et al. 2001).

Though all Basin amphibians can be found in riparian areas, only a few are found in riparian zones within sagebrush-steppe habitats. Johnson et al. 2001 found that only three of the 21 species of salamander in Oregon and Washington are known to occur in riparian areas within shrub-steppe habitats; though seven of the 11 native toads can be found there. Of these toads, only three, the Great Basin spadefoot (*Spea intermontana*), the Western (*Anaxyrus boreas*), and Woodhouse's toad (*Anaxyrus woodhousii*) can generally be found in these habitats away from standing water.

Ongoing threats to amphibians include road traffic, fires (both wild and prescribed), and annual agricultural activities such as mowing and disking. Another threat to amphibian species within the Basin comes from the introduced American bullfrog. These large frogs prey on native frogs and tadpoles, and other amphibians and small aquatic species, and frequently extirpate native species from local ponds, backwaters and ditches.

Reptiles

Reptiles are not considered closely associated with any specific habitat type in the Basin, though in shrub-steppe habitats their species diversity is relatively high. Reptile choice of habitats is driven more by the need for warm climates, rocks, talus, and soils than by the presence of general vegetation types, thus most reptiles are found in the Basin's lower-elevation grassland and shrub-steppe habitat types than in the higher forests or alpine areas (Sallabanks *et al.* 2001) where their desired thermal conditions are more consistently available than in other habitats (VanderHaegen et al. 2001). Within these thermally-preferred grassland and shrub-steppe habitats, however, reptiles

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[42] A detailed listing of most of these species and their habitat needs and associations can be found in Johnson et al, (2001), but such a listing or detailed species by species discussion is not duplicated here.

are drawn to riparian areas because of the relative of abundance of prey species there over that in the surrounding grass or shrublands.

As with other species, the reptiles of the Columbia Basin have declined in response to changes in their habitats including the reduction of shrub-steppe habitat and an increase in agriculture and urbanization. Ongoing pressures come from road traffic, fires, and agricultural activities which all take their toll of Basin reptiles each year.

Birds

Over 500 species of birds can be found across the habitats of the Basin, but their habitat use is generally clustered around riparian areas within the larger habitat types. Over 70 percent of birds <u>use</u> freshwater riparian and wetland habitats, and close to 80 percent <u>breed</u> there (Kauffman et al. 2001).

The alteration of historical vegetation communities (see Section 3.3.5.1.1, above) has impacted bird habitats through species' range reductions, population declines, and some local and regional extirpations. In the Columbia Plateau Breeding Bird Survey Physiographic Region, 16 species have substantial declining population trends (Altman and Holmes 2000). Several other species are considered by many to be declining (e.g., bobolink, Lewis' woodpecker) though data are lacking (Altman and Holmes 2000).

Riparian areas are especially important to bird populations in the Basin. Diversity of avian species in wetlands and riparian habitats is higher than in upland habitats, and more than half of the bird species are closely associated with this habitat type. Kauffman et al. (2001) found that over 82% of inland bird species in Oregon and Washington use riparian and wetland habitats and 77% breed there. These areas are essential for breeding for many bird species, and the reduction of them has resulted in a reduction in breeding bird populations (USFWS 1995).

Riparian areas are also critical wintering habitats for resident land birds and critical migratory habitats for species that winter north of the U.S. border (Knopf, et al 1988 and 1994). Neotropical migratory birds[43] focus on riparian areas for their breeding and migration, with the diversity of migrating species being as much as 14 times higher in riparian than in non-riparian habitats (Henke and Stone 1979). Stevens *et al. (*1977) found that the abundance of migrating Neotropical migratory birds may be ten times greater in riparian zones than in surrounding uplands.

Human actions within riparian habitats have been especially impacting to bird populations in the Basin. Altman and Holmes (2000) identified a number of factors impacting riparian habitats that have reduced bird populations here:

- Riparian habitats have been lost to riverine recreational developments, inundation from impoundments, cutting and spraying to ease access to water courses, gravel mining, etc. These actions are also a source of bird disturbance, particularly during nesting season, and particularly in high-use recreation areas.
- Riparian habitats have been reduced, vegetative structure has been simplified, and the area of natural flooding has been reduced by the dewatering or reduced flows from irrigation diversions. This has also limited recruitment of young cottonwoods, ash, willows, etc. in many areas.

[43] A Neotropical migratory bird is a bird that breeds in Canada and the United States during summers and spends the winters in Mexico, Central America, South America, or the Caribbean islands.

- Stream bank stabilization has narrowed stream channels, reduced the flood zones, and reduced the extent of riparian vegetation.
- Livestock grazing has degraded bird habitat in many riparian areas by widening channels, raising water temperatures, and reducing understory cover.
- Invasive plants such as reed canary grass, purple loosestrife, perennial pepperweed, salt cedar, indigo bush, and Russian olive habitat have eliminated or degraded native riparian shrub and herbaceous vegetative habitats.
- Large intact tracts of riparian habitat have been lost or fragmented, which have impacted area-sensitive species such as yellow-billed cuckoo.
- Landscapes hostile to native birds, such as those in proximity to agricultural and residential areas, now support a high density of nest parasites (brown-headed cowbird), exotic nest competitors (European starling), and domestic predators (cats), and are sources of high levels of human disturbance.
- Habitat conversions have favored the European starling, which now competes with native bird species such as Lewis' woodpecker, downy woodpecker, and tree swallow for cavities suitable for nesting. Even when the outcome of the competition is successful for native species, the high energetic costs from high rates of competitive interactions reduces reproductive success.

Impacts in shrub-steppe habitats have also impacted birds in the Basin. Approximately 56 native bird species are known to be highly-associated with shrub-steppe habitats for breeding, and though this is a relatively few species, several are dependent upon this vegetation type such that they are found nowhere else in Oregon and Washington (Rotenberry and Wiens 1978, Wiens et al. 1986). These include those species that require this specific habitat type: sage grouse, sage sparrow, sage thrasher, and Brewer's sparrow; and other non-obligate species such as burrowing owl, Swainson's hawk, ferruginous hawk, loggerhead shrike, long-billed curlew, sharp-tailed grouse, upland sandpiper, and black-throated sparrow.

Greater Sage-Grouse has been impacted greatly by the reduction and fragmentation of high quality shrub-steppe habitats. They have experienced declines and local extirpations in the Basin from habitat loss and fragmentation, juniper expansion into sagebrush, and impacts of increased fire frequency and intensity on sagebrush due to invasive annual plants. These birds require expansive sagebrush habitat that encompasses a mosaic of conditions including wet meadows and riparian fringes with abundant native forbs for brood-rearing. These are habitats on productive soils, the type of soils historically converted to agriculture. They are also sensitive to human disturbance at leks (their breeding sites).

Mammals

The Basin provides a diverse array of habitats and conditions that support over 80 species of mammals in its forests, woodlands, sagebrush-steppe, and riparian zones. Of these habitats, more mammals are associated with forest and woodland habitats than with sagebrush steppe. Shrub-steppe habitats support approximately half of the small mammal species (mice, shrews, gophers, and ground squirrels) than does forest and woodland habitats, and a quarter or less of the carnivore species (Vander Haugen et al 2001).

Riparian habitats, however, are found among all vegetative types and provide forage and structural conditions sought by many species, such that species more commonly associated with forest vegetation might also be found in larger riparian corridors within shrub-steppe communities (e.g. black bear and beaver) (Vander Haugen 2001). Lava formations, talus slopes, and rocky cliffs and outcrops are similar in their effect on mammal distribution in the Basin. Where species more closely associated with a structural component of habitat than vegetative may be found in most places where that feature occurs across many vegetative conditions.

Few mammal species are dependent on specific vegetation types in the Basin. The pronghorn and pygmy rabbit, and, to a lesser degree, the sagebrush vole, are the species most dependent on a specific vegetative type (sagebrush). All others exhibit use of a broad range of vegetative conditions, with selection dependent more on forage availability or structural features within the home range.

Some species (e.g. grizzly bear, wolf, and wolverine) require large areas remote from human disturbance. These conditions, and thus these species, are more readily found in the forest and woodlands in the mountainous areas of the Basin, though in some cases (wolf, for example) the species could also readily occupy high quality, low elevation, shrub-steppe and grassland habitats. These high-quality shrub and grassland habitats, however, have been converted to agricultural uses in most of the Basin, leaving only low-productivity habitats where forage production and prey availability is insufficient for supporting such species today.

Some species occupy both major habitat types in the basin. Mule deer, for example, are found year-round in both forest and sagebrush steppe, while elk are known to find their winter range in sagebrush-steppe habitats, but spend their summer and breeding periods in the higher-elevation forest and subalpine habitats.

Mammalian species most likely to be affected by aquatic and riparian restoration actions in the Basin are those most closely associated with riparian and aquatic habitats such as beaver, muskrat, mink, and otter. Of these, the beaver would likely be most affected, as its function as hydrologic engineer of floodplains would be mimicked by the use of beaver dam analogues (thereby increasing potential home ranges); its potential habitat would be expanded in secondary and side channel developments; and the animal itself would be translocated in the hopes of restoring their occupancy and function to specific drainages.

3.3.5.1.3 Wildlife Species Listed Under the Endangered Species Act

Many wildlife species in the Basin are listed as “Threatened” or “Endangered” under the Endangered Species Act (Table 11).

Table 11 ESA-listed wildlife species and likelihood of consequential* project actions within a species home range

Species, ESA-listing Status, and Critical Habitat designation			State				Likelihood of consequential* project actions within a species home range (with rationale)
Species	ESA Status	Critical Habitat	ID	MT	OR	WA	
Mammals							
Canada Lynx (*Lynx canadensis*)	T	yes	x	x	x	x	Unlikely (large home range and preferred/concentrated use areas remote from most action sites)
Columbia Basin Pygmy Rabbit (*Brachylagus idahoensis*)	E	no	-	-	-	x	Highly unlikely (only one ESA-listed population - in single county in Central Washington where habitat-damaging actions would not be applied.)
Columbian White-Tailed Deer (*Odocoileus virginianus leucurus)*	T	no	-	-	x	x	**Likely (where restoration actions are located in lower Columbia River)**
Fisher (*Pekania pennanti*)	C	n/a	x	x	x	x	**Likely (where restoration actions located in riparian within mature to late seral forests)**
Gray Wolf (*Canis lupus*)	E	no	-	-	-	x	Unlikely (large home range and preferred/concentrated use areas remote from most action sites)
Grizzly Bear (*Ursus arctos horribilis*)	T	no	x	x	-	x	Unlikely (large home range and preferred/concentrated use areas remote from most action sites)
North American Wolverine (*Gulo gulo)*	C	n/a	x	x	x	x	Unlikely (large home range and preferred/concentrated use areas remote from most action sites)
Northern Idaho ground squirrel (*Urocitellus brunneus*)	T	no	x	-	-	-	Highly unlikely (historical and current distribution located in two Idaho counties where no restoration actions past or foreseeable)
Red Tree Vole (*Arborimus longicaudus*)	C	n/a	-	-	x	-	Unlikely (only the North Oregon Coast population is proposed for listing, with only a narrow area of habitat in the Lower Columbia River with potential overlap with Basin; no actions past or foreseeable in this location)
Woodland Caribou (*Rangifer tarandus caribou*)	E	yes	x	-	-	x	Highly unlikely (extremely limited range; highly protected habitat in area where no restoration actions past or foreseeable)
Birds							
Marbled Murrelet (*Brachyramphus marmoratus*)	T	yes	-	-	x	x	**Likely (where restoration actions located in riparian within mature or late seral forests in lower Columbia River)**
Northern Spotted Owl (*Strix occidentalis caurina*)	T	)yes	-	-	x	x	**Likely (where restoration actions located in mature or late seral conifer forests in the Cascade Range**
Streaked Horned Lark (*Eremophila alpestris*)	T	no	-	-	x	x	**Likely (where restoration actions located in sparsely vegetated lands in lower Columbia River and Willamette Valley)**
Western Yellow-billed Cuckoo (*Coccyzus americanus*)	T	no	x	x	x	x	**Likely (where restoration actions located in riparian woodland patches greater than 50 acres)**
Amphibians							
Oregon Spotted Frog (*Rana pretiosa*)	T	yes	-	-	x	-	Unlikely (it's found in functionally intact, large, warm-water, perennial marshes which are unlikely sites for restoration actions)
Snails							

Banbury Springs Limpet (*Idaholanx fresti*)	E	no	x	-	-	-	Highly unlikely (extremely limited range in mainstem Snake River upstream of anadromous fish limits; no restoration actions past or foreseeable in range of these species)
Bliss Rapids Snail (*Taylorconcha serpenticola*)	T	no	x	-	-	-	
Bruneau Hot Springsnail (*Pyrgulopsis bruneauensis*)	E	no	x	-	-	-	
Snake River Physa (*Physella natricina*)	E	no	x	-	-	-	
Insects							
Fender's Blue Butterfly (*Icaricia icarioides fenderi*)	E	yes	-	-	x	-	Unlikely (it's found in Willamette Valley native prairie habitats which are unlikely sites for restoration actions)
Meltwater Lednian Stonefly (*Lednia tumana*)	C	n/a	-	x	-	-	Highly unlikely (it's found in high-elevation alpine streams which are unlikely sites for restoration actions)
Taylor's Checkerspot (*Euphydryas editha taylori*)	E	yes	-	-	x	x	Unlikely (it's found in open grasslands and grass-oak savannahs of western OR and WA which are unlikely sites for restoration actions)
*for the purposes of this discussion, the term "consequential" indicates a situation where a proposed action within a listed species' home range could, at a minimum, disturb or otherwise affect the behavior of the species considered.							

Among these species, only six are likely to use sites that could be proposed for restoration activities (see right column, Table 11, and individual species discussions, below). Of these, none are closely associated with riparian or wetland habitats commonly found within river or stream corridors, nor is their foraging preference identified as riparian, wetland, or floodplain habitats. Their ranges and habitat use tendencies, however, overlap areas and habitats which could be impacted by proposed restoration actions. These species may be impacted solely because restoration sites might be located in riparian corridors that are located within surrounding habitats and geographic areas known to be used by these species.

Columbian White-Tailed Deer

The Columbia River DPS of the Columbian white-tailed deer occurs along the lower Columbia River in Oregon and Washington from Wallace Island at River Mile (RM) 50 downstream to Karlson Island at RM 32. The islands and bottomlands within this 18-mile stretch of the lower Columbia River contain most of the Columbian white-tailed deer range and supports the four main subpopulations: Washington mainland, Tenasillahe Island, Puget Island, Wallace Island-Westport. There is an additional minor subpopulation at Karlson Island that is geographically separated from the others by a main river channel or patches of unfavorable habitat. Julia Butler Hansen National Wildlife Refuge was established in this 18-mile stretch by USFWS for the recovery and maintenance of the Columbian white-tailed deer.

Fisher

The fisher is a small carnivorous mammal in the weasel family that occupies continuous, mature/late-seral coniferous forest. Though this habitat type is abundant in the Basin, fisher populations have only recently been reintroduced to northwestern forests following their extirpation in the early 20th century. Populations now exist in the southern Oregon Cascades (outside the Basin) and in north-central Idaho (within the basin), but the remainder of the Basin appears to be occupied by scattered individuals with no discernable populations centers or increase (USFWS 2016 and Sauder 2014). Their apparent requirement for very dense forests with abundant large woody debris may limit their occupancy in most forests east of the Cascade Range where forests are more open and more frequent fires limit the amount of woody debris and understory vegetation.

Fishers prefer forests with very high canopy closures, moderately large trees for denning (minimum 24 inches in diameter in western forests as per Truex *et al* 1998 and USFWS 2016), and forest floors with a high degree of downed logs and coarse woody debris. Riparian areas are selected in forested habitats where recent fire, logging, or frequent fire-return intervals minimize these structural features in surrounding non-riparian areas. Fishers have large home ranges in the western United States, with females' averaging 7.3 square miles and males' averaging 20.6 square miles (USFWS 2016).

Fishers may have the potential to encounter restoration actions throughout the Basin. Their likely preference for riparian corridors in forests east of the Cascades and their large home ranges increases the likelihood they could encounter a restoration site, if that site was located in dense riparian forest rather than within an open floodplain.

Marbled Murrelet

The marbled murrelet is a small seabird that uses large trees within old-growth forests for roosting, courtship, and nesting. Its range includes Oregon and Washington where it has been seen to fly inland as far as (42 miles) to find suitable nesting habitat (Burger 2002).

Marbled murrelets have the potential to encounter restoration actions where those actions are in riparian areas within old-growth forest along the lower Columbia River or its tributaries within 50 miles of the ocean.

Northern Spotted Owl

The Northern spotted owl is found in old growth forests and occasionally in younger conifer forest of the Cascades, Sierra Nevada, and coastal mountains of British Columbia, Washington, Oregon, and northern California. The range of the spotted owl habitat generally coincides with old growth and late succession conifer forest below 5,000 feet elevation.

Northern spotted owls generally have large home ranges and use tracts of land containing substantial acreage of older forest (Thomas et al. 1990). Nesting pairs require 2,000 to 5,000 acres of conifer forest habitat, usually dominated by Douglas fir (Smith et al. 1997). Northern spotted owl nesting and roosting habitat typically include a moderate to high canopy closure of 60 to 80%. Multi-layered trees with various deformities provide cavities for spotted owl nesting (Thomas et al. 1990). Spotted owls use a wider variety of forest types for foraging, including more open and fragmented habitat (Thomas et al. 1990).

Northern spotted owls in riparian areas within old-growth forest along the lower Columbia River or in the Cascade Range in Oregon and Washington.

Streaked Horned Lark

The streaked horned lark, a subspecies of the wide-ranging horned lark, is endemic to the Pacific Northwest. It is a small, ground-dwelling bird, approximately six to eight inches in length. The current range of the streaked horned lark includes the Puget lowlands in Washington (outside the Basin); the Washington coast and lower Columbia River islands (including dredge spoil deposition sites near the Columbia River in Portland, Oregon); and the Willamette Valley in Oregon (USFWS 2019a).

Streaked horned larks require wide open spaces with no trees and few or no shrubs. They select for native prairies, grasslands, agricultural fields, and airports; and nest on the ground in sparsely vegetated sites (USFWS 2019a). Disturbance or active management is usually required to maintain habitat suitability for these birds. Their habitat adjacent to the Columbia River from Corbett, Oregon, west is designated critical habitat.

Streaked horned larks have the potential to encounter tributary restoration actions where those actions may include native prairies, fallow and active agricultural fields, wetland mudflats, sparsely-vegetated edges of grass fields, moderately- to heavily-grazed pastures, and gravel roads or gravel shoulders of lightly-traveled roads (USFWS 2019a).

Western Yellow-Billed Cuckoo

The yellow-billed cuckoo once ranged in the United States from the Rocky Mountains to the Pacific Ocean (Johnson 2009), but southeast Idaho is now the northern limit of breeding activity in the western interior. The yellow-billed cuckoo breeds throughout much of the eastern and central United States, winters almost entirely in South America east of the Andes, and migrates through Central America (USFWS 2019b). In the western U.S., the cuckoo is generally imperiled or presumed extirpated. In the Basin, it is presumed extirpated in Washington and Oregon, though transient individual sightings have been recorded in recent years (Marshall 2003); critically imperiled in Idaho, with breeding along the upper Snake River documented in recent years (Cavallaro 2011); and vulnerable in Montana (NatureServe 2019).

Habitat consists of low to moderate elevation riparian woodlands generally greater than 50 acres in size within arid to semi-arid surroundings. These large blocks of wooded habitat are needed to support the cuckoo's large home range size. Suitable habitat generally consists of multi-storied old-growth riparian forest with dense vegetation and a thick upper and mid canopy. In the western United States cuckoo nests are often placed in willows along streams and rivers, with nearby cottonwoods serving as foraging sites (USFWS 2019b). These conditions can be found in scattered locations along the major floodplains throughout the Columbia River Basin.

In 2014, the USFWS listed the Western yellow-billed cuckoo as Threatened and proposed critical habitat for the species. Within the Basin, the critical habitat proposal included only habitats in the Snake River valley in southern Idaho; and along the Big Wood, Henry's Fork, and Teton Rivers in the upper Snake River basin in southeastern Idaho. All of these areas are upstream of the range of anadromous fish, and generally outside of the Agencies' habitat restoration actions.

3.3.5.2 Environmental Consequences for Wildlife – Proposed Action

In general, restoration activities would have short-term adverse impacts with long-term positive effects on most wildlife species and their habitats. The goal of the proposed restoration actions is to restore the ecological function of native habitats primarily aquatic habitats, riparian corridors, and floodplains. Improvement of impaired aquatic and riparian habitat function and condition is expected to increase and improve wildlife habitat resiliency, carrying capacity, and connectivity within and between watersheds. This would increase wildlife species' reproductive potential both at the individual level (from improved site conditions within a home range) and at the population level (by improving dispersal capabilities between disjunct subpopulations).

During implementation of restoration activities, however, there would be some level of disturbance to wildlife individuals and their habitats. Though project design criteria (such as avoidance of known nest or den sites) and mitigation measures (such as timing restrictions and retention of large trees, logs, and snags) would be routinely applied to minimize such disturbance, some measure of disturbance impact would likely remain. Table 12 displays the type of impacts to wildlife and wildlife habitat each category of action is likely to create. The mechanism and scale of these impacts is deducible from Table 9, Section 3.3.3.2.

Table 12 Types of Impacts from restoration actions relevant to effects on wildlife

Categories of Action	Types of Impacts relevant to effects on wildlife			
	Human disturbance only (sight, sound, animal handling, etc.)	Short-term construction impacts	Short-term habitat impacts – non construction	Habitat type change
Category 1 - Fish Passage Restoration				
Dams, Water Control, or Legacy Structure Removal		x		
Consolidate or Replace Existing Irrigation Diversions		x		
Headcut and Grade Stabilization		x		
Low Flow Consolidation		x		
Providing Fish Passage at an Existing Facility		x		
Bridge and Culvert Removal or Replacement		x		
Bridge and Culvert Maintenance	x			
Installation of Fords		x		
Removal of Natural or Man-Made instream barriers		x		
Category 2 - Improving River, Stream, Floodplain, and Wetland Habitat				
Improve Secondary Channel and Floodplain Connectivity		x		x
Set-back or Removal of Existing, Berms, Dikes, and Levees		x		x
Protect Streambanks Using Bioengineering Methods		x		
Install Habitat-Forming Natural Material Instream Structure (Large & Small Wood & Boulders)		x	x	
Riparian and Wetland Vegetation Planting	x			
Channel Reconstruction		x		x
Install Habitat-Forming Natural Material Instream Structures (Sediment and Gravel)			x	
Remove Mine Tailings		x		
Category 3 - Invasive Plant Control				
Manage Vegetation using Physical Controls			x	
Manage Vegetation using Herbicides (Riverine)			x	
Juniper Removal			x	
Prescribed Burning for Invasive Woody Plant Control			x	
Prescribed Burning for Managing Vegetative Composition			x	
No-Till and Conservation Tillage Systems	x			
Category 4 - Piling Removal				
Piling Removal			x	
Category 5 - Road and Trail Erosion Control, Maintenance, & Decommissioning				
Maintain Roads	x			
Decommission Roads		x		

Categories of Action	Types of Impacts relevant to effects on wildlife			
	Human disturbance only (sight, sound, animal handling, etc.)	Short-term construction impacts	Short-term habitat impacts – non construction	Habitat type change
Construct, Relocate, or Widen Roads or Trails		x		
Category 6 - In-Channel Nutrient Enhancement				
Nutrient Enhancement	x			
Category 7 - Irrigation and Water Delivery/Management Actions				
Convert Delivery System to Drip or Sprinkler Irrigation	x			
Convert Water Conveyance from Open Ditch to Pipeline or Line Leaking Ditches or Canals		x		
Convert from Instream Diversions to Groundwater Wells for Primary Water Sources		x		
Install or Replace Return-Flow Cooling Systems		x		
Install Irrigation Water Siphon beneath Waterway		x		
Livestock Watering Facilities		x		
Install New or Upgrade/Maintain Existing Fish Screens		x		
Category 8 - Habitat, Hydrologic, and Geomorphologic Surveys				
Habitat, Hydrologic, and Geomorphologic Surveys	x			
Category 9 - Actions for Riparian and Upland Habitat Improvements and Structures				
Wildlife Structure Installation/Development		x		
Fence Construction for Livestock Control	x			
Upland Vegetation Planting	x			
Tree Removal for Large Wood Projects		x		
Debris Removal	x			
Interpretive Developments	x			
Upland Erosion and Sedimentation Control	x			
Category 10 - Artificial Pond Development and Management				
Artificial Pond Development and Management		x		x

The vulnerability of wildlife to disturbance or displacement from restoration sites would be dependent on the degree and type of use a species makes of the habitats affected. For species with small home ranges that are closely-associated with riparian habitats, short-term construction effects can be devastating; but for species with larger home ranges that use that same riparian area for foraging 50% of the time, that same action may simply have a temporary displacement effect.

Use of drones for surveys, monitoring, mapping, etc. could have a disturbance effect on wildlife. As discussed in Section 3.2.8, drones can get closer to wildlife in sensitive locations where people on foot or in vehicles could not. This can be stressful to the individual or may cause abandonment of nest sites or other sites critical to the well-being of the animal. Mitigation Measures in Section 2.4 and Appendix A are intended to prevent such adverse effects.

When animals come into contact with drones, they may experience physiological changes such as an increased heart rate, behavioral responses such as running or flying away, or even suffer stress that could disrupt their reproductive process. The degree of disturbance would be dependent on the frequency and intensity of the animals' contact with a drone, and the animal's sensitivity would vary by species and individual. Frequent intense contact (as evidenced by the animal's behavioral response) could result in nest or habitat abandonment, but they could also eventually become used to the drones. At worst, if drones fly too close to animals, collisions or attacks may cause wounds or death. Also, not all animal species or individuals react to drones in the same way, and they may be more vulnerable in certain situations such as breeding season, or in areas without protection or escape routes. Mitigation measures in Appendix A, however, prescribe specific operational distances around known nests of protected species to prevent such disturbances.

3.3.5.2.1 <u>Short-term adverse effects</u>

Effects to species closely associated with habitats affected by restoration actions

For species that are dependent on habitats affected by restoration actions for part or all of their life history requirements, the effects of restoration actions could be highly consequential. As shown in Figure 4, Section 3.3.3.2, some larger actions would completely eliminate the habitat upon which certain individuals depend. Smaller actions would likely not. Table 9, Section 3.3.3.2, displays the likely scale of habitat disturbance associated with each category of action.

The degree of effect is determined mostly by the degree of disturbance. Some actions disturb wildlife by the simple presence (sound, movement, shadows) of human beings, though no vegetation is destroyed. For these, the larger, more mobile, species such as birds and small mammals may be temporarily displaced from their home territories. Such displacement forces individuals into nearby territories likely occupied by others of their kind where there would now be increased competition for space and resources. This intra-species competition would be sustainable for the short term if individuals could return to their former habitats once the human disturbance had passed. For longer durations, the likelihood of mortality of displaced wildlife increases. For non-mobile species (*e.g.* invertebrates and amphibians), the presence of humans would be a source of stress (disrupted feeding, breeding, hiding, etc.) that they could not escape for the duration of the activity. Such stress or disturbance can make the animal more vulnerable to predation, or impact its physical condition perhaps affecting its survival.

Other types of disturbance can affect wildlife apart from the restoration site. These include noise, smoke, in-stream, turbidity, smells, etc. While these actions don't modify habitats, they can temporarily disrupt wildlife behavior and displace their habitats. Birds, for example, would be directly affected and some amount of nest abandonment could occur due to noise disturbance. Any use of blasting would be highly disturbing to wildlife, with effects far distant from the explosion. Effects can include temporary or permanent abandonment of nest sites or feeding areas, or disruption of feeding or reproductive activity. Depending on distance from the blast, hearing damage or other internal physiological harm is possible (Larkin 1994).

Some actions (*e.g.* prescribed burning or herbicide application (Category 3)) may affect the structure and condition of habitats while not eliminating the habitat altogether.

Most actions, however, remove the vegetation (the wildlife habitat) in part or in whole. In these actions, mobile species would be permanently displaced (at least as far as their individually short lifespans are concerned) as it may take three to ten growing seasons for desired habitat conditions to be restored. Intra-species competition because of increased densities from displaced individuals in habitats adjacent to action sites would not be sustainable over multiple seasons. There would likely be a loss of individuals or breeding pairs depending on the time period required before restoration of the species' habitat requirements on the sites affected. This is especially the case in aquatic and riparian habitats where available habitat is usually limited, and the ability of wildlife species that are closely associated with those habitats (see Section 3.3.5.1.1) to relocate is limited. Once the habitat has recovered from the construction actions, however, the number of breeding pairs would likely be restored to its original amount, if not increased.

For less mobile species such as invertebrates and amphibians, mortality from crushing by heavy equipment may occur as equipment and personnel work the project area. Even if not impacted directly, riparian vegetation projects would affect this type of species through unavoidable disturbance and changes in habitat structure.

Some restoration actions would modify habitats with the intent of converting the vegetation permanently to a more desired condition. Prescribed burning (Category 3) would have this goal, as would juniper removal (Category 3), and the conversion of sagebrush flats or agricultural fields back to a wet-meadow floodplain reconnected to its stream or river (Category 2). Species dependent on the condition being converted by these restoration actions would be permanently displaced, and then replaced by species associated with the desired future condition.

Effects to "habitat generalist" species

Habitat generalist species are those that can use a variety of habitat conditions and would not be direly affected by the temporary loss or modification of one component of their home range conditions. Larger or more mobile species of this type (*e.g.* deer, coyote, and red - tailed hawk) have a high degree of adaptability and thus an ability to focus on other habitat types within their home range, or slightly shift their home range boundaries. The competition and mortality risks triggered by actions in riparian areas are much lower for these species than for those discussed in Section 3.3.5.2.1, above. However, immobile species, and those with very small home ranges (*e.g.* invertebrates, amphibians, and reptiles) can anticipate the same kinds of risks and losses discussed in Section 3.3.5.2.1. For these, the risk comes from their immobility or their limited home range, rather than from a dependency on a specific habitat type. Though not dependent on the habitat condition affected by the restoration action, that action may encompass their entire home range and thus displace or destroy them.

Some species in this category would be affected primarily because their prey species may be dependent on a specific habitat type or area impacted by restoration actions. There would be a loss of habitat and cover for prey species (small mammals, birds, insects, and eggs), and by avoidance of the area by prey species within the project area. The temporary loss of insects from aquatic restoration projects may adversely affect bat reproduction and survival, or the survival of fish downstream of the site. The loss of small bird and mammal habitats in a large stream or river restoration project or prescribed burn may affect the foraging area of a Cooper's hawk or weasel.

For all restoration actions, mitigation measures (Section 2.4 and Appendix B) are prescribed for the protection of species listed under the ESA, the Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and other federal acts if an action is found to be within the home range of such a species.

3.3.5.2.2 Long-term beneficial effects

The adverse effects described above would be short-term (one to ten years) and would occur on habitats that would likely have had some need of improvement. In nearly all cases, however, the resulting condition of the restoration action would be habitat conditions that would be re stored, improved, or expanded over what had been there previously, with the intended vegetative conditions having a higher carrying capacity for both dependent and generalist wildlife than that of the existing condition[44]. Though these restored conditions would likely not benefit the individuals affected by the original action, the local population of their species is anticipated to benefit for the long term.

Most habitat improvements would take the form of increased plant species richness and diversity (numbers and proportions of species), increased habitat structural diversity (increased foliage layers, down woody debris, woodpiles, and dense vegetation), increased habitat heterogeneity (increased numbers of habitats within a broader area), and increased extent of riparian habitat. Most restoration actions would be applied in riparian areas, rather than in their surrounding upland habitats, so most of these increases would be seen within the unique and specific expression of riparian conditions located in forests, floodplains, grasslands, sagebrush-steppe, or agricultural settings.

Some habitat improvements affect wildlife populations by actions other than vegetative modification. Improved aquatic function in streams and rivers would provide increased habitats for fish which would increase the foraging opportunities for piscivorous species such as ospreys, eagles, mergansers, otters, and bear. Beaver dam analogues (Category 2) and beaver relocations would increase and expand beaver populations. Fence construction for livestock control (Category 9) would protect riparian areas from livestock impact, but also from their presence, increasing both cover and forage opportunities along riparian areas for ungulates. Road decommissioning projects (Category 5) would decrease road densities across the landscape, which would decrease human disturbance and reduce habitat fragmentation to the benefit of ungulates and large predators.

3.3.5.2.3 Effects on Threatened and Endangered Wildlife Species

Only six species listed as Threatened or Endangered under the ESA in the Basin are likely to use sites that could be proposed for restoration activities (Table 11) and are the ones most likely to be affected by the proposed actions. However, none of these are closely associated with, or dependent, on riparian or wetland habitats, nor is their foraging preference for these areas. They could be affected solely because restoration sites might be located in riparian corridors that are located within surrounding habitats and geographic areas known to be used by them, as discussed below.

Columbian White-Tailed Deer

Columbian white-tailed deer may be impacted by proposed restoration actions. Restoration of tributary (non-estuarine) habitats in the Lower Columbia River could provide suitable habitat for these deer. The amount of new or improved habitat created would likely be minimal in comparison to this species' home range needs, but forage and cover values would be increased on the lands treated.

Fisher

Fisher would be impacted by the human activity at restoration sites located along riparian corridors within dense mature or late seral conifer forests. Human disturbance would be the primary impact, and would displace fisher from foraging or denning in or near the restoration site for the duration of human presence. The site may also be rendered unsuitable for fisher foraging or denning for a few years until dense vegetation recovers, with the degree of this effect varying according the extent of the habitat modified.

These effects on fisher would be incidental with limited consequence. They have large home ranges and are highly mobile. A restoration site and its surroundings would represent a very small

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[44] Some actions, such as the installation of a fish screen or culvert, may not result in an improvement of wildlife habitat at the site of short-term construction activity impacts.

proportion of their home range, and their temporary loss of use of these acres would not likely displace the animal from its home range or place it at any risk of adverse effect from other factors. The effects to fishers would be low.

Marbled Murrelet and Northern Spotted Owl

Like the fisher, marbled murrelets and northern spotted owls could be affected by human activity at restoration sites located along riparian corridors within dense mature or late seral conifer forests. Though there is little likelihood that project activities would adversely affect the physical conditions of either of these species' nesting habitats, there is the potential for noise and human activity disturbance during critical breeding times. Marbled murrelet is not known to be particularly sensitive to human noise or activity where they choose nest sites near regular human actions with higher than natural ambient noise levels such as along roads or trails, etc. (Long and Ralph 1998), though a large increase of noise over ambient conditions would be disturbing. Spotted owls appear to be more sensitive to disturbance (Wasser *et al*. 1997). Restoration actions would likely be a source of such disturbing noise.

Disturbance of these species during nesting can force an incubating bird off the nest, exposing the egg or recently hatched young to loss from exposure or predation. Adult feeding of young may also be disrupted. If not managed, nest abandonment or reproductive failure could result. Project design criteria therefore would be applied that would schedule restoration activities outside of known nesting areas during nesting and fledging periods (see Appendix A), and would keep the effects to these birds low.

Streaked Horned Lark

The Streaked horned lark could be affected by modifications or impacts to its preferred habitats along the lower Columbia River and in the Willamette Valley. These birds have the potential to encounter tributary restoration actions where those actions may include or abut large open areas (300 acres or more) of native prairie, agricultural fields, wetland mudflats, sparsely-vegetated edges of grass fields, moderately- to heavily-grazed pastures, and gravel roads or gravel shoulders of lightly-traveled roads (USFWS 2019a). Such sites could be the focus of native-prairie restoration efforts (mowing, burning, herbicide applications, etc.) or they could be the site of staging areas for actions in nearby riparian areas.

Restoration actions could create noise and activity disturbances that could disrupt breeding behaviors of nearby birds or destroy nests if staging or restoration actions are located over nest sites. Feeding behaviors and wintering use of habitat could also be disrupted. These disturbances would have only a short-term influence on larks with low effect, but long-term consequential effects from habitat losses are possible.

Habitat loss could occur by land management changes on croplands or pastures, which could occur from the development of side channels or secondary channels that reconnect rivers to former floodplains, though these actions are uncommon in lark habitats. Such loss of suitable habitat would require individual larks that previously used this site for breeding, feeding, or sheltering to find alternate habitat. But this need to seek new habitat would not be unusual for streaked horned larks as their native habitat is transient by nature, requiring their periodic relocation. Streaked horned larks are known to migrate distances of 80 to 250 miles one-way between nesting and wintering seasons (Pearson et al. 2005). Given this annual migration distance, it is expected that larks could locate suitable habitat elsewhere along the Columbia River or Willamette River valleys after being displaced from the project areas.

Mitigation measures for detecting or protecting streaked horned larks are not specified in this Programmatic EA, but would be identified on a project-by-project basis through ESA consultation and would be uniquely designed for the habitat and operational conditions for each project.

Western Yellow-Billed Cuckoo

Western yellow-billed cuckoo have the potential to be affected by human disturbance in small-scale restoration actions such as culvert replacements, or irrigation diversion or fish screen actions in large blocks of riparian woodland. There is no large-scale restoration action proposed here that would remove riparian hardwood trees or patches of such trees in any amount sufficient to fragment or deforest such a woodland forest as required by this bird.

The most likely impact would thus come from actions relating to irrigation or transportation infrastructure, rather than from any habitat changes. These actions impact very little ground, but they can be very loud and disruptive for nearby nesting birds. Adverse effects would be from human presence or noise, which could disrupt nest building or egg-laying, or displace the birds from their nesting areas (Laymon 1998). Cuckoos are known to be limited in their ability to relocate nest sites or territories because of the fragmentation and isolation of their required habitat. Such actions' impacts would be mitigated by project-specific conservation measures (*e.g.* timing, noise amelioration, etc.) identified in ESA consultation to keep effects low.

3.3.5.3 Effects Conclusion for the Proposed Action on Wildlife

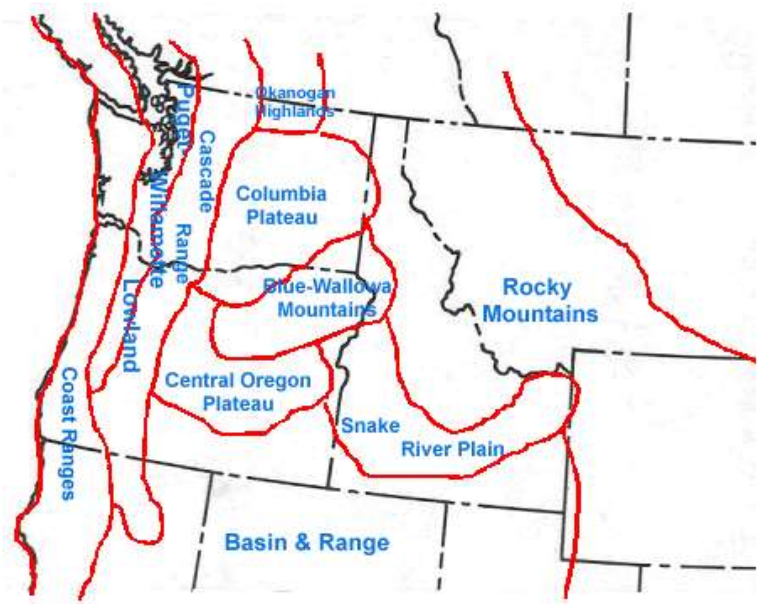
The short-term effects on small wildlife species may be moderate to high for individuals that are harmed or killed by construction activities, but effects would be comparatively minor for larger animals that may only be displaced from habitats rendered unsuitable for occupancy for a period of time. The long-term effects on wildlife populations, however, would be beneficial from the increased habitat quality and carrying capacity resulting from the proposed projects. The overall effects would be low.

3.3.6 Geology and Soils

3.3.6.1 Affected Environment

The Columbia River Basin is bounded on the west by the Cascade Range running down the centers of Washington and Oregon; on the north by the Okanogan Highlands and Canadian Rocky Mountains; the Northern Rocky Mountains of Idaho and western Montana to the east; and the Central Oregon Plateau and flanks of the Great Basin on the south.

Figure 12 Landscape Regions of the Columbia Basin



Situated among these plateaus and mountains is the Columbia Plateau, a wide, arid, lowland area characterized by steep river canyons, extensive plateaus, and in places, tall and sinuous ridges. This region is overlain with geologic deposits from over 100 cataclysmic glacial floods that inundated various portions of it over a 2,500 year period from about 16,000 years ago; and by wind-blown glacial dust and silt that accumulated during interglacial warm periods. Underlying this is thousands of feet of basalt from over 300 lava flows (Tolan and others, 1989) from volcanic eruptions in the Cascade Range and eastern Oregon and Washington over a period of two million years, from around 2.7 million years ago.

Soils in the Columbia Plateau have developed almost entirely from unconsolidated sedimentary material deposited by the wind, glaciers, and floods mentioned above. The wind-blown materials are generally fine-grained silts and sands; the glacial materials are coarse-grained gravel and sand; and the flood-sourced materials are fine grained silt, clay and fine sand. In general, each of these materials dominates the soil structure in a particular part of the Basin, though some mixing by floods and winds has occurred over the eons. Wind-blown silts dominate the eastern parts, glacial sand and gravels in the north central parts, and flood-born silts and sands in the southern parts. Some areas, known as scablands, have some protrusion through these soils of the underlying volcanic basalts.

Pre-agricultural vegetative patterns also influenced soil formation in the Columbia Plateau. The eastern parts of the Plateau receive about five more inches of precipitation each year than does the western part, and could thus support a cover of grasses while the western portion was only able to support scattered dry-land shrubs. Soils in the eastern part are now deeper and darker in color than in the western part, having a higher proportion of organic material. All of the soils contain lime carbonate in some part of the soil profile. In the eastern part of the Plateau, the lime carbonate is found only in the subsoil at depths generally exceeding three feet; in the west, it is present at the soil's surface.

Most of the proposed actions would occur along rivers and streams in riparian, floodplain, and wetland habitats. Soils in these sites, while fundamentally formed by the processes discussed above, were further shaped by the hydrologic erosion and deposition processes of their rivers and streams over thousands of years of channel migration and periodic flooding. Vegetation was prolific in these areas, providing abundant organic material for soil formation over time. Soils here are distinguished from surrounding upland soils by the presence of a large number or organisms, stratification (layering from a series of floods), and the existence of buried dark humus (organic) horizons. These soils are highly productive and were the focus of early grazing pressure and agricultural development.

Riparian and floodplain soils in the mountains surrounding the Columbia Plateau are less developed than those in that lower basin. Rivers and streams here are generally higher in gradient, faster in flow, with narrower floodplains and riparian areas. Most rivers and streams in the mountains serve to transport silts and gravels to lower elevations rather than to deposit them locally. Nonetheless, these mountainous and forest riparian soils are still more productive than those in their surrounding hillside forests given their higher amount of fines, organic material, and moisture.

Soils are an integral part of ecosystem function, playing a fundamental role in the above- and below-ground interaction of organisms. The ecological function of soil includes the mechanical support for plants; their supply of nutrients, air, and water; the filtering, buffering, and transforming of contaminants; and the regulation of water infiltration, runoff, and evapotranspiration (Greiner *et al* 2017). While none of the restoration actions specifically target soils for restoration or enhancement (as they do species or habitat), they nonetheless have the capacity to improve on soils quality and capacity for serving these functions as they restore hydrologic function and vegetative conditions. However, in achieving these enhancements, the actions would likely damage soils in the short-term.

3.3.6.2 Environmental Consequences for Geology and Soils – Proposed Action

Some restoration actions would create no ground disturbance and thus have no impact on soils. Maintenance activities, seeding, and beaver dam analogues are examples of actions here that would have minimal, if any, effect on soils. Other actions, particularly those that require heavy machinery, would have a major impact on soils. Table 12 displays those restoration actions that would have short-term construction impacts, and Table 9 provides an indication of the likely scale of those actions' impact. For the actions so displayed in these tables, soil impacts can be much as described in detail in Section 3.1 and displayed in Figure 4. To minimize the impact of these actions, relevant design criteria, mitigation measures, and best management practices would all be applied to minimize impacts and maintain long-term productivity of soils in riparian ecosystems and facilitate long-term recovery of soil properties and function where needed.

The use of heavy construction equipment would impact soils (see Section 3.1). Heavy equipment use can compact it, displace it (move it from one place to another), mix its horizons, and cause puddling[45]. These impacts can be expected throughout any construction site but would be limited to the footprint of the projects in both scope and scale. Soil productivity and function would be impaired in the short-term, but should be recovered within 15 years (Fleming et al 2006; Lloyd et al 2013; Page-Dumroese et al 2006).

Another action with potential for adverse effects on soil would be prescribed burning. While the damage from mechanized equipment would be by physical mechanisms (movement, pressure, etc.) the damage from fire would be thermal. Its effect on soil starts with vegetation removal that can change the input of nutrients, increase surface temperature from increased solar radiation, and

[45] Soil puddling is the effect of operating heavy machinery in soils with a high moisture content to produce uniformly soft structure-less mud. It can be an intentional condition created for rice production, or an unintentional effect of heavy equipment operation in saturated soils.

change the soil's water content by altering the altering the rate of evapotranspiration. Then, the presence of the flame will transfer heat to the soil where it would consume organic material, kill soil microorganisms, and alter the nutrient content and availability in the soil. The degree of this effect is dependent on the intensity of the heat applied, which is a function of fuel loading, combustion rate, direction of heating, and soil moisture, with the most intense impacts coming from slow- or non-moving burns in heavy fuels over soils low in moisture content (Cathelijne et al 2013). These conditions, however, are those minimized or precluded in the properly prepared burn prescriptions that would be applied in this action. Nonetheless, at points where fuels are overly dense, or where downed logs or stumps may burn for extended periods of time, a fire's intense heat can penetrate deep into the soil and create these effects in spots. Such spots could experience a decrease in soil carbon and kill microorganisms deep into the soil which would reduce its capability to hold moisture, nutrients, and microorganisms which all affect nutrient cycling, nutrient uptake by plants, and decomposition (Certini, 2005). Low-intensity prescribed fire would also beneficially cause an increase in soil carbon (from the input of ashes and the combustion of soil organic matter), and make nutrients more rapidly available to new vegetative growth.

Herbicide use could also affect soils adversely. Studies generally indicate that the impacts of herbicide application on soil function are only minor and temporary, but there some that suggest effects that could substantially alter soil function. These include disruptions to earthworm ecology in soils exposed to glyphosate and atrazine; inhibition of soil N-cycling (including biological N2-fixation, mineralization and nitrification) by sulfonylurea herbicides in alkaline or low organic matter soils; and site-specific increases in disease resulting from the application of a variety of herbicides (Rose et al 2016).

As discussed throughout this EA, these restoration actions are for long term improvement of the ecological function of streams, riparian areas, wetlands, and floodplains. Though short-term impacts to soil will be experienced, the long-term effects of these restoration actions would ultimately improve soil quality and productivity.

Many projects are designed to restore natural flooding and sediment deposition regimes. In a natural or restored environment, seasonal flooding contributes to fine sediment deposits, which promote riparian growth of vegetation with propagules[46], seeds, and organic matter. The deposited sediment also amends the soil's physical function by increasing water-holding capacity and providing a substrate for seedlings to establish. Reestablishment of these processes in riparian areas and floodplains allows soil hydrologic, biologic, and nutrient-cycling functions to be restored and maintained (Stromberg et al 2007; Tabacchi et al 1998).

The Proposed Action also includes the funding of no-till and conservation tillage systems (Category 3) that would increase soil productivity at the soils surface by retaining organic matter and increasing soil microbial activity at the soil's surface.

Planting, prescribed burning, juniper control, and invasive plant control (Category 3) are all intended to restore native plant communities. Soil biology and nutrient cycling is highly tied to these plant communities and vegetation dynamics since the below-ground soil organism populations are closely tied to that vegetation. By restoring the aboveground vegetation, the below-ground soil biology would result in improved biological and nutrient cycling functions (Barrios 2007; Ettema 2002).

Road decommissioning (Category 5) would have a beneficial impact on soil quality and productivity. Roads are typically severely compacted with limited soil functions and impaired soil

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[46] Propagules are vegetative structures that can become detached from a plant and give rise to a new plant, *e.g.* a bud, sucker, or spore.

productivity. Soil structure, water infiltration, aeration, root penetrability, and soil biological activity improvements are observed with road decommissioning techniques (Lloyd et al. 2013). Combined with a long-term reduction in erosion and mass wasting, an overall increase of soil quality and productivity would be realized (Foltz et al 2007; Grace and Clinton 2007).

3.3.6.3 Effects Conclusion for the Proposed Action on Geology and Soils

The effects of the Proposed Action on Geology and Soils would be moderate to high in the short-term, but with implementation of mitigation measures and the long-term benefits, the overall effects would be moderate.

3.3.7 Transportation

3.3.7.1 Affected Environment

The transportation system in the Basin consists of a dense and highly networked system of roads and railways, many of which travel along the tributaries of the Columbia River. Every type of road, from native-surfaced, single-lane, rural roads, to multi-lane interstate freeways factors into the impacts on fish and wildlife in the Basin.

Interstate freeways in the Basin (Interstate freeways 5, 90, 82, and 84) cross many of the major rivers and streams that are tributaries to the Columbia River, but are not commonly located alongside them, except where crossing major mountain ranges (*e.g.* I-90 east of Seattle and east of Spokane, and I-84 through the Columbia Gorge). In most areas, however, they traverse the largest of valleys and passes with location opportunities not topographically constrained to floodplains and riparian zones. Their impact on fish and wildlife habitats in riparian areas is thus mostly localized to these crossings with little intersection with the Agencies' habitat restoration actions.

Interstate highways, however, serve as collectors and alternatives to the major Interstate freeways, and their locations typically follow smaller Columbia River tributaries, with road locations in the mountains commonly constrained topographically to narrow river bottoms or even the river banks themselves (*e.g.* east-west Interstate highways 2, 12, 26, 20 and north-south Interstate highways 97, 95, 93). State highways follow even smaller tributaries with even more constrained route locations. Many railways in the Basin follow Interstate freeway and highway system routes.

These highway route locations frequently encroach on waterways when in narrow floodplains and corridors, constricting those waterways with the rip-rapped banks necessary for protection of the transportation infrastructure. In many places, the rivers and streams are disconnected from their historical floodplains by an effectual hardened berm (the road or railway), and in many others, confined to narrower channels than otherwise, thereby increasing their rates of flow and erosive forces; and disrupting the waterway's historical gravel and sediment transport dynamics. These affected reaches are now often long, simple, stretches of riffles with no pools or structural habitat diversity, and minimal streamside vegetation. They are of limited value to fish, and subject to the roadway's polluted runoff and impacts from increased human access.

Branching from these state and Federal highways are local roads that tie communities together and serve local populations. These roads may also traverse stream courses, but often travel overland across floodplains and mountains, through agricultural lands, range lands, and forests.

There is a high density of these rural roads throughout the basin, with some areas exceeding four miles of road per square mile. High road densities in hilly or mountainous areas intercept, redirect, and concentrate precipitation and runoff. This can contribute to flash flooding and increased sediment inputs to streams, and require resources for maintenance that land managers often do not have. Some of these roads have no surfacing. Nearly all have stream crossings: bridges, culverts, or simple fords, with most of the culverts designed for effective water transport, but not for fish, gravel, or natural debris passage. Many of the fords were not designed to minimize sediment input.

Over the last 30 years, efforts have been intensifying to rectify the fish passage, hydrologic, and sedimentation issues presented by local roads (especially on public lands), and are a frequent focus of restoration actions proposed here.

3.3.7.2 Environmental Consequences for Transportation – Proposed Action

The transportation system would be affected by a number of actions proposed.

Actions that would modify or replace culverts to provide fish passage (Category 1) would likely require the closing of a road or the restriction of traffic during the construction period. This would create a minor inconvenience for road users, but the end result would likely improve the effectiveness of the stream crossing and thereby reduce maintenance requirements (and cost) and lower the risk of flood damage or road loss over time.

Road decommissioning is proposed under Category 5 for areas with high road densities. This will eliminate roads usually primitive and/or unsurfaced roads through unoccupied forest or rangelands that are duplicative (they go where other roads already go) and/or not needed for efficient land management. This would impact users of that road, and add minor cost or inconvenience for land management actions in areas conveniently accessed by that road. For major land management actions, or emergency needs, such decommissioned roads may be temporarily re-constructed since the road alignment still available, and elements of the road prism may still be usable (see footnote 9, Section 2.1.5.1).

The relocation of roads out of floodplains or away from riverbanks, etc. is proposed under Category 2. There would be temporary road closure or inconvenience to road users during construction, and the end result may add more road length to travelers and for maintenance needs. With the road no longer in the floodplain, there may be reduced maintenance costs (fewer water crossings) and a reduced risk of loss or disrupted utility due to flooding.

Road surfaces would be maintained or improved (add gravel or asphalt surfacing) to address dust or sedimentation issues. Road users would be inconvenienced during project activities, but road use experience would be improved as a result.

Some of the actions in Category 2 (Section 2.1.2) would greatly modify the channel structure and hydraulic characteristics of streams and rivers in the project reach. Such modifications create the potential for changed flow conditions that could affect downstream road prisms, culverts, and bridges. These impacts would be considered in the Agencies' review and approval of such projects by requiring design engineers to disclose their data, analysis, and modelling of the stream and the project at various flood levels to ensure downstream infrastructure would not be placed at increased risk.

3.3.7.3 Effects Conclusion for the Proposed Action on Transportation

Though project actions may impact roads for a short period, and some roads may be removed from the system, the overall effect on transportation would be low.

3.3.8 Land Use and Recreation

3.3.8.1 Affected Environment

3.3.8.1.1 Land Use

Land uses in the Basin are as diverse as its landscape, from designated Wilderness, to recreation, forestry, grazing, and mining managed by private, state, and federal entities on forested mountains and range lands; to private agricultural and ranching lands in the foothills and plains; and to the residential, urban, and industrial uses along the tributaries and the Columbia River itself.

Most proposed actions are located in lands used for agriculture or ranching; and in the riparian areas of public lands. Rarely are there projects in an urban, roadless, or wilderness setting.

Agriculture in the Columbia Basin

Agriculture use is widespread throughout the Basin, with agricultural areas in nearly every tributary wherever there is a floodplain wide enough to support a hayfield. Agriculture is a minor land use in some areas, where recreation, forestry, or grazing may otherwise dominate, but agriculture is the dominant use in much of the Basin, particularly in the Columbia Plateau in eastern Washington State and north central Oregon; the Snake River plains of southern Idaho; and the Willamette Valley.

Agriculture in the Columbia Plateau consists of both non-irrigated, "rain-fed", crops (primarily winter wheat), and irrigated crops such as potatoes, vegetables, fruits, alfalfa, and hops. Irrigation for farming much of the Columbia Plateau east of the Columbia River is provided by the Reclamation's Columbia Basin Project, the largest water reclamation project in the United States. It supplies irrigation water to over 670,000 farmed acres via an irrigation network starting at Grand Coulee Dam. Much of this area, however, is not accessible to anadromous fish, and is therefore not a major focus of the restoration actions proposed here. Irrigated agricultural areas in the Columbia Plateau west of the Columbia River are, however, accessible to anadromous fish and many river/floodplain restoration and irrigation (water use) actions (Sections 2.1.2 and 2.1.7) have been conducted and are proposed there, particularly in the Yakima River Basin.

Agriculture in southern Idaho is supported by Reclamation's Minidoka Project which provides irrigation water throughout the Snake River plain in Southern Idaho from a series of five reservoirs. Southwestern Idaho is a major cattle producer, as well as growing sugar beets, potatoes, seed crops, and fruit orchards. South-central Idaho is a mixture of very productive irrigated farms in the lowlands and pasture land for grazing in the upland regions. A large variety of crops are grown in the irrigated areas including onions, corn and apples. Southeastern Idaho is known for the famous Idaho potato; and crops of hay, wheat, alfalfa, as well as livestock and dairy farming make the area one of the most productive in the state. Essentially all of southern Idaho is inaccessible to anadromous fish (Section 3.3.1.1) and restoration actions here focus more on terrestrial habitat improvements (Section 2.1.5 and 2.1.9) on tribal lands to benefit wildlife.

A major focus of aquatic and floodplain restoration efforts have been in smaller agricultural areas still accessible to anadromous fish where irrigation practices and river modifications have impacted habitats critical for salmon and steelhead spawning, rearing, and over-wintering as described in Section 3.3.2.1.1. The John Day, Grand Ronde, and Lostine river basins in northeastern Oregon; and the Upper Salmon, Lemhi and Pahsimeroi basins in east-central Idaho are two such areas with active stream/river and floodplain restoration programs. Agriculture uses in these areas focus on higher-elevation, cold weather commodities such as root crops (e.g. potatoes and sugar beets), mint, hay, beef cattle and some vegetables.

Similar agricultural areas in northern Idaho (Kootenai and Pend Oreille valleys) and northwestern Montana (Flathead, Clark Fork, and Bitterroot Valleys) are outside of the natural range of anadromy for salmon and steelhead (Section 3.3.1.1) and are generally not the focus of extensive river or floodplain restoration actions, though some large river restoration actions for others species such as sturgeon, have been implemented here. Actions in these areas are mostly those that benefit resident fish species and upland habitats for wildlife.

Agriculture in the Willamette Valley does not generate the number of aquatic, riparian or floodplain restoration projects for the agencies as it does in areas east of the Cascade Range. The climate here provides more water year-round, and the Coast and Cascade Ranges feed large rivers into the valley along its entire length. There is, therefore, ample water for irrigation, and conflicts with fish needs have not arisen to the degree they have in other areas. The supply versus demand for water in the Willamette Valley is unlike that in agricultural areas in the John Day, Lemhi, or Grand Ronde River valleys, where irrigation withdrawals have dewatered steams or reduced flows in some areas to the point where habitat is unavailable for salmon spawning, rearing, or over-wintering. The Willamette Valley is therefore not an area of focus for extensive river or floodplain restoration actions.

Forest and Rangeland Use in the Columbia Basin

Most of the forest and much of the range lands in the Columbia Basin are <u>public lands</u> managed for multiple uses (Hewes *et al* 2017, Launchbaugh *et al* 2012), Land management agencies (states, U.S. Forest Service, Bureau of Land Management, etc.) often manage these lands under a system of land allocations, where some areas are managed predominately for one use while other areas are managed for other uses. Major land uses such as designated Wilderness, roadless, and timber management are sometimes incompatible with each other, and thus have their unique allocations[47]. Other uses, such as recreation and grazing, can be compatible with most underlying allocations and are therefore managed across the landscape with measures applied to ensure compatibility with underlying allocations. Across all land use allocations in forest and rangelands, however, run the riparian areas and roads which are a common focus of the proposed restoration actions.

Riparian areas on public forest and range lands most often have designations, state laws, or otherwise-required management guidelines designed for their protection and enhancement. These areas had been heavily and adversely impacted by logging and grazing in the previous century, and continue to be affected by their modified conditions and that of their surrounding forests rangelands. Within these areas and under applicable guidelines, projects that improve floodplain connections and in-stream habitat conditions have been implemented by the land management agencies and the Agencies' and would continue to be proposed.

As with riparian areas, roads within forests and rangelands have received a lot of attention over the past 30 years. Built primarily to support commercial logging during the 1960s through the 1980s, they lacked the aquatic-organism passage features and sedimentation/erosion protections needed to maintain fish populations and distributions (see Section 3.3.7.1). Many roads remain to be corrected and thus continue to adversely affect in-stream and upland habitats. These are the needs being addressed in many of the actions proposed here.

<u>Private (and many state) forests</u> are generally managed for profit. Industrial forests owned by larger corporations or states are often managed for long-term timber productivity and harvest potential. Timber harvests on these lands are most often silviculturally designed to maintain

[47] In no land allocation, however, does a single use exclude other considerations. Timber management on federally-managed lands, for example, is highly constrained (even in areas designated for that primary output) to protect other resource values such as watershed function, wildlife habitat, and scenery.

productive forest conditions, albeit in varying successional stages, and designed for maximum timber productivity, not necessarily holistic ecological productivity. Appropriate silviculture practices may include clearcutting in the western Cascade Range and some form of partial-cutting in other forests of the Basin. Some privately-owned forests, however, may be managed for short-term profit and turnover for other types of development. These lands are frequently clearcut (where all merchantable trees removed) or "high-graded" (where all of the highest quality trees are removed) regardless of silvicultural applicability, with only the most minimal resource protections required by state law being applied. These actions are often applied on small acreages (compared to the industrial forest lands), with sites often converted to residential subdivisions or individual home sites. Habitat restoration actions funded by Bonneville have not been applied in private or state-managed forest lands in the past due to a lack of sponsored proposals (Section 2.2.2), and are not envisioned in the future.

3.3.8.1.2 __Recreation__

The Basin provides the environment for the full spectrum of recreational activities. Urban-centered recreation such as organized team sports, of course, would not interface with the actions proposed here, but some rural outdoor recreational pursuits would. Recreational activities centered on stream, river, or fish use would have the most direct interface with proposed actions, but upland pursuits such as backpacking, rock climbing, big game hunting, snowmobiling, off-road vehicle use, and skiing usually would not.

Fishing, rafting, kayaking, streamside camping could be affected, as could other activities that overlap into riparian areas such as hunting , hiking, or cross-country skiing that may use riparian areas, though not dependent on them.

Recreation focused on waterways is dependent on the size of waterway (and its flow amounts and timing), and the degree of access available. Restoration actions in large rivers would be more likely to affect boaters, floaters, kayakers, and fishers than they would in smaller streams; and those with flows adequate to support such recreation through the summer months would be more likely to affect these uses than would rivers with flashy spring flows with low, slow, shallow waters during the summer recreation season.

Access for river-based recreation is a critical determinant of recreational opportunity. Access is affected by land ownership (public versus private, and whether it is allowed), road access (how close can the road take the user to the river, and is there available parking), terrain (steep, unsafe, canyon walls or gently sloping banks), and vegetation (impassable willow thickets, swampy riparian woodlands, or park-like settings). Restoration actions on large rivers with ample summer flows and public access would be likely to impact recreationists. Restoration actions on streams essentially dewatered for agricultural needs on surrounding private lands would encounter little interaction with public recreation.

3.3.8.2 Environmental Consequences for Land Use and Recreation – Proposed Action

3.3.8.2.1 __Land Use__

Restoration actions would not create a change in land uses over a large area, though there may be small-scale use modifications given the changes in water distribution and vegetation patterns on specific acres within a restoration project site. However, management allocations on forest lands for multiple uses would not be changed as a result of a site-specific restoration action; and agricultural lands would not be converted to recreational lands or nature reserves. In a common example, pasture conditions may be altered and grazing practices may change on a few riparian acres, but the landowner would still be managing the farm or ranch for agricultural purposes. Rarely would there be a change in land use, and when there is, it would be by the intent of a willing land owner who might value a functioning floodplain with multiple stream channels over an irrigated field in a specific location on her property.

While there may not be changes from one land use to another, there would be changes in how specific project sites might be used by the landowner or manager. There would be modification of some lands that had previously been grazed or farmed. New channels may be constructed that would change how lands are accessed. A new hydrologic regime with seasonal flooding might now be the norm when previously those high waters were contained within a channelized river – which would alter how a pasture may be grazed. For protection of newly established riparian vegetation, grazing restrictions or a new grazing plan would be in practice, with fencing to maintain and timing and grazing intensity to be managed.

The consolidation and reconstruction of irrigation water diversions would change the location or amount of water used for irrigation. In some cases, water use might be reduced and irrigation practices changed from flood irrigation to sprinkler irrigation. The amount of water, however, would always remain within the water rights held by the landowner, unless those rights were sold or donated for conservation purposes by a willing rights-holder.

With those irrigation changes, landowners might now be managing pumps, pipelines, and sprinklers rather than over-land flood irrigation flows; and maintenance tasks would change. There might be less maintenance with fewer (and upgraded) water diversions to manage. There would be riparian fences to maintain, and an increased need to move livestock among pastures that may now be more productive from water table elevation, but more sensitive at certain times of year.

On state or federally-managed public lands, there would be no change in the land management objective that would be driven by the proposed restoration actions. These actions would be taken consistently with a land management plan or with the legislation establishing the particular public land holding.

Road improvements or decommissioning may affect land uses by changing the short-term or long-term accessibility of lands (see Section 3.3.7.2), but may improve land management efficiencies by improving the roads' running surfaces, and reducing road management costs.

3.3.8.2.2 __Recreation__

Effects on recreational opportunity would most likely occur on public lands, where nearly all lands are accessible for recreational pursuits. Most private lands, where many restoration actions are focused, provide no public access for recreation, thus there would be no effect. On public lands however, access is provided, recreation is welcomed, and recreation opportunities would be affected.

Effects to recreation would include adverse short-term construction-related impacts such as visual and noise disturbance, and traffic delays on recreation roads. Recreation could also be affected for the long term by changes in the environmental setting and changes in accessibility. A loss of accessibility could mean a loss of recreational opportunity. A change in the setting could change the suite of recreational opportunities at a site. The restoration of stream or river connectivity to floodplains could eliminate vehicle access to formerly hardened river banks that previously may have been used for camping or day use activities, but provide new opportunity for waterfowl hunting or fishing. The conversion of a single channel with hardened banks to a multi-threaded anastomosed series of channels could eliminate the potential for a reach of river to support rafting or tubing, yet increase opportunity for fishing and wildlife viewing or photography.

Recreation may also be enhanced for the long term as a result of habitat modifications. Creating more diverse and productive wetland and riparian areas would increase the amount and diversity of fish and wildlife species using the restoration sites. This could increase the amount and quality of recreational experiences such as wildlife viewing, fishing, and hunting. If public access is available to restoration sites, these recreation opportunities could be enhanced.

In smaller streams, the recreation opportunity would be enhanced for fishers, hikers, and other users that recreate from or along the shoreline. In larger rivers, however, where restoration actions might install large wood structures along the bank and in the channels, boaters, kayakers, and tubers could face hazards as they use the rivers' surface and flows. These log structures could extend into the current of the river and create the potential for snagging or damaging passing boats. People floating on inner tubes could be injured or entrained by the swirling currents created by the structures. However, mitigation measures such as installing signage to warn river users of installed wood structures would reduce the likelihood of these impacts. The occurrence of this type of conflict is expected to be uncommon, though possible in larger river with heavy recreation use such as the Methow or the Wenatchee Rivers in north central Washington State.

Long-term improvement in fishing opportunities are anticipated as fish populations respond to improved habitat conditions.

Restoration sites may also attract recreationists, or include designs for their use. Such use can create conflicts with neighboring landowners through trespass, noise, conflicts with intensive agricultural use, damage to infrastructure, and changes to transportation patterns in the area. Parking and other facilities sited on the property boundaries may create conflicts that need to be evaluated during site-specific planning. Generally, however, restored sites would be on private or tribal lands not used for recreation and thus, would not have facilities to support or attract such uses. Restoration sites on public lands or state wildlife areas may provide for increased recreation use.

3.3.8.3 Effects Conclusion for the Proposed Action on Land Use and Recreation

Land use practices underlying project sites would not be changed for most projects. Some may have slight modifications to use practices such as grazing, and some small acreages along stream courses areas may revert from agricultural uses back to the wetland, and riparian conditions from which they had historically been converted. The overall effects on land uses and recreation are expected to be low to moderate.

3.3.9 Visual Resources

3.3.9.1 Affected Environment

Visual resources consist of natural and human-made features that give a particular environment its aesthetic qualities. Views are considered sensitive when they have high scenic quality and are experienced by relatively large numbers of people (i.e., views from publicly accessible areas). Scenic quality is a measure of the overall impression or appeal of an area created by the physical features of the landscape, such as natural features (landforms, vegetation, water, color, adjacent scenery, and scarcity) and human made features (roads, buildings, railroads, other built elements, and agricultural patterns).

The scenic values throughout the Columbia River Basin are remarkable. Scenic views of shrub-steppe or rural agricultural landscapes with dramatic mountain backdrops are common, and the basin hosts the outstanding scenery of the Columbia River Gorge National Scenic Area and the Sawtooth National Recreation Area. Figure 13 demonstrates the varied and remarkable landscape scenery in the Basin created by visually pleasant foregrounds against dramatic backgrounds.

Figure 13 Scenery in the Columbia Basin (clockwise from top left: high elevation hay farming in eastern Idaho, low elevation row crops and orchards in central Washington, Columbia River Gorge National Scenic Area, Sawtooth National Recreation Area)

3.3.9.2 Environmental Consequences for Visual Resources – Proposed Action

The potential effects of the activities from the Proposed Action would be visible primarily in foreground views, but none would be large enough, or would introduce visible changes or impacts large enough, to alter scenery in middle or background views. A flood irrigated field may be converted to an irrigation system; an irrigation diversion dam might be replaced with a new structure with a fish screen nearby; an agricultural field might be replaced with a new stream channel or wetland. These changes would be evident to someone standing at the site with knowledge of the past and current settings; but for most viewers, driving by the area for the first time, there would be nothing evident to identify a completed action. The character of the overall scenic landscape would remain unchanged and consistent with that of the larger setting.

The actions proposed here with potential for scenic impacts are most often situated in agricultural settings (typified by the top two photos in Figure 13) and would affect localized features on small acreages. There may be a new structure set into, or alongside, a river or irrigation channel; or there may be a new secondary river channel branching off a river and meandering toward a roadway, but there would be nothing visually intrusive or inconsistent with the landscape. Though a few projects may affect hundreds of acres, the majority affect only a few, with none of them altering the character of the landscape.

Landscape character can be altered by constructing a large building in a former agricultural field, thereby changing the landscape's character from agricultural to industrial or commercial. None of the proposed actions would do this. Some, however, could convert an agricultural field to a functional floodplain or wetland, thereby converting the visual character from agriculture to a natural-appearing river bottom. This, however, would maintain the overall rural character of the affected landscape.

There would be short-term visual impacts. Heavy equipment use that denudes an area of vegetation to create new river channels or connected floodplains would look barren until the newly planted grasses, forbs, shrubs, and trees begin to visually restore the setting (see Figures 9 and 11 under Section 3.3.4.2 as examples). Such sites, however, would be hydro-seeded with a mixture of water, seed, and mulch, or otherwise planted, immediately upon completion of project actions for erosion and invasive plant control. The sites would not look barren for long, and the long term result would be a natural-appearing riparian area or floodplain; or a new piece of agriculture infrastructure (in the case of fish screens or diversions) consistent with similar structures throughout the area.

In upland sites, visual quality could be temporarily impacted by the burned appearance of the landscape following prescribed burns, or the by the dead vegetation in areas treated with herbicides for invasive plants. In each of these areas, however, green-up is anticipated in weeks or months following the impact.

3.3.9.3 Effects Conclusion for the Proposed Action on Visual Resources

The effects on scenic values from the proposed action would be low, but site-specific evaluations for each project would evaluate the landscape character and assess whether a project would appear compatible with existing features, or if it would contrast noticeably with the setting and appear out of place.

3.3.10 Air Quality, Noise, and Public Health and Safety

3.3.10.1 Affected Environment

3.3.10.1.1 Air Quality

Under the Clean Air Act, 42 U.S.C. §§ 7401 *et seq.*, the EPA established National Ambient Air Quality Standards to protect the public from air pollution. These standards identify six criteria pollutants which are of particular concern for human health and the environment: particulate matter (PM 2.5 or PM 10)[48], carbon monoxide, nitrogen dioxide, sulfur dioxide, ozone, and lead.

All states in the Basin have monitoring networks which measure the levels of these pollutants to identify attainment, nonattainment, and maintenances areas across each state. When an area's monitoring results exceed the National Ambient Air Quality Standards a certain number of times, the EPA designates this area as a "nonattainment area". Throughout the Basin there are areas, around towns and cities, where air quality standards are not being met, or are identified as areas of concern bordering on non-attainment. Nearly all of these areas are identified because of elevated particulate matter, PM 2.5 or PM 10, which comes from all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes. Some areas include ozone and carbon monoxide as being problematic.

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[48] PM 2.5 and PM 10 is the nomenclature for fine particulate matter (referring to less than 2.5 or 10 microns in diameter), that reduce visibility, cause the air to appear hazy, and is able to lodge deep in human lungs when levels are elevated.

Air quality can be impacted by a multitude of land management activities, including the types of actions included in the Proposed Action. Any project that raises dust or smoke, or generates exhaust from construction equipment would contribute particulate matter to the air, even with the BMPs prescribed in Appendix A to minimize these impacts.

3.3.10.1.2 Noise

Noise is generally defined as unwanted sound that disrupts normal human activities or that diminishes the quality of the environment. It is usually caused by human activity that adds to the natural acoustic setting of a locale. For this assessment, the A-weighted decibel scale[49], abbreviated as dBA, is used to describe sound and noise levels.

In 1974, EPA identified indoor and outdoor noise levels to protect public health and welfare (Table 13). A 24-hour exposure level (Leq (24) [50]) of 70 decibels was identified as the level of environmental noise which will prevent any measurable hearing loss over a lifetime. An Ldn [51] of 55 decibels outdoors and an Ldn of 45 decibels indoors were identified as preventing activity interference or annoyance. These levels are not "peak" levels, but are 24-hour averages over several years. Occasional high levels of noise may occur.

Table 13 EPA's Protective Sound Limits

EFFECT	LEVEL (dBA)*	EPA AREA	Relevance to Proposed Action
Hearing	Leq(24) < 70	All areas (at the ear)	All
Outdoor activity interference/annoyance	Ldn < 55	Outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places where quiet is a basis for use.	Project sites near home sites or small towns
Outdoor activity interference/annoyance	Leq(24) < 55	Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, etc.	Rural lands; most project sites
Indoor activity interference/annoyance	Ldn < 45	Indoor residential areas.	Not relevant
Indoor activity interference/annoyance	Leq(24) < 45	Other indoor areas with human activities, such as schools, etc.	Offices, etc.

The dominant character of nearly all restoration action sites is rural, either in an agricultural, range, or forested setting. Ambient noise levels in these locations come primarily from scattered farm or forestry operations, low-level traffic on local highways, and human activity in the several small towns scattered in the subbasins. These noise levels vary with the season and time of day, with traffic noise generally greater during the summer months when tourists venture into these rural areas. Typical day/night average sound levels for agricultural crop land is around 45 dB (EPA 1974). Table 14 displays different levels of noise, typical sources of specific noise levels, and the likely noise level created by different restoration actions.

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[49] This is a logarithmic scale that ranges from 0 dBA to about 160 dBA and approximates the range of human hearing. The threshold of human hearing is about 0 dBA; less than 30 dBA is very quiet; 30 -60 dBA is quiet; 60-90 dBA is moderately loud; 90-110 dBA is very loud; and 110-130 is uncomfortably loud. A 10-decibel increase in sound levels is perceived as a doubling of the loudness. Ldn is also a noise level measurement used to indicate the average noise level over a 24-hour (day night) period.

[50] Leq is the equivalent continuous sound level in decibels equivalent to the total sound energy measured over a stated period of time. It is also known as the time-average sound level (LAT). Leq(24) is the average of the total sound energy measured over a 24 hour period, converted into dBA.

[51] Ldn is the noise level over a 24 hour period with a penalty of 10 dB(A) for noise from 23:00-07:00, in decibels.

Table 14 Noise Levels*, Relevance, and likely Proposed Actions that create them

Source(s)	Sound Levels** (dBA)	Relevance of sound at this level	Proposed Action with Potential to generate this sound level
Shotgun, Rifle, Handgun Fireworks (at three ft.)	>160	Sounds created by a shock wave	Blasting for fish passage restoration or construction
Jet engine (taking off)	150	Harmfully loud	none
Airplane (taking off)	140		
Stock car races Jet takeoff (at 100-200 ft.)	130	Threshold of pain	none
Heavy machinery Chainsaw	120	Threshold of sensation or feeling	Restoration actions with short-term construction activities (equipment operator)
Car horn Baby crying / Maximum vocal effort.	110	Regular exposure of more than one minute risks permanent hearing loss. Physical discomfort.	
Snowmobile Garbage truck Jet takeoff (at 2000 ft.)	100	> 95 dBA- no more than 15 minutes/day unprotected exposure recommended; One hour per day risks hearing loss.	Restoration actions with short-term construction activities (at construction site, 50' away)
Heavy truck (at 50 ft.) Motorcycle (operator) Power lawnmower Jet ski Shouted conversation	90	Very annoying	
Heavy traffic Many industrial workplaces Electric razor	85	Level at which hearing damage begins with eight hour exposure	
Average city noise Freight train (at 50 ft.)	80	Annoying; interferes with conversation	
Freeway traffic (at 50 ft.) Urban housing on major avenue (Ldn) Inside a car TV audio	70	Interferes with telephone conversation. EPA Ldn sound level for lifetime exposure without hearing loss.	Prescribed burning
Normal conversation Sewing machine	60	Intrusive Interference with human speech begins at about 60 dBA	Fencing
Rainfall Refrigerator Wooded residential (Ldn) Light auto traffic (at 100 ft.)	50	Quiet Comfortable Sleep disturbance may occur at less than 50 dBA.	Invasive plant control Planting Trapping, tagging, transporting fish and wildlife
Quiet office, library Quiet residential area Rural Residential (Ldn)	40		Surveys
Soft whisper (at 15 ft.)	30	Very quiet	
Normal breathing	10	Just audible	
	0	Threshold of human hearing	

*Adapted from EPA 1974, League for the Hard of Hearing, www.lhh.org ; and The Canadian Hearing Society, www.chs.ca
**These are typical levels near the noise source and some may be approximate averages of ranges; actual sound levels experienced by the public may depend on several factors, most importantly, distance from the sound source.

Noise can be a concern when actions are located near sensitive receptor sites, such as schools or hospitals. The proposed actions, however, would generally be implemented on private agricultural or public lands far from schools or hospitals, and these sensitive receptor sites would not be an issue. Site-specific analyses for individual projects would identify effects of noise if any actions are near sensitive receptor sites, and prescribe mitigation measures (*e.g.* limitations on the time of day for equipment operations) to minimize adverse effects.

3.3.10.1.3 Public Health and Safety

Existing risks to public health and safety on sites envisioned for restoration projects are anticipated to be few, and would be those common to agricultural and rural settings along rivers such as those associated with the operation of agricultural machinery and equipment, livestock-related incidents, collapse of old structures, falling trees, drowning, falls, and electrocution.

Other considerations would be for any potential impact by the Proposed Action on the public safety infrastructure in rural areas near project sites. Emergency services such as fire, medical, and law enforcement in rural areas are often less funded, use volunteer services, have fewer equipment options, and have longer response times than in urban areas. Any disruption to these in time of emergency need could lead to an impact on people and property.

3.3.10.2 Environmental Consequences for Air Quality, Noise, and Public Health and Safety – Proposed Action

3.3.10.2.1 Air Quality

The proposed activities' impacts to air quality are expected to be low both in concentration and duration. Construction equipment would emit some carbon monoxide, nitrogen oxide, unburned hydrocarbons, and particulates (primarily soot) from tailpipe emissions and cause dust during ground disturbance and travel along unpaved access roads. These could affect air quality locally for short durations. While use of herbicide for invasive species control could cause air quality degradation if applied during high temperatures or inversions, herbicide label requirements restrict application during these conditions, and this is not expected to occur.

Implementation of the Proposed Action is not expected to generate long-term or short-term violations of state air quality standards. Impacts from site-specific restoration projects would primarily occur from construction and would be temporary and localized in nature and would not have long-term impacts on air quality. Annual effects to air quality from stewardship, research, monitoring, and evaluation actions would consist primarily of emissions related to travel to and from project sites for maintenance purposes and would also be low.

3.3.10.2.2 Noise

Restoration efforts implemented in the Basin would involve the use of heavy equipment for short periods on the larger projects, such as river and stream restoration, road decommissioning, and construction of new irrigation systems. This would increase ambient noise levels in the short-term. The ambient noise level for most restoration sites would typically be around 45 dBA for agricultural and forest sites, though that level may rise to 50 or so near flowing rivers or streams. Construction activities would elevate that level to between 80-100 dBA at the construction site. Such noise would come from construction, transportation, and site rehabilitation activities and the associated equipment (heavy machinery, heavy equipment, vehicles, generators, compressors, etc.). Many of these noises are loud, but they would vary in duration and timing. High noise levels would not be constant.

The effects of noise on humans are varied and are dependent on the noise's intensity, its frequency, and its duration; the sensitivity and expectations of the person affected; and the environment in which the noise is perceived. The same noise that would be highly intrusive to someone in a quiet park might be barely perceptible in the middle of a freeway at rush hour. Therefore, planning for an acceptable noise exposure must take into account the types of activities and corresponding noise sensitivity in a specified location for each particular set of land uses.

Excessive noise can affect the human condition in many ways. Sudden, short-term and infrequent high-pitched and high-intensity sounds can be startling and stressful, even fearful, particularly when not expected. While short-term and infrequent periods of high pitch and/or high intensity noise can cause both temporary and permanent hearing loss, the most common human response to such un-wanted noise is annoyance with a short-term mitigation such as increasing the volume of conversation or audio equipment; pausing in conversation or other activity; turning off audio equipment; and/or leaving the area. Adverse effects of long-term excessive noise, however, can include effects such as permanent hearing loss or ringing/buzzing in the ears; stress and related illness/disease; increased blood pressure or hypertension; rest disturbance, sleep deprivation, fatigue; communication difficulties; and learning/education difficulties.

The Proposed Action is unlikely to produce the effects of excessive noise to the degree described above. Blasting, which would be very uncommon in implementing the Proposed Action, would be the only action likely to produce such effects but would not occur in areas near homes or workplaces. The other construction actions may produce extended periods of excessive noise, but these would also routinely be hundreds or thousands of feet from homes or workplaces. The people primarily affected by the excessive noise of construction actions would be the construction workers themselves, or inspectors; but they would likely be aware of the imminent actions, and be using hearing protection.

Construction-related noise could impact nearby neighbors, businesses, and wildlife during construction. Projects would, therefore, typically limit construction activities to normal daytime working hours. At night, activities generating noise would be limited to only those necessary, such as for dewatering pumps or equipment use when needed to accommodate tidal schedules. Short-term effects due to noise are expected to be low due to the relatively short duration of construction. Restoration actions that do not require heavy equipment or earth moving would not produce high noise levels. Most actions would produce noise levels consistent with that produced by rural agricultural activities, and would be expected to be perceived as such by people nearby.

Once implemented, the site-specific projects would not make noise, except for that from limited vehicle access to the site to monitor and maintain it. Follow-up maintenance actions would likely be limited to infrequent use of equipment for vegetation maintenance (such as mowing) and monitoring if applicable. The noise from these actions, however, is expected to be similar to that from agricultural operations generated prior to restoration actions, and from those in surrounding areas.

Over the long term, people living, working, or recreating near restoration sites would likely experience a decrease in human-created noise coming from restoration sites and an increase in natural sounds associated with restored riparian habitats.

3.3.10.2.3 Public Health and Safety

The primary impact of the Proposed Action on public health and safety would be the potential to hinder traffic flow and response time of emergency vehicles for those projects that are situated on or near roads (e.g. culvert replacement), or by the presence of construction equipment or supply vehicles on rural roads and highways. The short-term construction and restoration activities would not be expected to overburden the existing health and safety infrastructure near site-specific projects. The potential health and safety risks to workers and the public during construction would not be greater than a standard construction project, and therefore the short-term effects of the project to health and safety would be low. Adequate signage and other routine safeguards for worker and public safety would be applied to minimize these effects.

Restored flow regimes and seasonal flooding at restoration sites is an intended result from many restoration projects. The restored site could create low-lying or poorly-drained areas which could seasonally pond water long enough to provide breeding habitat for mosquitoes, which are a nuisance and a public health threat, since they can serve as vectors for disease. This effect is anticipated to be negligible given the minimal incremental increase in such habitat any project area would create along any river when its entire course is at high flows.

3.3.10.3 Effects Conclusion for the Proposed Action on Air Quality, Noise, and Public Health and Safety

The effects of noise from the Proposed Action on the human environment would be low.

The effects of the restoration program on air quality, public health, and safety would be low.

3.3.11 Cultural Resources

Cultural resources include things and places that demonstrate evidence of human occupation or activity related to history, architecture, archaeology, engineering, and culture. Historic properties, as defined by 36 CFR 800, the implementing regulations of the NHPA (54 U.S.C. § 300101 et seq.), are a subset of cultural resources that meet defined eligibility criteria for inclusion in the National Register of Historic Places (referred to as the National Register). Historic properties may be districts, sites, buildings, structures, artifacts, ruins, objects, works of art, or natural features important in human history at the national, state, or local level, or properties of traditional religious and cultural importance to an Indian tribe.

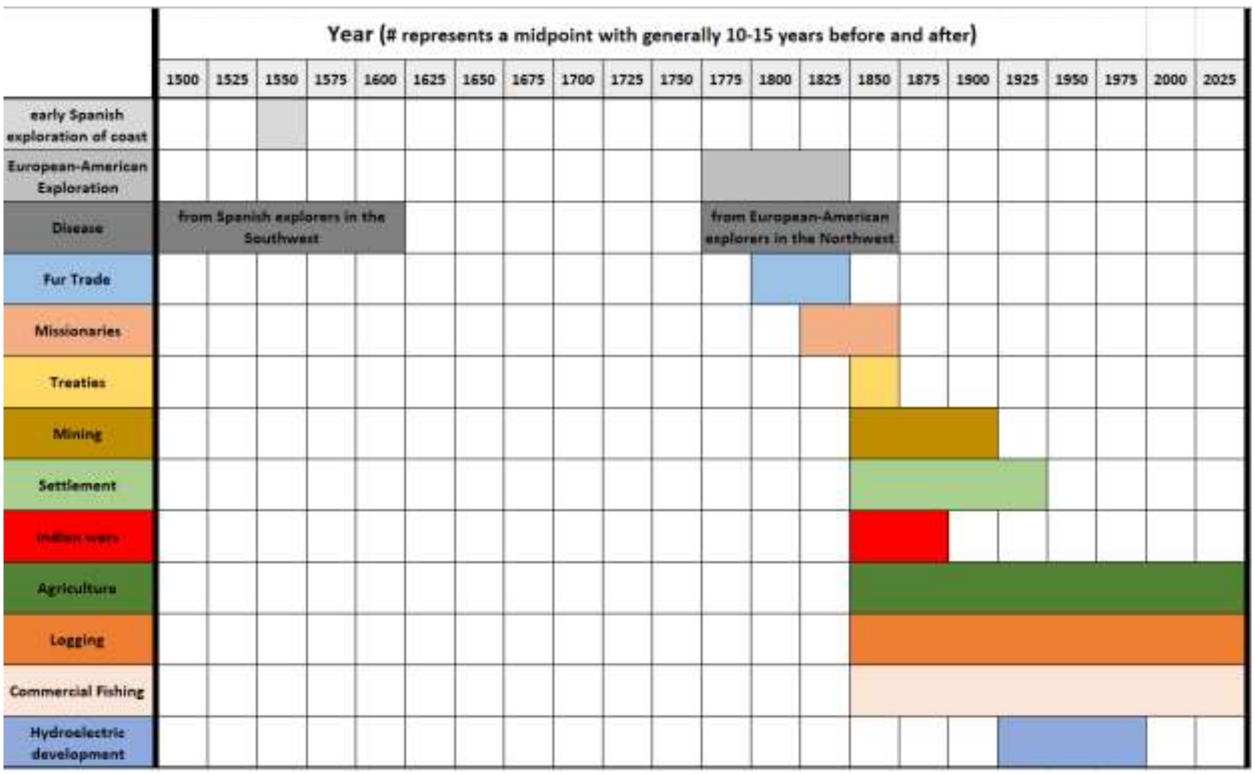
Section 106 of the NHPA requires that a federal agency make a "good faith effort" to identify and evaluate cultural resources for eligibility for listing on the National Register. It also stipulates that federal agencies evaluate, consider, and seek ways to avoid, minimize, or mitigate any adverse effects on historic properties. This is accomplished through public involvement and consultation with State Historic Preservation Officers, Tribal Historic Preservation Officers, affected tribes, state and federal agencies, and special interest groups. Cultural resources are evaluated for eligibility in the National Register using four criteria commonly known as Criteria A, B, C, and D which include an examination of the cultural resource's age, integrity (of location, design, setting, materials, workmanship, feeling and association), and significance in American culture, among other things. A cultural resource must meet at least one criterion to be eligible for listing on the National Register.

3.3.11.1 Affected Environment

Record of pre-contact human occupation of the Columbia Basin reaches back at least 13,000 years, with tribes and bands living in small mobile groups following seasonal foods, plentiful salmon, plant resources, and large mammalian fauna found there. (Ames et al. 1998). Geography, resource availability, and tribal history influenced the size and location of each tribe's territory, which likely overlapped with their neighbors' territories. During the winter, people generally lived in permanent villages along the Columbia River and its tributaries (Walker 1998:3). These areas provided warmer conditions in the winter and prime fishing for salmon and sturgeon in the spring and summer. This was also a time for community and ceremonial gatherings, storytelling, and intergenerational sharing of knowledge. During early spring, roots would be gathered and stored, and spring salmon runs would provide fishing opportunities. During the summer months, some groups would reconvene along the rivers in temporary camps to take part in summer fisheries focused on salmon and steelhead, while others would head upland to gather berries, harvest roots, and other plant resources. The fall brought hunting opportunities for deer, antelope, and elk, and by the end of fall, most people would have returned to their winter villages (Hunn 1990). Stone artifacts and waste materials related to the manufacture of tools, refuse scatters and middens, petroglyphs, fishing weirs, faunal remains, and basketry from various periods of this pre-historic human occupation are commonly identified during cultural resource inventories for restoration projects.

The historical period began with the introduction of European American influence, and while the history of each tributary is unique, the impact of the horse, epidemic diseases, trade goods, missionaries, and settlers was felt throughout the Columbia River Basin. The general historical progression of European American activity in the Columbia Basin as a whole (see Figure 14, below) was repeated to some degree in nearly every tributary by the specific peoples living there.

Figure 14 Overview of the historical period of the Columbia Basin



The first European-American influence crept into the basin from the south, as diseases introduced by Spanish explorers in the American southwest spread throughout the Americas, killing over 50% of native populations (Campbell 1989). The horse (ultimately from Spanish explorers in the 1500s) was introduced to tribes in the Basin in the early 1770s forever changing the lifestyle and economy of the Basin tribes (Haines 1964). Spanish, Russian, and English explorers entered the Basin in the 1770s and in 1792, Robert Gray became the first European American to record seeing the mouth of the Columbia River, after which non-Native use of the lower Columbia River and trading with the Native inhabitants increased rapidly. Disease again impacted the native populations, ultimately killing 60-90% of the native population by 1863 (Boyd 1994). In 1805, the Corps of Discovery (also known as the Lewis and Clark Expedition) entered the basin over the Lemhi Pass and followed the

Lemhi, Salmon, Snake, and Columbia Rivers to the Pacific Ocean. Fur traders and missionaries quickly followed. Conflict between the newcomers and native peoples began around mid-1800 as European-American settlers (farmers), miners, loggers, and fishermen arrived and began competing for natural resources. Wars with some tribes arose in the 1850s and treaties were signed with many tribes consigned to reservations by 1855 [Beckham 1995]. Native dissatisfaction with their reservations, and treaty violations by settlers, resulted in continued armed conflict between these peoples with battles and wars continuing until the final Nez Perce War in 1877, which involved Chief Joseph's famous fighting retreat toward Canada.

Agriculture in the Basin began with settlers moving there in response to a series of U.S. Government land settlement acts such as the Donation Land Claim Act of 1850 and the Homestead Act of 1862. With agricultural development came the diversion of rivers and streams for irrigation as described in Section 3.3.8, above. Remains and artifacts from this settlement and agricultural development such as irrigation structures and homesteads, can dumps, wagon frames, and railroad grades are frequently identified during cultural resources inventory efforts conducted for proposed restoration actions.

Two major mining rushes occurred in the Basin during the second half of the nineteenth century: the Colville gold rush (1855) and the Clearwater gold rush (1861). The Colville gold rush attracted hundreds of miners to the Basin, but was short-lived. The Clearwater gold rush was substantial and ultimately produced wealth that shaped the settlement of the Basin from the 1860s to the present and established the towns of Lewiston, Pierce City, Orofino, and Walla Walla that exist today. Other lesser gold rushes occurred throughout the basin, with gold mining practices ultimately affecting tributary habitat conditions throughout Idaho, Northeast Oregon, and in the mountains of central and northern Washington. This mining activity left cultural resources such as tools, equipment, roads, canals, and structures, as well as degraded habitat conditions such as mine tailings and dredged streams that are the focus of some restoration actions.

3.3.11.2 Environmental Consequences for Cultural Resources – Proposed Action

Each project would be reviewed by an appropriately qualified cultural resource specialist with an expertise in the potentially affected cultural resources. The Agencies would ensure this specialist meets the qualifications provided in 36 CFR 61 and relevant state standards as appropriate, especially if the project includes state or private lands. The cultural resources specialist would facilitate compliance with Section 106 of the NHPA This may include conducting surveys and excavation as part of site-specific evaluation, and consultation with the applicable State Historic Preservation Office, affected tribes, and other interested parties to ensure compliance with that act.

Some actions within this Proposed Action may have the potential to have an adverse effect on historic properties eligible for listing under the National Register of Historic Places. Where such is the case, this potential would be identified in the surveys and consultation under Section 106 of the NHPA, and necessary design changes would be applied to seek ways to avoid and minimize effects to these resources. Where adverse effects cannot be avoided, then data recovery actions or mitigation may be applied as identified through the Section 106 consultation process of the NHPA. While uncommon, unresolvable adverse effects may sometimes not be avoidable. Any proposed projects' adverse effects to cultural or historic resources that cannot be appropriately mitigated through the NHPA Section 106 consultation process would indicate the need for more site-specific NEPA analysis sufficient to evaluate this likely significant effect, and would not be tiered to this programmatic environmental assessment.

3.3.11.3 Effects Conclusion for the Proposed Action on Cultural Resources

The effect on cultural resources from the Proposed Action would be low because cultural resources would either be avoided by project construction, effects would be appropriately mitigated through the NHPA Section 106 consultation process, and any proposed projects' adverse effects to cultural or historic resources that cannot be appropriately mitigated through the NHPA Section 106 consultation process would not be tiered to this programmatic environmental assessment.

3.3.12 Indian Trust Assets

The Department of the Interior (DOI) requires that all effects to Indian Trust Assets (ITAs), even those considered non-significant, be discussed in NEPA analyses and appropriate compensation and/or mitigation implemented. ITAs are lands, natural resources, money, or other assets held by the federal government in trust or that are restricted against alienation for Indian tribes and individual Indians.

Reclamation's NEPA Handbook (2012) recommends a separate ITA section in all NEPA documents. These sections should be prepared in consultation with potentially affected tribal trust beneficiaries.

3.3.12.1 Affected Environment

The area of analysis will vary with each future proposed tributary habitat restoration project. The agencies would consult with all appropriate federally recognized tribes to determine the presence of ITAs and potential project effects on those resources.

The process for identifying ITAs and evaluating effects from the alternatives includes:

- Query Reclamation's geospatial database.
- If ITAs are identified, coordinate with the Bureau of Indian Affairs and relevant tribes or tribal individuals on identified trust assets.
- Prepare affected environment and environmental consequences sections of the draft NEPA document.
- Provide these sections, as necessary, with tribes who provided input.
- Finalize draft NEPA document section

3.3.12.2 Environmental Consequences – Proposed Action

The effects on ITAs from the Proposed Action cannot be identified at this time. As detailed above, as individual projects actions are identified, Reclamation would utilize its process for identifying site-specific effects to ITAs. Required mitigation of effects that cannot be avoided or minimized through project design would likewise be analyzed through site-specific NEPA analysis.

3.3.13 Socioeconomics and Environmental Justice

3.3.13.1 Affected Environment

The socioeconomics across the Basin vary greatly and are shaped by each locale's natural resources, population, and transportation network; and as a locale's geography and natural environment differ greatly between east and west sides of the Cascade range, so too does its socioeconomic landscape.

West of the Cascades lies the Willamette Valley and the Portland/Vancouver Metropolitan area, with its abundant rainfall, lush agricultural areas, diverse high-density transportation network, high population densities, and comparatively close cities. East of the Cascades, the climate is drier, the soil less productive in many places, and the population is less dense, with communities farther apart and centered around lands where agriculture is made possible by areas of productive soils with water for irrigation.

*3.3.13.1.1 **Population Characteristics***

Portland/Vancouver metropolitan area and the Willamette Valley

The Portland/Vancouver metropolitan area, located at the confluence of the Columbia and Willamette Rivers, is the Basin's largest urban center and is the 23rd largest in the United States. It supports nearly 2.5 million people, has grown nearly 50% in the past few decades, and is predicted to grow to nearly 4 million by 2040. While it is more ethnically diverse than the areas east of the Cascades, it is less diverse than the nation as a whole. As shown in Table 15.

Table 15 Demographic comparisons across the Columbia Basin and the United States*

Ethnicity	Portland / Vancouver area	Salem	Eugene/Springfield	Areas east of the Cascade Mountains	United States
White	81%	83.1%	85.8%	90%	73%
Hispanic	10.9%	14.6%	7.8%	7%	17.6%
Asian	5.7%	2.4%	4.0%	<0.5%	5.5%
Black	2.9%	1.3%	1.4%	0.5%	12.7%
Native American/ Alaskan Native	0.9%	1.5%	1.0%	2.0%	0.8%
Pacific Islander	.05%	0.5%	0.2%	<0.5%	0.5%
*These numbers don't add up to 100% exactly because of the overlap in reporting of people claiming two or more races, etc.					

The Willamette Valley supports many small towns and the small cities of Salem and Eugene/Springfield; each with about 156,000 population and located at the confluences of the Valley's major rivers. These towns and cities are large by comparison to all but a few of the communities east of the Cascade Mountains, and their proximity to one another is sufficiently close to provide robust economic interchange.

Areas East of the crest of the Cascade Mountains

By comparison to the Willamette Valley, the Basin east of the crest of the Cascade Mountains is sparsely populated, covering about eight percent of the land area of the United States while containing about one percent of the Nation's population. This results in a population density less than one-sixth of the U.S. average. Nearly half the population is located in 12 of the 100 counties, although just six of these (Ada and Canyon Counties in Idaho; and Benton, Yakima, Franklin, and Spokane Counties in Washington) are large enough to be called metropolitan counties. The area contains a larger proportion of whites (approximately 90 percent) and American Indians (just over 2% percent) than does the United States overall (approximately 72 percent and 1.6% percent, respectively); and a smaller proportion are black (just over 0.5% percent, compared to over 12.3% percent nationally), or Hispanic (approximately 7% percent, compared to about 16.7 percent nationally).

Like much of the rural West, the Basin has experienced recent, rapid population growth that is expected to continue, especially in communities known for their recreation and tourism opportunities such as Bend and The Dalles, Oregon. The Basin contains nearly 500 small, rural communities of 10,000 people or fewer that have been undergoing substantial social and economic change.

3.3.13.1.2 <u>Economic Characteristics</u>

Portland/Vancouver metropolitan area and the Willamette Valley

The metropolitan area first grew as a trading center during local gold rushes, then developed into a forest and food products processing and shipping point, and in the past 40 years evolved from that resource-based economy into a high-tech manufacturing and information-based economic center for the computer and electronic products economy. Population growth, as a result, has increasingly concentrated in this urban area, where most jobs in these sectors are located. Today, the Portland/Vancouver is described as a "wonderfully well-evolved, progressive and cosmopolitan city" [Best Places 2020].

The Willamette Valley supports a wide range of economic activities – from metropolitan cities to college towns, from farming to wood products. Historically, the Willamette Valley was the ultimate destination for immigrants over the Oregon Trail with its promise of rich agricultural and timber lands with ready access to river transport for their products. The region's dependence upon natural resource and goods producing industries has since declined, but the Willamette Valley is still a key timber and agricultural producer recognized for the diversity of crops grown: hazelnuts, grass seed, wheat, berries, hops, and nursery plants. The Valley has also become a major producer of wine and wine grapes in the last 20 years. Two-thirds of Oregon's wineries are found in the Willamette Valley.

As the Portland/Vancouver metropolitan area economy has recently evolved, so has the economy of the Willamette Valley. Since the 2009 recession, the industrial mix has transformed with strong growth in service sector jobs. In particular, the Valley has seen employment gains in professional and business; educational and health; and leisure and hospitality industries. The Willamette Valley now has a balanced occupational mix and has seen strong growth in both high- and low-wage jobs.

Areas East of the crest of the Cascade Mountains

The Basin has a diverse economy that makes up almost four percent of the U.S. economy. A U.S. Forest Service analysis in 1996 found that job growth in the Basin was above the U.S. average, that per-capita income grew faster than in the rest of the U.S., and that the poverty rate was generally lower than the national average (USFS 1996). Those trends have continued to the present.

Agriculture and agricultural services are, and have been historically, the primary economic generators in the Basin. Six metropolitan areas, however, have been the centers of recent economic growth in the Basin: Spokane, Yakima, Pasco/Kennewick/Richland ("Tri-Cities"), and Wenatchee, Washington; Bend, Oregon; and Boise, Idaho. Over the past four decades these cities have experienced a transition from a resource-based economy based on grazing, mining, and timber to a diverse economy oriented toward the technology, transportation, and service sectors.

Recreation is another primary economic generator that has been growing over the past few decades. Counties in the Basin with high recreation and tourism attraction had higher per-capita income than manufacturing counties in 1996, indicating they are areas of higher economic wellbeing and fiscal capacity (USFS 1996). That trend has also continued to the present.

General economic growth in the Basin is expected to continue, sustained by in-migration in some areas. Growth is expected in services, finance, insurance, real estate, trade, and agricultural services. Fastest growth is expected in the service sector, which includes health, business, educational, and legal services. The manufacturing, farming, and government sectors are expected to decline as a percent of the economy over the next 50 years (USFS 1996).

Within the Basin, most project actions would occur in agricultural areas, some near larger communities such as Yakima, Washington, and some in areas with smaller populations such as Wallowa County in northeastern Oregon and Lemhi County in eastern Idaho. In areas with small populations, the larger, construction-related, restoration projects could have some beneficial short-term economic effect.

3.3.13.1.3 Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, directs federal agencies to take the appropriate and necessary steps to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of federal programs, policies, and activities on the health or environment of minority populations and low-income populations (collectively, the environmental justice populations) to the greatest extent practicable and permitted by law. (USFS 1996)

Guidelines provided by the CEQ (1997) and EPA (1998) indicate that a minority community may be defined where either 1) the minority population comprises more than 50 percent of the total population, or 2) the minority population of the affected area is meaningfully greater than the minority population in the general population of an appropriate benchmark region used for comparison. Project-specific NEPA evaluations would identify whether such populations exist within or near a project area and the effects that adverse short-term resource impacts from any specific project might have on those populations.

The Proposed Action includes activities that would be implemented on Indian Reservations, and near non-reservation communities that could meet the definition of an environmental justice population as defined above. Projects funded by Bonneville on or near Indian Reservations are frequently sponsored by the tribes themselves on lands they control or on lands whose owners or managers are participating in the action, and Bonneville's funding of these projects frequently includes funding for tribal staff and staff time. Such actions have had in the past, and are anticipated to have in the future, a low effect on the environmental justice population represented by the funded tribe.

Actions not funded by tribes nor implemented by tribal members funded with project funds may produce short-term adverse natural resource impacts as described in Section 3.1 that could potentially adversely impact environmental justice communities. The scoping process for site-specific NEPA would identify this potential and provide, in most cases, opportunity to modify actions or implement mitigation measures sufficient to minimize adverse effects. Past experience with these actions and funded actions by tribes, however, has not revealed moderate or high adverse impacts to environmental justice populations, and similar results would be anticipated for future actions under this EA.

3.3.13.2 Environmental Consequences for Socioeconomics – Proposed Action

3.3.13.2.1 Effects on Population

There would generally be no, to low, effects on local populations as a result of implementing the activities in the Proposed Action. None of the actions would generate a requirement for additional permanent employees nor would they require individuals to leave the local area, or relocate within it. There would therefore be no effect on housing available for local populations. This Proposed Action would not displace people or eliminate residential suitability from lands being restored or from lands near restoration project sites.

3.3.13.2.2 Effects on Local Economies

Implementation of the restoration actions would likely create short-term beneficial economic effects for local businesses in smaller communities through purchases of food, fuel, lodging, and materials associated with construction and restoration actions. Materials necessary to build projects may also be sourced locally (*e.g.*, logs, gravel), and lodging, food, and other services would be required to support construction workers traveling from outside of the immediate area. When practicable, local companies would be utilized for restoration project activities which could provide a shot term increase in jobs. Although beneficial, the positive impact from construction of restoration projects would be small and temporary when compared to the larger local economy.

These benefits would likely most be realized in the small communities east of th e Cascade Mountains. There would likely be no measurable effect on the economies of the Portland/Vancouver metropolitan area or the Willamette Valley, because the projects there are fewer and generally smaller (see Section 3.3.8.1.1) and because the benefits themselves are so small in comparison to the area's economy.

Therefore, the construction-related effects on socioeconomics are considered low due to the minimal amount of goods and services that are expected to be required during these site-specific projects, and their temporal nature in most places. Some places, such as in the Lemhi Valley in eastern Idaho and the Grande Ronde Valley in northeastern Oregon, however, have had, and would likely continue to have, a high number of restoration actions being implemented on a regular basis, allowing a few construction contractors to specialize in such work and establish new small businesses.

The restoration actions may also improve fish runs and natural scenery leading to long-term benefits for fishing and tourism near communities serving such recreational opportunities.

Land use conversions in restored riparian areas from agriculture to natural habitats may require changes in grazing practices or some land uses, but no proposed action is anticipated to impact agricultural productivity or revenue sufficient to change land uses, decrease ranching- or farming-related jobs, or lead to a decrease in agricultural support services.

Potential economic effects to landowners adjacent to restored sites would need to be carefully assessed in the site specific assessments. The potential for altered flow regimes to flood adjacent lands would need to be evaluated and mitigated if necessary to avoid adverse economic impacts to those landowners. The potential for wildlife damage or nuisance issues, in the case of increased wildlife populations in restored sites, would also need to be assessed. Similarly, restored sites may bring ESA-listed species to properties or permitted use areas[52] of landowners whose operations might not previously have been exposed to the legal considerations of their presence.

3.3.13.3 Environmental Consequences for Environmental Justice

Site-specific analyses would identify the present or near-proximity of any environmental justice populations. The Proposed Action, however, generally includes no activity that would result in displacements of human activity or land uses except in locations where willing landowners altered land uses on their own lands to accommodate restoration actions. The Proposed Action would also

[52] Some restoration actions may provide access for ESA-listed fish to public lands where they had not been for decades. Some of these lands are leased or permitted for grazing by private ranchers. The presence of these fish on such permitted lands may require the agency to consider their protection needs in the terms and conditions associated with those permits. These new protection measures may have an economic impact to the permit holder.

not generate any human health or environmental effects that might disadvantage any population, including minority or low-income populations (see Section 3.3.10).

Exceptions to this may be the short-term effect of smoke from prescribed burning, or the potential short-term loss of riparian, wetland, or upland habitats while waiting for restored, more productive habitats to develop. Whether these actions would have consequential adverse effects on cultural or traditional practices of Indian Tribes (the most likely environmental justice population to be affected) would be a necessary assessment in site specific analyses.

3.3.13.4 Effects Conclusion for the Proposed Action on Socioeconomics and Environmental Justice

Effects to the socioeconomics of the Basin as a whole with the implementation of the Proposed Action would be low due to the small scale and dispersed nature of the projects.

Overall no permanent adverse effects to populations where environmental justice would be a consideration are expected. Some site-specific situations may have short-term adverse effects. Effects are not expected to be disproportionately high and adverse from the program overall. The required site-specific analysis would identify and disclose the degree to which environmental justice populations are impacted.

3.3.14 Climate Change

3.3.14.1Affected Environment

Greenhouse gases (GHGs) are chemical compounds in the earth's atmosphere that absorb and trap infrared radiation (heat) that is reflected or emitted from the surface of the earth. The trapping and subsequent buildup of heat in the atmosphere creates a greenhouse-like effect that maintains a global temperature warm enough to sustain life. Some forms of GHGs can be produced either by natural processes or as a result of human activities. However, the current scientific consensus is that human-made sources are increasing atmospheric GHG concentrations to levels that would raise the earth's average temperature. The United States Global Climate Research Program (USGCRP) found that since the 1970s, average U.S. temperatures and sea levels have risen, precipitation patterns have changed, and are likely continuing to do so (USGCRP 2017). Numerous studies have projected that warming will continue, there would be more winter rain than snow, snowpack in the Basin is likely to decline in most areas, summers would be drier, winter and spring flows would be higher, and there would longer periods of lower summer flows (RMJOC 2018).

Ongoing global climate change has implications for the current and likely future condition of in-stream and riparian habitats for fish and wildlife in the Basin. Historical patterns of precipitation (rain and snow) and snow melt have shaped the Basin's hydrology, and thereby its aquatic and riparian habitats and the patterns by which native species use them. Changes in those precipitation and hydrologic patterns would bring changes in habitat conditions, and thereby changes in use by native species.

Recent studies, particularly by the Independent Scientific Advisory Board (ISAB), describe the potential impacts of climate change, and resulting changes in the Basin's hydrology, on salmonids in the Basin (ISAB 2007).

- Water temperature increase would result in the loss of cold-water habitat (temperatures would exceed the upper thermal limits for a species). Projected salmon habitat loss would be most severe in Oregon and Idaho, possibly higher than 40% of 2007 by 2090. Habitat loss would be less extreme in Washington at 22% by 2090. However, this assumes a high rate of greenhouse gas emissions and used a climate model that projected a 5º C in global temperatures by 2090, a value that is higher than the scenarios considered most likely (ISAB 2007).

- Variations in rainfall intensity may alter seasonal hydrography. With reduced snowpack and greater rainfall, the timing of stream flow would likely change, reducing spring and summer stream flow and increasing peak river flows (ISAB 2007). This reduction in stream flow may impact the quality and quantity of tributary rearing habitat, greatly affecting spring and summer salmon and steelhead runs. In addition, the Pacific Northwest's low late-summer and early-fall stream flows are likely to be further reduced, which would limit juvenile fall Chinook and chum salmon shallow mainstem rearing habitat.
- Considering both the water temperature and hydrologic effects of climate change, abundance of Snake River spring/summer Chinook populations would be substantially decreased (20-50% decline from simulated average abundance based on historical 1915-2002 climate; (Crozier et al. 2008). This substantially increases extinction risks in the long term.
- Eggs of fall and winter spawning fish, including Chinook, Coho, chum, and sockeye salmon, may suffer higher levels of mortality when exposed to increased flood flows.
- Increases in seasonal mainstem Snake and Columbia River water temperature would accelerate the rate of egg development of fall Chinook that spawn in the mainstem of the Snake and Columbia rivers and lead to earlier (smaller size) hatching. Thermal stress may also lead to increased risk of parasitism and disease.
- Earlier snowmelt and higher spring flows, warmer temperatures, more rain, and less snow may cause spring Chinook and steelhead yearlings to smolt and emigrate to the estuary and ocean earlier in spring. The early emigration coupled with a projected delay in the onset of coastal upwelling could cause these fish to enter the ocean before foraging conditions are optimal. The first few weeks in the ocean are thought to be critical to the survival of salmon off Oregon and Washington, so a growing mismatch between smolt migrations and coastal upwelling would likely have substantial negative impacts on early ocean survival rates.

In addition to likely effects on anadromous salmonids, native trout species would also be impacted. Changes in flow regimes that increase early-year runoff and flooding; decrease summer and fall flow; and generally increase water temperatures would likely eliminate some areas from spawning, feeding or migrating use by bull trout and other native trout species.

Instream, riparian, and floodplain habitats would also be impacted. More rain, less snow, earlier snowmelt, increased rainfall intensity, and higher spring flows would alter seasonal flow patterns. These would increase peak river flows, flooding, and overflows onto floodplains in river valleys. More extensive, intensive, and frequent spring flooding is anticipated than has been experienced in recent history. Stream courses that had been simplified (channeled and disconnected from their floodplains) to accommodate land uses would be at increased risk of overflowing, cutting new channels, or down-cutting.

Erosion (instream and along the banks) could increase and would elevate turbidity levels and modify riparian habitat patterns. River, stream, and riparian habitats are naturally dynamic, so plant species here are adapted to such events, but the scale and pace of these changes may eliminate some mature riparian habitat blocks, and keep some areas in long-term states of change, with limited opportunity for shrubs and trees to mature.

Anticipated climate changes would affect upland habitats as well. The warming climate is already stressing upland forests and rangelands, creating drier conditions and increasing wildfire potential across the Basin. The Cascade Range and Rocky Mountains within the Basin are some of the most fire-prone regions in the western United States and the incidence of large forest fires here has increased since the early 1980s. It is projected to continue increasing as temperatures rise (USGCRP 2017). This effect could intensify as drier and warmer summers lead to increased wildfire frequency and larger burned areas. Wildfires are now, and are expected to continue to be, larger and more intense, with a higher degree of plant community and wildlife habitat modification than has been the case over the past 100 years (USGCRP 2017).

Changes are also anticipated in plant community composition and position on the landscape. Plants and plant communities are found where temperature and moisture regimes provide the environment in which they compete most effectively, and are anticipated to migrate with those conditions. The plant communities recognized today are generally anticipated to migrate upslope and north, as the climate gets drier and warmer at lower elevations. The plants and plant communities already at higher elevations would be at risk in some locations. The Whitebark pine (*Pinus albicaulis*) is already listed as endangered under the ESA for this cause. Replacement of forested lands by expanding sage-brush steppe habitats is likely at lower elevations or in drier ecosystems. Such changes are likely in the aftermath of wildfire, where the prior plant community may not return, and one better adapted to the new drier and warmer climate would take its place.

3.3.14.2 Environmental Consequences for Climate Change – Proposed Action

Greenhouse gas emissions associated with the projects (primarily carbon dioxide, methane, and nitrous oxide) would be localized and temporary. They would be generated by the short-term emissions from construction equipment, off-road vehicles, on-road vehicles (including worker commuting and material delivery), and dust from ground disturbing activities. Given the short construction duration, low number of vehicles and equipment, and estimate of emissions well below the EPA's reporting threshold[53], the impact from greenhouse gas emissions would be low and therefore the potential for the Proposed Action to accelerate climate change would be low.

The Proposed Action would, however, contribute to the amelioration of global climate change and its adverse warming effects. The restoration of functional riparian, wetland, and floodplain habitats would expand the amount of wetland soils in which atmospheric carbon would be sequestered (Nahlik and Fennessy 2016). Wetlands can accumulate large carbon stores, making them an important sink for atmospheric carbon dioxide and holding up to, or in some cases, even more than 40% soil carbon (Vepraskas and Craft 2016), which is substantially greater than the 0.5–2% carbon commonly found in agricultural soils (Lal *et al* 1995). By increasing stored carbon through the increase of wetland soils, the Proposed Action would help mitigate for the release of greenhouse gases.

The Proposed Action would also provide for an increase of long-term water table inputs through restoring floodplain function and increasing connectivity of streams and rivers to their floodplains. It would also increase riparian shading of streams and rivers (see Section 3.3.1.2.2.2). Both of these

[53] On October 30, 2009, the U.S. Environmental Protection Agency published a rule (40 CFR Part 98) for the mandatory reporting of 25,000 metric tons or more of carbon dioxide equivalent per year of greenhouse gases from large GHG emissions sources in the United States.

results from the Proposed Action would help lower water temperatures, thereby ameliorating the effects of climate change on aquatic species.

3.3.14.3 Effects Conclusion for the Proposed Action on Climate Change

The short-term effects of emissions from motorized equipment operations during construction or implementation of the proposed activities would be offset to some degree by the ameliorating effects of restored floodplain function with increased water table inputs, increased carbon sequestration in expanded wetlands, and water temperature decreases from improved instream and riparian habitat conditions. The overall effects of the Proposed Action on Climate Change would be low.

3.4 Cumulative Effects

Cumulative effects are the incremental effects of a project or program when added to effects of other past, present, and reasonably foreseeable future actions. Sections 3.1 through 3.3 of this chapter present information about current environmental conditions and the environmental and socioeconomic consequences of implementing the Proposed Action.

Past actions of cumulative environmental consequence in the Basin include agriculture, road and railroad construction, dam construction, urban and rural development, grazing, timber cutting, suppression of natural fire regimes, and harvests of fish and wildlife.

Present (Ongoing) Actions include the use and maintenance of roads, highways, and railroads; ongoing land uses and management actions such as agriculture, grazing, forest management, wildfire suppression and prescribed fire use; hydroelectric facility operation; the management and harvest of fish and wildlife populations; and ecosystem restoration and resource preservation actions by public and private entities throughout the Pacific Northwest.

Reasonably Foreseeable Future Actions include the continuance of the ongoing actions listed above, with some increases in land use pressures and those ongoing actions as populations increase.

Short-Term Cumulative Effects

The Proposed Action is to implement restoration projects, the purpose of which is to address the cumulative adverse effects of past actions with adverse effects on rivers and floodplains in the Basin. While these actions may create short term (weeks to months) adverse impacts, the sites of those impacts would be restored and improved for the long term; and many of those would be implemented on properties protected by conservation easements or owned by conservation organizations where continued long-term benefit from the restoration action is reasonably ensured. From a cumulative effects standpoint, therefore, these projects would not be adding to the long-term cumulative effects of past or ongoing environmentally consumptive or impactful actions. There would, however, be short-term adverse impacts, and those may have the potential to add cumulatively to preexisting, ongoing, adverse effects from past actions of cumulative environmental consequence in the Basin.

Long-Term Cumulative Effects

The long-term cumulative effect of the Proposed Action would be a cumulative contribution of improved environmental conditions to those of ongoing restoration actions of the past few decades. These restoration actions, albeit small in scale compared to the cumulative adverse environmental impacts from land uses, vegetative cover changes, and waterway alterations from European-American settlement and development in the Basin, are beginning to reshape the Basin's natural resources. Both public and private entities are engaged in projects across the Basin to restore natural hydrologic form and processes in the rivers and floodplains where such actions can be taken in concert with protection of developed infrastructure and authorized water uses. Concerted effort by Federal land management agencies is also being applied to restore more historically-sustainable and near-natural forest and range vegetative conditions and ecological processes on the lands they manage.

This Proposed Action would contribute cumulatively to the ongoing restoration of tributary and floodplain hydrology; and riparian and floodplain habitats in the Basin. The Proposed Action would be implemented on many private and state lands not benefitting from the restoration focus of management on federal public and National Forest System lands, where monitoring and research suggest their goals of maintaining or restoring aquatic and riparian habitats and key ecological processes at watershed and larger scales is being achieved (USFS 2018). They would, however, be on lands with soils often of higher resource productivity (*e.g.* agricultural lands) than those managed by the BLM and USFS, and would help fill a gap in natural resource restoration by funding such actions in highly productive aquatic, riparian, and wetland habitats at lower elevations.

3.4.1 Fish and Aquatic Species – Cumulative Effects

There would be short-term adverse effects on fish and aquatic species and their habitat during construction activities by the projects in Category 1, "Reestablishing and Improving Fish Passage", Category 2, "Improving River, Stream Floodplain, and Wetland Habitats", and to a far less degree, the actions of other Categories. Though numerous mitigation measures are in place to minimize effects as much as possible, those effects would temporarily add to the adverse effects of poor habitat conditions the local aquatic species would be experiencing at and near these construction sites. The short-term cumulative effects to fish and their habitat by the projects would not, however, extend beyond the areas where construction is occurring (with the exception of turbidity effects, which may moderately affect habitat downstream during construction activities). These adverse project effects would also be short-term only, followed by long-term increases in aquatic-species' habitat condition, diversity, and carrying capacity.

This Proposed Action would contribute cumulatively to the ongoing restoration of tributary and floodplain hydrology; and riparian and floodplain habitats in the Basin. The incremental beneficial effects of the Proposed Action's restoration of fish and aquatic species' habitat when added to the beneficial effects of other past, present, and reasonably foreseeable future restoration actions would be moderate.

3.4.2 Water Resources – Cumulative Effects

There would be cumulative impacts to water quantity from the Proposed Action because water use actions under Category 7 would assist in conserving water and protecting water instream to benefit of fish and wildlife. The incremental impact of these activities when added to effects of other past, present, and reasonably foreseeable future actions would be low.

There would be short-term impacts to water quality from the sedimentation anticipated at each construction site, which would add cumulatively to the turbidity effects from nearby urban, forestry, grazing, or agricultural activities. However, environmental design features and mitigation measures described in Appendix A and Section 2.4, "Mitigation Measures", would ensure that project impacts on water resources would be low, and would have a low, temporary contribution to the cumulative water quality degradation when combined with other past, present and reasonably foreseeable future actions.

3.4.3 Vegetation –Cumulative Effects

Vegetation at many project sites has been impacted by human activities and animal uses, and the proposed construction actions would cumulatively degrade those conditions in the short term. As is the discussion in Section 3.4.1 "*Fish and Aquatic Species – Cumulative Effects*", above, the construction effects would be cumulative to the adverse effects of poor vegetative conditions already in place at many of the construction sites and in the Basin's tributaries. The effects may be high in the short term as vegetation is disturbed by construction, and for some sites, the effect may be destructive in the short term. And, as above, that short-term adverse effects would be quickly replaced by a more robust, native vegetative condition for the long term. Thus, the incremental effects of the Proposed Action's improvements of native riparian vegetative communities when added to the effects of other past, present, and reasonably foreseeable restoration actions would be moderate and beneficial.

3.4.4 Wetlands and Floodplains –Cumulative Effects

The discussion of short-term cumulative effects on wetlands and floodplains follows closely with that of "Vegetation" and "Fish and Aquatic Species", above. The existing condition is degraded from past and present activities, and adding heavy equipment operations and the redesign of hydrologic systems to those poor existing conditions would temporarily increase the cumulative impact on wetland and floodplain function and disturbance in the project areas. But those effects would be only temporary during construction, and more importantly, would not extend into the high-flow or potential flooding periods of the winter and spring following the late summer or fall construction activities. Even for those few projects that would likely be implemented over two to three years, each construction season would wrap up with implemented mitigation measures from Appendix A and Section 2.4, "*Mitigation Measures*", to maintain a functional floodplain and protect wetlands. As above, this temporary floodplain and wetland disturbance would be quickly replaced by a more effective and well-connected floodplain and wetland system for the long term. The long-term incremental effects of the Proposed Action's localized restoration of wetland and floodplain condition and function when added to effects of other past, present, and reasonably foreseeable restoration actions would be moderate and beneficial.

3.4.5 Wildlife –Cumulative Effects

Wildlife habitats have been degraded and populations have been reduced by human development and constant activity throughout the Basin over the past 150 years. The Proposed Action's construction disturbance and vegetation (habitat) removal would add to these effects in the short term, as most wildlife would likely be temporarily displaced, and some small species (*e.g.* mice, gophers, frogs, snakes), might be killed. As with fish and other aquatic species, these short-term adverse effects would be replaced by long-term improvements in habitat availability, diversity, and carrying capacity. The incremental effects of the Proposed Action's improvements of wildlife habitats when added to the effects of other past, present, and reasonably foreseeable restoration actions would be moderate and beneficial.

3.4.6 Geology and Soils –Cumulative Effects

The proposed short-term habitat restoration actions that include construction actions would cumulatively add to impacts on soils and geology from past, present, and reasonably foreseeable future actions of continued land-disturbing grazing, agriculture, forestry, fire, mining, and other land use and development. In the short term, soils would be impacted as described in Section 3.3.6 "*Geology and Soils*". But each project's earthwork would be short term and would occur during the dry late summer and early fall months (minimizing erosion potential), and environmental design features and mitigation measures would limit long-term project-related impacts to soils. Overall, the temporary nature with project minimization measures would ensure that the cumulative impacts on geology and soils from the Proposed Action when added to effects of other past, present, and reasonably foreseeable land-disturbing actions would be adverse and negligible to low.

3.4.7 Transportation – Cumulative Effects

The main sources of traffic in nearly all proposed project areas are agricultural/ranching/forestry-related, residential, and recreational; and these sources would continue as the proposed restoration activities commence. The Proposed Action would add additional construction traffic to the rural roads in the Basin, but this addition would be minimal and the pre-existing traffic in rural areas is also light. Traffic delays where actions occur on or adjacent to roads (*e.g.* culvert and bridge work) would be added to this minimally increased traffic. The effects, however, would be mitigated through safety and traffic-control measures aimed at reducing the impacts from traffic delays. Some road decommissioning would be accomplished, and some roads may be relocated, but construction of new permanent roads is not included in this Proposed Action. The short-term effects of the proposed actions on traffic would be low, thus the cumulative effect of these projects on transportation when added to the existing transportation network and traffic amounts would be adverse and negligible to low.

3.4.8 Land Use and Recreation – Cumulative Effects

Land Use

For each of the project areas, there would be temporary changes to land use, simply because current land uses could not continue while the project is under construction; or long-term changes following construction on some of the project sites where prior agricultural, forestry, or grazing activities would not occur within restored riparian areas. There may thus be a loss of grazing, agricultural, or forestry activity, or perhaps some modifications of those land use practices, on small acreages in riparian habitats. None of the actions, however, are anticipated to require land use changes over land areas large enough to substantially contribute cumulatively to the past, present, and reasonably foreseeable conversions of riparian habitats or other wildlands to agricultural, residential, commercial, or industrial uses in the Basin. Thus, the incremental effects of the Proposed Action on land use when added to effects of other past, present, and reasonably foreseeable future actions would be low and beneficial.

Recreation

Cumulative impacts to recreational use and opportunity in the Basin would be low. Many actions would be on private lands or other lands not open for public recreational access, and the proposed actions here would not change that. There may be delays to recreational traffic, or limitations on recreational use of lands being treated during construction activities, and these would contribute cumulatively in the short term with other recreation-limiting conditions throughout the basin to limit outdoor recreational pursuits. These delays and limitations, however, would be short-term and temporary as would their cumulative impact. For the long term, the proposed actions would be improving habitats for fish and wildlife which can reasonably be expected to improve outdoor recreational opportunities, reducing some of the cumulative adverse effect of land use changes across the basin on these recreational pursuits. Given the minimal short-term cumulative effects on recreation, and the long-term improvement in outdoor recreational opportunities, the cumulative effect of the proposed action on recreation would be low and beneficial.

3.4.9 Visual Resources – Cumulative Effects

The Proposed Action would introduce large construction equipment and construction activities into the rural landscape for one, or rarely two, seasons (generally mid- to late-summer and early fall). The actions would generally not be visible in the foreground of any major highway (exceptions would be culvert changes and bridge construction) for any project, nor would they be visually inconsistent from the routine past, present, and likely reasonably foreseeable future agricultural, ranching, or forestry activities common around project sites throughout the Basin either during their operations or in their ultimate visual results. The cumulative effect on visual resources, when considering the existing visual character and past, present, and likely reasonably foreseeable future activities in the Basin would be short-term, temporary, and low.

3.4.10 Air, Noise, and Public Health and Safety – Cumulative Effects

Air Quality

Vehicular traffic and land use activities throughout the Basin area all contribute to air quality impacts in the Basin, but as discussed in Section 3.3.10.1.1, these impacts are problematic primarily around towns and cities. The incremental contribution of emissions from the Proposed Action's construction activities is anticipated to have minimal cumulative impact to existing air quality problem areas since the actions would primarily be implemented in rural areas and would each be short term. And though the actions are anticipated annually for the foreseeable future, they would all be in different rural locations at different times, and no proposed project action would create a facility or practice that would regularly produce emissions over the long term in a fixed location near towns and cities that would contribute cumulatively to the existing air quality issues identified by the states. The minimal emissions and dust generation added by the proposed projects away from cities and towns are expected to have a low, temporary, and localized cumulative air quality effect.

Noise

The predominant past, present, and reasonably foreseeable future sources of noise within likely project areas would be that associated with rural living; agricultural, grazing, or forestry activities; recreational activity; and vehicular traffic. These noise sources would continue to generate the sounds of human uses throughout the Basin into the foreseeable future, and the Proposed Action would add construction noises to it, also into the foreseeable future. This added noise, however, would be in different locations at different times, with no proposed action creating a fixed, long-term, noise-generating structure or source. The proposed construction projects are therefore anticipated to have a low cumulative noise impact since the added noise would be low when combined with other noise sources, would rarely be near residential areas, would be mitigated by specified timing and equipment maintenance requirements, and would cease after construction ended.

Public Health and Safety

The projects would add only temporary construction-related safety risks for each project, with no long-term structure, facility, or construction that would add environmental safety or health hazards to the human environment, nor produce a long-term increased demand for public emergency services in rural areas. The projects would not hinder the effective function of any public emergency or health service beyond minor temporary delays in traffic flow (as described above). The cumulative effect on public health and safety would be low.

3.4.11 Cultural Resources – Cumulative Effects

It is likely that cultural resources in many project areas have already been affected by past agricultural, forestry, grazing, transportation, and other rural development activities, and would continue to be affected by such ongoing and future actions on private lands. The proposed projects would likely have a low cumulative impact on historic properties because all projects would be subject to Section 106 requirements, thus historic properties or archaeological resources would rarely be adversely affected; and where they might be, appropriate data recovery or mitigation would be developed in Section 106 consultation with consulting parties. In the event unresolved adverse effects would occur, project-specific NEPA analyses would be conducted to assess these effects. Additionally, implementation of the measures described in Section 2.4 would reduce the potential for construction activities to cumulatively impact known and previously unknown cultural resources in the area. The incremental effects of the Proposed Action on cultural resources when added to the effects of past, present, and reasonably foreseeable future agricultural and other land management actions in the Basin would be low.

3.4.12 Indian Trust Assets

The cumulative effects of the proposed action on ITAs would be analyzed in site-specific NEPA analyses for future projects. Future project-specific cumulative effects analyses - inclusive of reasonably foreseeable future actions in proximity to site-specific study areas - would be conducted when ITAs are identified using Reclamation's geospatial database.

3.4.13 Socioeconomics and Environmental Justice – Cumulative Effects

Socioeconomics

Socioeconomic benefits (jobs and contracting opportunities) of the Proposed Action's projects, and other agencies' habitat restoration projects, could combine for small, temporal, and localized cumulative beneficial socioeconomic benefits. The projects would not directly add permanent jobs to most areas of the Basin, so there would be little incremental cumulative effect on most local populations and income, and thus no need to increase infrastructure and services to accommodate new residents. Very few areas (*e.g.* Lemhi and Grande Ronde Valleys) would likely see new businesses develop as discussed in Section 3.3.12.2.2, but these new ventures would likely be the result of occupational changes of current residents and not create demand for new residents to move into an area. These would also, therefore, not be large cumulative additions to local economies.

The Proposed Action would likely increase fish habitat productivity and population capacity in many areas across the Basin, and the addition of these habitat restoration actions in concert with habitat improvement efforts by others and anadromous fish-hatchery production throughout the Basin is anticipated to ultimately increase anadromous fish returns. This would increase recreational opportunities and tourist income. Forecasts of future returns of anadromous salmonids are not possible, so expenditures and income associated with their potential contribution to future recreation cannot be predicted, but increased returns of salmon and steelhead to the Basin are reasonably expected to positively affect local and regional economies, many of which may already be profiting from recreational fishing by tourists.

Considering the small economic contribution the jobs and expenditures from both construction and recreational activity the Proposed Action would generate in relation to past, present, and reasonably foreseeable future (stable) economic activities, the cumulative impacts from the Proposed Action's projects on socioeconomics would be low and beneficial.

Environmental Justice

The Proposed Action would not result in displacement of human activity or changes in land uses nor generate any permanent human health or environmental effect that might majorly disadvantage any minority or low-income population. It would therefore not have disproportionately high and adverse effects on environmental justice populations. The Proposed Action would not alter nor contribute cumulatively to past (historical) actions on environmental justice populations, specifically Indian tribes; nor would it contribute cumulatively to the ongoing and reasonably foreseeable future social and economic conditions resulting from those reservations and treaties. However, the cumulative effect of these actions of increasing anadromous fish returns over time is anticipated to improve local and regional economies, and to further support tribal social and cultural interests to some degree, with no cumulative adverse effect.

3.4.14 Climate Change – Cumulative Effects

The Proposed Action would have a cumulative effect on climate change by adding GHGs to the atmosphere in the short term. Local vehicular traffic, ranching, agriculture, forestry management, and residential activities all contributed to past and ongoing GHG accumulations. These sources of GHG emissions would continue, and any addition, when considered globally, would contribute incrementally to long-term atmospheric conditions for climate change. The Proposed Action would contribute incremental additions of GHGs through restoration actions that require construction activities using heavy equipment. These contributions would each be short-term and of a small scale, and they would be numerous and ongoing for the foreseeable future, but they would be minute in comparison to GHGs generated basin-wide by ongoing rural economic and recreational activity during any construction period, or in any project locale.

The Proposed Action would also ameliorate the warming effects of climate change by its reduction of stream temperatures through improved hydraulics and restored riparian habitats. It would also mitigate the cumulative contribution of GHGs of these actions by the expansion of wetlands which sequester atmospheric carbon and provide an effective long-term carbon sink for this GHG (see Section 3.3.13.2).

The effect of the Proposed Action's incremental contribution of greenhouse gasses to the atmosphere and the benefits of additional long-term carbon sinks when added to the effects of other past, present, and reasonably foreseeable future contributions from agricultural and other activities in the Basin, and considering its temperature reducing effects and carbon-sink services, would be low and beneficial.

3.5 Effects of the No Action Alternative

The No Action Alternative would continue aquatic and habitat improvements in the Basin's tributaries at the current pace, where individual NEPA documents would need to be prepared for many future restoration actions without the benefit of programmatic coverage from this EA. Given the time frame required for Environmental Assessments' analysis and documentation under NEPA, projects under this alternative are thus expected to be implemented more slowly and sequentially than under the Proposed Action, with far less likelihood of efficiently sequenced or concurrent actions under the No Action Alternative.

This slower pace, however, can have its benefits. There is expected to be less of the concentrated short-term adverse impacts associated with project implementation, and short-term adverse impacts would likely unfold more sequentially and thus slowly.

However, the long-term beneficial effects would certainly develop more slowly as well, with long-term benefits to fish and wildlife populations and habitats developing later and more gradually over time. And for anadromous fish, this gradual improvement may not be sufficient to support increasing populations that are being enabled by estuary and mainstem habitat improvements and hatchery production efforts. Existing degraded habitats have a lower carrying capacity than would restored habitats, and increasing returns of salmon and steelhead may be exceeding habitat capacity in some areas (ISAB 2015).

4 Environmental Consultation, Review, and Permit Requirements

This chapter addresses statutes, implementing regulations, and executive orders applicable to the Proposed Action.

4.1 Agency Coordination and Public Involvement

Notification of this proposal was sent to tribes, federal agencies, state agencies, and state and local governments during the public scoping effort described in Section 1.6.1, and these entities were kept informed as this assessment progressed based on their expressed level of interest. Bonneville has also contacted elected officials at the county, state, and Federal levels. Conservation organizations and individuals from county, state, and federal entities engaged in restoration projects as part of the Council's Fish and Wildlife Program (Section 1.5.1) throughout the Basin were also notified.

4.2 Environmental Review and Coordination

In conducting the actions described in this EA, the Agencies would comply with applicable Federal laws, regulations, and executive orders. The following sections describe how the Proposed Action is in compliance with the various environmental laws and other relevant Federal executive orders.

4.2.1 National Environmental Policy Act

This Programmatic EA was prepared pursuant to regulations implementing NEPA (42 U.S.C. 4321 *et seq*.), which requires federal agencies to assess the impacts that their actions may have on the environment. NEPA requires preparation of an EIS for major federal actions significantly affecting the quality of the human environment. The Agencies prepared this Programmatic EA to determine if the Proposed Action would create any significant environmental impacts that would warrant preparing an EIS, or if a Finding of No Significant Impact is justified.

In this EA, the Agencies evaluated two alternatives to meet the purpose and need as described in Chapter 2: The Proposed Action and the No Action Alternative. The Proposed Action would implement a programmatic NEPA approach to analyze the various aquatic and upland restoration actions proposed throughout the Basin that vary in scale and impact.

4.3 Fish and Wildlife

4.3.1 Endangered Species Act

The ESA (16 USC 1531 et seq.) establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and plants, and the preservation of the ecosystems on which they depend. The ESA is administered by USFWS for terrestrial species and some freshwater fish species, and by National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) for anadromous fish and marine species. Section 7(a) of the ESA requires federal agencies to ensure that the actions they authorize, fund, and carry out do not jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat. Section 7(c) of the ESA and other federal regulations require that federal agencies prepare a biological assessment (BA) addressing the potential effects of their actions on listed or proposed endangered species and critical habitats. The effects on species listed under the ESA are discussed in Chapter 3 of this EA, specifically in Section 3.3.1, "Fish and Aquatic Species"; and Section 3.3.5 "Wildlife".

The actions assessed in this EA have been consulted on under the ESA with NMFS and USFWS in Bonneville's Habitat Improvement Program (HIP) consultation (2003- present), now in its fourth iteration (HIP IV). Many more actions are included in this assessment than were consulted on in HIP, but upon implementation of such actions, individual consultations under ESA would be conducted for site-specific projects as necessary.

4.3.2 Migratory Bird Treaty Act

The Migratory Bird Treaty Act, as amended, implements various treaties and conventions between the U.S. and other countries, including Canada, Japan, Mexico, and Russia, for the protection of migratory birds (16 U.S.C. 703-712). Under this Act, taking, killing, or possessing migratory birds, or their eggs or nests, is unlawful. The act classifies most species of birds as migratory, except for upland and nonnative birds.

Executive Order 13186, issued in January 2001, directs each federal agency undertaking actions that may negatively impact migratory bird populations to work with USFWS to develop an agreement to conserve those birds. The protocols developed by this consultation are intended to guide future agency regulatory actions and policy decisions; renewal of permits, contr acts, or other agreements; and the creation of or revisions to land management plans. This order also directs that the environmental analysis process include effects of federal actions on migratory birds. On August 26, 2013, USFWS and the U.S. Department of Energy signed a Memorandum of Understanding to complement the Executive Order. This Memorandum of Understanding addresses how Bonneville and USFWS work cooperatively to address migratory bird conservation and is in the process of being renewed.

This Proposed Action includes ground-disturbing activities that could impact migratory birds as discussed in Chapter 3. The construction actions here would be implemented primarily in mid to late summer, outside of the nesting season for migratory birds, as directed by mitigation measures in Appendix A. Shrubby riparian areas (key migratory bird nesting areas) would not be impacted in the spring (key migratory bird nesting period) by heavy equipment actions (too wet, and not in approved operating windows to protect fish), though hand work such as fencing and planting would occur then. The impact to migratory birds would be negligible, and likely from unintentional disturbance rather than destruction of nest sites, but each project would be required to assess potential impacts to migratory birds and identify the site-specific measures necessary to protect them in compliance with this Act.

4.3.3 Fish and Wildlife Conservation Act and Fish and Wildlife Coordination Act

The Fish and Wildlife Conservation Act of 1980 (16 U.S.C. 2901 *et seq.*) encourages federal agencies to conserve and promote conservation of non-game fish and wildlife and their habitats. The Fish and Wildlife Coordination Act (16 U.S.C. 661 *et seq.*) requires federal agencies with projects affecting water resources to consult with USFWS and the state agency responsible for fish and wildlife resources. The analysis in Section 3.3.1, "Fish and Aquatic Species", and 3.3.5, "Wildlife", of this EA indicates that the alternatives would have limited impacts on fish and wildlife, with implementation of appropriate mitigation.

4.3.4 Magnuson-Stevens Fishery Conservation and Management Act of 1976

The National Marine Fisheries Service is responsible for ensuring compliance with the Magnuson-Stevens Fishery Conservation and Management Act of 1975 (16 U.S.C. 1801 *et seq.*). Public Law 104–297, the Sustainable Fisheries Act of 1996, amended the Magnuson-Stevens Fishery Conservation and Management Act to establish new requirements for evaluating and consulting on adverse effects to essential fish habitat (EFH). Under Section 305(b)(4) of the act, Bonneville is required to consult with NMFS for actions that adversely affect EFH; in turn, NMFS is required to provide EFH conservation and enhancement recommendations. As discussed in Section 3.3.1, "Fish and Aquatic Species", the Proposed Action would result in net improvement to in-stream fish habitat after producing rather dramatic short-term impacts.

4.3.5 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d) provides for the protection of the bald eagle and the golden eagle (as amended in 1962). The act focuses on the animal primarily, and not its habitat, though disturbance of occupied habitat could be in violation of this law.

The Proposed Action has the potential to disturb bald eagle nesting if nesting birds are situated within proposed project areas. Site-specific evaluations of each project would identify any such potential and provide for protection measures as necessary to ensure bald eagles would not be taken or otherwise harmed as a result of the Proposed Action (Section 2.4.10 #223), and could benefit in the long term from an increased source of food in the form of increased anadromous fish runs.

4.4 Wetlands, Floodplains, and Water Resources

As part of the NEPA review, U.S. Department of Energy NEPA regulations require that impacts on floodplains and wetlands be assessed and alternatives for protection of these resources be evaluated in accordance with Compliance with Floodplain/Wetlands Environmental Review Requirements (10 CFR 1022.12); Executive Order 11988, Floodplain Management; and Executive Order 11990, Protection of Wetlands. Evaluation of impacts of the Proposed Action on floodplains and wetlands is discussed in detail in Section 3.3.4, "Wetlands and Floodplains", of this EA. The evaluation determined that the Proposed Action would not result in long-term adverse impacts to wetlands or floodplains.

Wetland and waterway management, regulation, and protection are addressed in several sections of the Clean Water Act, including Sections 401, 402, and 404.

4.4.1 Clean Water Act Section 401

A federal permit to conduct an activity that causes discharges into navigable waters is issued only after the affected state certifies that existing water quality standards would not be violated if the permit were issued. The appropriate state agency would review the project's Section 404 permit applications for compliance with the state's water quality standards and grant certification if the permits comply with these standards.

4.4.2 Clean Water Act Section 402

This section authorizes National Pollutant Discharge Elimination System (NPDES) permits for the discharge of pollutants, such as stormwater. General permits for stormwater discharges are required for certain construction activities. If applicable to a project, project sponsors would issue a Notice of Intent to obtain coverage under the applicable general permits from the applicable permitting agency, and would prepare a Stormwater Pollution Prevention Plan to address stabilization practices, structural practices, stormwater management, and other controls.

4.4.3 Clean Water Act Section 404

Authorization from the U.S. Army Corps of Engineers is required in accordance with the provisions of Section 404 of the Clean Water Act when dredged or fill material is discharged into waters of the United States.

All project sponsors with construction actions proposed here would coordinate with the Corps to obtain a Section 404 permit for any fill placed in wetlands or non-wetland waters and work with the appropriate state agency to obtain Section 401 water quality certification prior to implementation.

4.5 National Historic Preservation Act

The National Historic Preservation Act (NHPA) of 1966, as amended (16 U.S.C. 470 *et seq.*), requires federal agencies to take into account the potential effects of their undertakings on properties that are listed or eligible for listing on the National Register of Historic Places (National Register). Implementing regulations at 36 CFR Part 800 (referred to as Section 106) require that federal agencies consult with the State Historic Preservation Office, affected Indian tribes, and additional parties regarding the inventory and evaluation of properties potentially eligible for inclusion on the National Register. As part of this process, federal agencies also determine whether the project would adversely affect these properties within the project area.

Each action would require site-specific review to determine appropriate compliance with the NHPA. This could involve public notification (either through the NEPA scoping process or through the Section 106 process); background research and ethnographic studies to identify known resources and surveys for previously unknown resources; and consultation with interested parties, state and federal agencies, municipalities and affected tribes.
As part of complying with Section 106 Bonneville and Reclamation may choose to enter into an agreement (such as a memorandum of understanding) regarding roles and responsibilities for each agency in fulfillment of their Section 106 compliance obligations including who would serve as lead for compliance. These decisions may be made on a project-by-project basis recognizing in some instances both agencies may not be involved in a project or other federal agencies may be involved.

To the extent feasible, Bonneville and Reclamation would seek to avoid damaging cultural resources and historic properties. In those cases where it is not possible to avoid historic properties and still accomplish the desired habitat improvements, Bonneville and Reclamation would work to resolve the adverse effects to the extent possible.

Bonneville and Reclamation also comply with other laws and directives for the management of cultural resources, including:

- Antiquities Act of 1906 (16 U.S.C. 431–433),
- Historic Sites Act of 1935 (16 U.S.C. 461–467),
- Section 106 of the NHPA (54 U.S.C. 306108), as amended,
- Archaeological Data Preservation Act of 1974 (16 U.S.C. 469 a–c),
- Archaeological Resources Protection Act of 1979 (16 U.S.C. 470 et seq.), as amended,
- Native American Graves Protection and Repatriation Act (25 U.S.C. 3001 et seq.),
- Executive Order 13007 Indian Sacred Sites, and
- American Indian Religious Freedom Act of 1978 (PL 95-341, 92 Stat. 469, 42 U.S.C. 1996, 1996a).

4.6 Sacred Sites

Executive Order 13007 directs that Federal agencies shall accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions. It also states that Federal agencies will avoid adversely affecting the physical integrity of sacred sites, but like the provision regarding access, this is subject to restrictions based on practicability, legality, and essential agency function.

As defined in the Executive Order, a sacred site "means any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious importance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site" (Clinton 1996).

Pursuant to the Executive Order, the agencies conducting future site-specific NEPA analysis that may tier off of this EA would contact appropriate tribes to request their assistance in identifying sacred sites within the study area. Effect analysis methodologies appropriate to specific mechanisms would be utilized where applicable per site specific analysis.

4.7 Air Quality, Noise and Public Health and Safety

The federal Clean Air Act, as amended (42 U.S.C. 7401 et seq.), requires the EPA and individual states to carry out a wide range of regulatory programs intended to assure attainment of the National Ambient Air Quality Standards. Air quality impacts from this action would include limited temporary fugitive dust and vehicle emissions from construction, and negligible effects from operation, as discussed in Section 3.3.10.2.1.

The Federal Noise Control Act of 1972 (42 U.S.C. 4901 et seq.) sets forth a broad goal of protecting all people from noise that jeopardizes their health or welfare. The act further states that federal agencies are authorized and directed, to the fullest extent consistent with their authority under federal laws administered by them, to carry out the programs within their control in such a manner as to further this policy. The analysis in Section 3.3.10.2.2, of this EA indicates that the Proposed Action would have low potential for temporary noise impacts during construction activities, and would meet applicable noise requirements.

4.8 Executive Order on Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations was signed by President Clinton on February 11, 1994. This Executive Order directs federal agencies to take the appropriate and necessary steps to identify and address disproportionately high and adverse human health or environmental effects of federal programs, policies, and activities on the health or environment of minority populations and low-income populations (collectively, the environmental justice populations) to the greatest extent practicable and permitted by law.

As discussed in Section 3.3.12.4, there would be no effects to environmental justice populations.

4.9 Climate Change

Proposed Action activities that would produce GHG emissions include "soil carbon" emissions produced through the removal or disturbance of natural vegetation and soils during construction; the use of gasoline and diesel powered vehicles and equipment during construction; and the use of gasoline and diesel powered vehicles for employee commuting, supply deliveries, etc. These activities would make minimal contributions to the GHG emissions associated with climate change, as discussed in Section 3.3.13 of this EA.

4.10 Farmland Protection Policy Act

The Farmland Protection Policy Act (7 U.S.C. 4201 *et seq.*) directs federal agencies to identify and quantify adverse impacts of federal programs on farmlands. The purpose of this Act is to minimize the number of federal programs that contribute to the unnecessary and irreversible conversion of agricultural land to non-agricultural uses. Three types of farmland are recognized by the Act: prime farmlands, unique farmlands, and farmland of statewide or local importance.

The activities proposed in this Proposed Action would not irreversibly convert agricultural lands to non-agricultural uses. Though agricultural lands may be converted to wetland or riparian habitats, those would not be irreversible, and could more properly be referred to as "reversions" than "conversions", since the land would revert to a condition more like its original condition prior to conversion to agricultural uses.

4.11 Hazardous Materials

Several federal laws related to hazardous materials and toxic substances potentially apply to the Proposed Action, depending upon the exact quantities and types of hazardous materials created or stored at the project sites.

4.11.1 Spill Prevention Control and Countermeasures Rule

The Spill Prevention Control and Countermeasures Rule (40 C.F.R Part 112) includes requirements to prevent discharges of oil and oil-related materials from reaching navigable waters and adjoining shorelines. It applies to facilities with total aboveground oil storage capacity (not actual gallons onsite) of greater than 1,320 gallons and facilities with below-ground storage capacity of 42,000 gallons.

4.12 Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act, as amended, is designed to provide a program for managing and controlling hazardous waste by imposing requirements on generators and transporters of hazardous waste, and on owners and operators of treatment, storage, and disposal facilities (42 U.S.C. 6901 *et seq.*). Each facility owner or operator is required to have a permit issued by EPA or the state. Typical construction and maintenance activities have generated small amounts of these hazardous wastes—solvents, pesticides, paint products, motor and lubricating oils, and cleaners. Small amounts of hazardous wastes may be generated by the Proposed Action. These materials would be disposed of according to state law and the Resource Conservation and Recovery Act. Solid wastes would be disposed of at an approved landfill or recycled. Records of disposal of RCRA or State-listed wastes would be retained for at least 3 years and in accordance with 40 CFR 262 and applicable state regulations.

4.13 Toxic Substances Control Act and the Federal Insecticide, Fungicide and Rodenticide Act

The Toxic Substances Control Act (15 U.S.C. 2601-2692) gives authority to the EPA to regulate substances that present unreasonable risks to public health and the environment. The Federal Insecticide, Fungicide, and Rodenticide Act (7 USC 136 [a-y]) registers and regulates pesticides.

Pesticides may be used as part of the Proposed Action and would be used in accordance with all applicable federal and state regulations. Herbicide containers would be disposed of according to Resource Conservation and Recovery Act standards.

4.14 Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response Compensation Liability Act (42 U.S.C. 9601 *et seq.*), as amended, provides funding for hazardous materials training in emergency planning, preparedness, mitigation implementation, response, and recovery. Eligible individuals include public officials, emergency service responders, medical personnel, and other tribal response and planning personnel. No Superfund sites are located within the Proposed Action.

4.15 Distribution and Availability

Bonneville mailed letters to landowners, tribes, government agencies, and other potentially affected or concerned citizens and interest groups announcing the availability of the EA. This EA is available for review on the Bonneville website: (*http://www.bpa.gov/goto/TribProgramatic*). A copy of the EA is available on request from Bonneville by calling the toll-free document request line at 1-800-622-4520.

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Appendix A - Design Criteria and Mitigation Measures Specific to Project Actions

The design criteria and mitigation measures in this section include those from Bonneville's ESA consultation with NMFS and the USFWS in Bonneville's Habitat Improvement Program (HIP) consultation (2003- present), now in its fourth iteration (HIP IV). The measures in this Appendix are those applicable to the types of actions included in the Proposed Action. The design criteria and methodologies prescribed here are integral to the actions described in Chapter 2, and considered to be applied for the assessment of effects in Chapter 3. Site-specific analyses of projects tiered to this programmatic analysis would identify if any additions, deletions, or modifications to these measures would be appropriate for any specific action.

Fish Passage Restoration Actions

Dams, Water Control Structures, or Legacy Structures Removal

1) Reuse material from the structure being removed (i.e. large wood, boulders, etc.) that is typically found within the stream or floodplain at that site to implement habitat improvements. Adhere to appropriate conservation measures for all activities in Category 2: "*River, Stream, Floodplain, and Wetland Restoration*".
2) If the legacy structures (log, rock, or gabion weirs) were placed to provide grade control, evaluate the site for potential headcutting and incision due to structure removal by using the appropriate guidance.[54] If headcutting and channel incision are likely to occur due to structure removal, apply additional measures to reduce these impacts. See grade control options described under activity category 1c) Headcut and Grade Stabilization.
3) In the design plans, display the profile of the stream channel thalweg to provide enough information to clearly demonstrate project impacts to the stream channel and the potential for channel degradation, for a minimum of 10 upstream and 10 downstream channel widths from the upstream and downstream boundaries of the project.
4) Sample to characterize the sediment and identify the proportion of coarse sediment (>2mm) stored in the reservoir area. Reservoirs with a D35 greater than 2 mm (i.e., 65% of the sediment by weight exceeds 2 mm in diameter) may be removed without excavation of stored material, if the sediment contains no contaminants. Reservoirs with a D35 less than 2 mm (i.e., 65% of the sediment by weight is less than 2 mm in diameter) would require partial removal of the fine sediment to create a pilot channel, in conjunction with stabilization of the newly exposed streambanks with native vegetation.
5) Estimate volume of potentially mobile material and perform an assessment of potential downstream impacts. Conduct surveys of any downstream spawning areas that may be affected by sediment released due to removal of the water control structure or dam.
6) Following removal of the structure, restore all bank lines and fill in all holes with native materials to natural contours of streambank and floodplain. Compact the fill material adequately to prevent washing out of the soil during over-bank flooding. Do not mine

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

material from the stream channel to fill in "key" holes. When removal of buried (keyed) structures could result in substantial disruption to riparian vegetation and/or the floodplain, consider leaving the buried structure sections within the streambank.

7) If the structure is being removed because it has caused an over-widening of the channel, consider implementing other HIP restoration categories to decrease the width-to-depth ratio of the stream at that location to a level similar to the natural and representative upstream and downstream sections of the stream, within the same channel type.

Consolidate or Replace Existing Irrigation Diversions

1) If structures are removed, see the activity category "*Dams, Water Control Structures, or Legacy Structures Removal*", above, for appropriate conservation measures.
2) If placement of rock structures or engineered riffles is required for headcut or grade stabilization, see the activity category "*Headcut and Grade Stabilization*", below, for appropriate conservation measures.
3) Apply conservation measures from activity category "*Installing, Upgrading, or Maintaining Fish Exclusion Devices and Bypass Systems*" if fish exclusion is added or modified.
4) Design diversion structures to meet NMFS Anadromous Salmonid Passage Facility Design Guidelines (NMFS 2011 or more recent version)[55] and, where appropriate, *"Guidelines for incorporating adult Pacific lamprey passage at fishways" (PLTW 2017)*[56].
5) Design and replace irrigation diversion intake and return points to prevent ESA- listed and threatened fish species from swimming into, or being entrained in, the irrigation system.
6) For irrigation efficiency and water conservation actions within this activity category, use state-approved regulatory mechanisms (e.g., Oregon ORS 537.455-.500, Washington RCW 90.42) for ensuring that water savings will be protected as instream water rights. In states with such regulatory mechanisms, identify how the water conserved will remain instream to benefit fish without any substantial loss of the instream flows to downstream diversions.
7) Include in the project design the installation of a totalizing flow meter on all diversions for which installation of this device is possible. A staff gauge or other device capable of measuring instantaneous flow would be utilized on all other diversions.

Headcut and Grade Stabilization

1) For grade control structures that are greater than 18 inches in height (elevation differential across headcut from streambed), show the profile of the stream channel thalweg in the design plan to provide enough information to clearly demonstrate the action's impacts to the stream channel and the potential for channel degradation, for a minimum for (10) upstream and (10) downstream channel widths of the downstream and upstream boundaries of the action.
2) Design all structures to the design benchmarks set forth in NMFS 2011a (or most recent version).

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[55] NMFS. 2011. Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, Oregon. Available at: http://www.westcoast.fisheries.noaa.gov/publications/hydropower/fish_passage_design_criteria.pdf

[56] *Practical guidelines for incorporating adult Pacific lamprey passage at fishways* (Pacific Lamprey Technical Workgroup 2017) (https://www.fws.gov/pacificlamprey/mainpage.cfm); and *Effectiveness of common fish screen materials to protect lamprey ammocoetes* (Rose and Mesa 2012).

Boulder weirs

1) Install boulder weirs low in relation to channel dimensions so that they are completely overtopped during channel-forming flow events (approximately a 1.5-year flow event).
2) Place boulder weirs perpendicularly across the channel or in upstream pointing "V" or "U" configurations (with the apex oriented upstream). The apex should be lower in elevation than the structure wings to support low flow consolidation.
3) Construct boulder weirs to allow upstream and downstream passage of all native fish species and life stages that occur in the stream. This can be accomplished by providing plunges no greater than six inches in height, allowing for juvenile fish passage at all flows.
4) Key the weirs into the streambed (preferably at least 2.5 times their exposure height)) to minimize structure undermining due to scour. The weir should also be keyed into both banks in a manner that prevents water from cutting around the structure.
5) Include fine material in the weir material mix to help seal the weir/channel bed, thereby preventing subsurface flow. Geotextile material can be used as an alternative approach to prevent subsurface flow.
6) Ensure rock for boulder weirs are durable and of suitable quality to ensure permanence in the climate in which it is to be used.
7) Use no gabions, cable, or other means to prevent the movement of individual boulders in a boulder weir.

Headcut stabilization and roughened riffles

1) Provide fish passage over stabilized head-cut or constructed riffle according to NMFS 2011a (or most recent version). Passage can be provided through a series of log or rock weir structures or a roughened channel.
2) Armor features intended for grade stabilization with sufficiently-sized and amounts of material to provide a structure capable of withstanding a 100-year flow event (or other approved design flow) without further progressing the headcut or substantially degrading the riffle.
3) Construct headcut stabilization structures and roughened riffles utilizing an engineered stream simulation bed material, and pressure-wash it into place until surface flow is apparent, to ensure fish passage immediately following construction (if natural flows are sufficient). Minimize voids within placed matrix such that ponding occurs with little to no percolation losses.
4) For grade stabilization efforts, design considerations should extend beyond the control structure to include the plunge pool downstream and the upstream approach. Also consider floodplain return flows and flanking that could create potential new headcut conditions, and potential changes in bank erosion conditions due to structure placement.
5) Minimize lateral migration of the channel around the head cut or riffle ("flanking") by designing the downstream face with a lower elevation in the center of the channel cross section to direct flows to the middle of channel.
6) Materials used for construction can be native to the area if gradation is shown to be appropriate.

Low Flow Consolidation

1) Design fish passage to the design benchmarks set forth in NMFS 2011a (or most recent version) and, where appropriate, guidelines set forth in Pacific Lamprey Technical Workgroup (2017).

2) Remove all temporary material placed in the stream to aid low-flow fish passage when stream flow increases, prior to anticipated high flows that could wash consolidation measures away or cause flow to go around them.

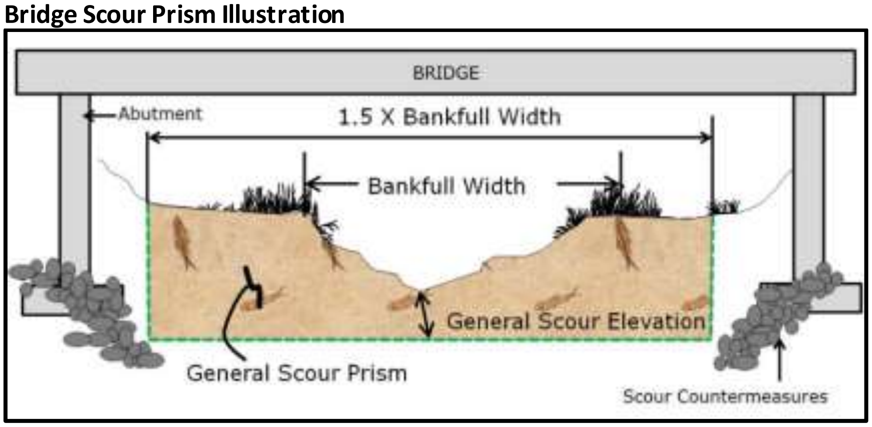
Provide Fish Passage at an Existing Facility

1) For maintenance activities where sediment is placed in stream, see activity category "*Install Habitat-Forming Instream Structures (Large Wood, Small Wood, and Boulders)*", below, for appropriate conservation measures.
2) Design fish passage to the design benchmarks set forth in NMFS 2011a (or most recent version).
3) Provide design consideration for Pacific lamprey passage, as described in guidelines set forth in Pacific Lamprey Technical Workgroup 2017. Briefly, fish ladders that are primarily designed for salmonids are usually impediments to lamprey passage as they do not have continuous, adequate surfaces for attachment, velocities are often too high, and there are inadequate places for resting. Providing rounded corners, smooth continuous floor for attachment, resting areas, or providing a natural stream channel (stream simulation) or wetted ramp for passage over the impediment have been effective in facilitating lamprey passage.
4) Use no treated wood and copper- or zinc-plated hardware in the construction of fish ladders. Cure or dry[57] concrete before allowing it to contact stream flow.

Bridge and Culvert Removal or Replacement

1) For bridges or culverts that require grade control, see additional apply conservation measures from activity category "*Headcut and Grade Stabilization*". Include suitable grade controls to prevent passage failure caused by changes in stream elevation. Grade control structures to prevent headcutting should be placed above or below the culvert or bridge and may be built using rock or wood.
2) Design bridges and open bottom culverts so they are wide enough to maintain a clear, unobstructed opening during events that approximate a two-year recurrence interval.
    a. For single-span bridges or stream simulation culverts, maintain a clear and unobstructed opening 1.5 times the bankfull width or greater (see the figure "*Bridge Scour Prism Illustration*" below).

Bridge Scour Prism Illustration



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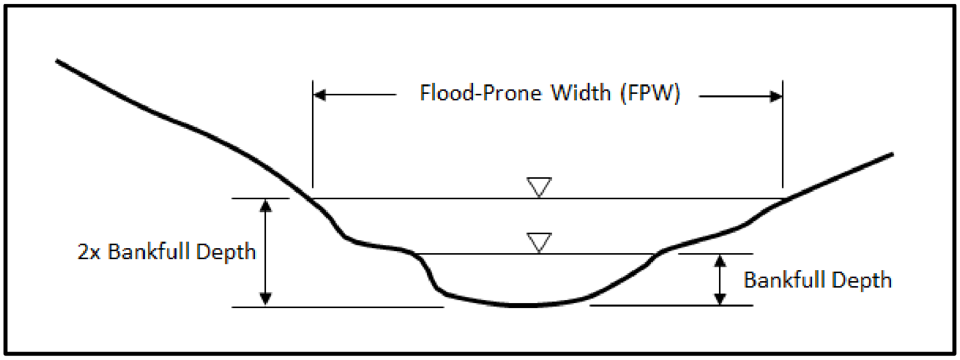
[57] 48 to 72 hours, depending on temperature (Bonneville 2020).

b. For multiple-span bridges, maintain a total clear and unobstructed opening 2.2 times the bankfull width or greater.
c. For bridge structures across steep canyons or tidal sloughs, entrenchment ratios (ER) may be used in order to calculate appropriate span (see the figure "*Flood Prone Width and Bankfull Width*", below).

Flood Prone Width and Bankfull Width



3) Design the slope of the reconstructed streambed within the culvert to approximate the average slope of the adjacent stream from approximately ten channel widths upstream and downstream of the site in which it is being placed, or approximate the average slope of an appropriate reference reach that represents natural conditions outside the zone of the road crossing influence.
4) Do not apply bridge scour and stream stability countermeasures within the general scour prism (the brown shaded area in the "Bridge Scour Prism Illustration" above) and calculate general scour according to the "*Guidelines for Calculating General Scour Elevations*", below.
5) Reshape streambanks in a manner that does not create a velocity that differs from upstream and downstream conditions for flows up to 2-year flow event.
6) For stream fill materials within the general scour prism, use materials of similar size, composition, and mobility to natural bed materials in an appropriate reference reach. Do not use angular rock unless the natural material is angular (e.g. basalt lithology).
7) Include in the design plans a construction note requirement to wash fines to seal bed properly and prevent flows from going subsurface.
8) If the crossing will occur within 300 feet of an active spawning area, construct full-span bridges or open bottom culverts utilizing streambed simulation (continuous streambed that simulates natural channel width, depth, and slope connects the reaches up and downstream of the crossing).
9) Utilize a bridge or open bottom culvert for projects in channels with gradients above six percent.
10) Ensure closed bottom culverts are a minimum of nine feet in diameter to accommodate:
    a. A channel vertical clearance (the minimum vertical clearance between the culvert bed and ceiling) greater than six feet.
    b. An embedment (the burial depth of the bottom of a culvert) into the streambed not less than 30% at the outlet, not more than 50% at the inlet of the culvert height, and to a minimum depth of three feet.
11) Ensure that the length of bridges and culverts (maximum length of road crossing) utilizing the streambed simulation method does not exceed 150 feet.
12) Use concrete, metal, or untreated wood. Ensure that concrete is sufficiently cured or dried before coming into contact with stream flow. Do not use treated wood for bridge construction or replacement.

13) Remove unused bridge supports down to an elevation below the total scour depth.
14) Design relief conduits (if they are necessary) to pass through existing fill.
15) Determine bankfull width in a local reference reach that is unaffected by existing bridges or infrastructure. Apply the bankfull width determination and measurements methods described in Appendix C of the 2013 Washington Dept. of Fish and "*Wildlife Water Crossing Design Guidelines*". Document the bankfull width determination process and considerations in the Basis of Design Report.
16) Use the following guidelines for calculating general scour elevations:
    a. General scour is a lowering of the streambed across the stream or waterway at the crossing. This lowering may be uniform across the bed or non-uniform, that is, the depth of scour may be deeper in some parts of the cross section. The following method would be the minimum analyses required to determine general scour elevation and, in combination with the 1.5 times bankfull top width, used to establish the general scour prism as presented in the "Bridge Scour Prism Illustration", above.
    b. Equation #1 is used to determine the flow velocity (Vc) needed to move the streambed material. The bankfull depth (y) is determined from hydraulic model results for the 2-year flood. The computed bankfull depth should be compared against the field measured bankfull depth with the larger of the two values used for (y) in Equation #1. The D50 particle size should be defined from the project-reach-specific pebble count.

1. Equation 1

$$V_c = 11.17 y^{1/6} D_{50}^{1/3}$$

V_c = Critical velocity above which bed material of size D and smaller will be transported (ft)
y = Bankfull depth within the proposed culvert or bridge (ft)
D_{50} = Particle for which 50% is finer (ft)

    c. Equation #2 is used to determine the scour depth (ds) below the streambed elevation. The bankfull depth (y) and the critical velocity (Vc) are taken from Equation #1 above. The mean velocity (Vm) is determined from hydraulic model results for the 2-year flood.

2. Equation 2

$$d_s = y\left(\frac{V_m}{V_c} - 1\right)$$

d_s = Scour depth below streambed at thalweg (ft)
y = Bankfull depth within the proposed culvert or bridge (ft)
V_c = Critical velocity above which bed material of size D and smaller will be transported (ft)
V_m = Mean velocity within the proposed culvert or bridge (ft)

    d. Results from the scour depth calculation should be compared against observed scour holes or pools within or adjacent to the project reach. Consideration should be also given to evaluating the stream bed mobility upstream and downstream of the proposed crossing. The general scour prism and the proposed stream crossing would be presented relative to a surveyed cross section of the stream channel and floodplain.
    e. For additional guidance on engineering calculations for all components of bridge and culvert scour analysis, the designer is directed to Evaluating Scour at Bridges, Fifth Edition, Hydraulic Engineering Circular No. 18, April 2012, Publication No.

FHWA-HIF-12-003, U.S. Department of Transportation Federal Highway Administration; and Barnard *et al.* 2013.

17) Use the following guidelines for calculating entrenchment ratios:
   a) Steep canyons and tidal sloughs often require smaller spans due to limited floodplain connection. If the stream crossing is located in a tidal slough or in a canyon steeper than 5%, use the following method to determine bridge and culvert spans:
   b) Calculate the entrenchment ratio (ER) per Rosgen (1994).
      i. ER = flood-prone width (FPW) / bankfull width (BFW)
      ii. FPW is defined as the water surface width at a height of twice the bankfull depth above the bed ("Flood Prone Width and Bankfull Width" illustration, above). The BFW would be determined at an appropriate reference location not impacted by an existing bridge.
   c) For single span structures:
      iii. If ER is greater than 1.5, a minimum opening of 1.5x BFW is required.
      iv. If ER is less than 1.5, the minimum opening would be equal to the ER, but not less than 1.2x BFW.
   d) For multiple span structures:
      v. If ER is greater than 2.2, a minimum opening of 2.2x BFW is required.
      vi. If ER is less than 2.2, the minimum opening would be equal to the ER, but not less than 1.5x BFW

Bridge and Culvert Maintenance

1) Clean culverts by working from the top of the bank, unless culvert access using work area isolation would result in less habitat disturbance. Remove only the minimum amount of wood, sediment and other natural debris necessary to maintain culvert function. Do not disturb spawning gravel.
2) Clean all large wood, cobbles, and gravels recovered during cleaning and place downstream of the culvert.
3) Conduct all routine work in the dry. If this is not possible, follow work area isolation criteria outlined in the Work Area Isolation & Fish Salvage Requirements in Appendix B.

Installation of Fords

1) Do not create barriers to the passage of adult and juvenile fish when developing fords. This includes upstream passage of Pacific lamprey, so any corners should be rounded to allow their passage.
2) Place river rock along the stream bottom in ford crossings. Use rock that is of properly-sized gradation for that stream and, if possible, non-angular.
3) Use existing access roads, trails, and stream crossings whenever possible, unless new construction would result in less habitat disturbance and the old crossing would be retired.
4) Do not locate fords in a location that would result in disturbance or damage to a properly functioning riparian area.
5) Place fords on bedrock or stable substrates whenever possible.
6) Do not place fords in areas where ESA-listed salmonids (salmon, steelhead, bull trout) spawn or are suspected of spawning; or within 300 feet of such areas if spawning areas may be disturbed. Sufficient information detailing locations of ESA-listed salmonid spawning

areas within the reach would be provided to demonstrate adherence to this mitigation measure.

7) Stabilize bank cuts, if any, with vegetation; and protect approaches and crossings with river rock (not crushed rock) when necessary to prevent erosion.
8) Develop fords with a maximum width of 15 feet (downstream-upstream) to minimize the time that livestock spends in the crossing or riparian area.
9) Install fences (if not already existing and functioning) along with all new and replaced fords to limit access of livestock to riparian areas. Maximize the size of fenced-off riparian areas and plant with native vegetation. Install fences so as to not inhibit upstream or downstream movement of fish or substantially impede bedload movement. Where appropriate, construct fences at fords to allow passage of large wood and other natural debris.
10) Construct vehicle fords only in streams with no salmonid fish spawning.
11) Design fords to accommodate reasonably foreseeable flood risks, including associated bedload and debris, and to prevent the diversion of streamflow out of the channel and down the trail if the crossing fails.

Removal of In-Stream Barriers

1) Follow all applicable Federal, state, county, and local regulations applicable to blasting.
2) Apply Best Management Practices and industry standards developed by The International Society of Explosive Engineers (ISEE) and The Institute of Makers of Explosives (IME) as found in their Safety Library Publications (SLPs) in all blasting operations.
3) Prepare a Blasting Procedures plan, including a test blasting plan (see Timothy, 2013).
4) Use no ammonium-nitrate fuel oil mixtures in or near waterways.
5) Wherever possible, apply blasting in areas physically separated from the flowing stream, i.e. inside a coffer dam.
6) Apply timing restrictions to minimize impacts to ESA-listed fish.
7) Design charges to be no larger than necessary to accomplish the task and set them in a manner (timing, frequency, location) such that in-stream concussion is minimized. Include micro-second delays to minimize impacts to fish.
8) Use only qualified blasting specialists and a blaster-in charge to conduct blasting operations.
9) Use only controlled blasting techniques.[58]
10) Prepare a contingency plan for misfires and spills and be action-ready prior to operations.
11) Remove all shock tubes and blast waste from the waterway and dispose of them off-site.

[58] Controlled blasting techniques are applied by the blaster-in-charge who relies on training, knowledge, skills, and experience to select the appropriate techniques. Controlled blasting techniques include drill-hole diameter and depth, loading density, delay patterns, pre-splitting, line drilling, and cushion blasting.

Improving River, Stream, Floodplain, and Wetland Habitat

Improve Secondary Channel and Floodplain Interactions

1) Reconnection of historical fragmented habitats and increasing water surface elevations are preferred to the excavation of newly constructed side channels in floodplains. Propose new side channel construction within the historic floodplain (e.g. 5-year flow event), current channel meander migration zone, and require limited excavation for construction. Apply the conservation measures in activity category "Channel Reconstruction" for side channel excavation in floodplains connected less than the 5-year flow event.
2) Apply the conservation measures in activity category "Channel Reconstruction" for side channel creation with flows similar to the mainstem or depths greater than th e mainstem.
3) Place excavated natural materials instream if possible according to activity category "*Channel Reconstruction*" or "*Install Habitat Forming Natural Materials*" as appropriate. Haul any excess or unsuitable materials to an upland site or spread across the adjacent floodplain in a manner that does not restrict floodplain capacity. Hydric soils may be salvaged to provide appropriate substrate and/or seed source for hydrophytic plant community development. Obtain hydric soils only from wetland salvage sites. Assess sediment to be placed in-water for contaminants.
4) Demonstrate in the designs that the project will be self-sustaining over time or promote the recovery of natural habitat-forming processes. Self-sustaining means the restored or created habitat would not require major or periodic maintenance, but function naturally within the processes of the floodplain.
5) Take adequate precautions in floodplains and intermittent side channels to prevent the creation of fish passage issues or stranding or increase mortality of juvenile or adult fish.
    a. Side channels will be constructed to prevent fish stranding by providing a continual positive overall grade.
6) Conduct side channel and pool habitat work in isolation from waters occupied by ESA-listed salmonid species until project completion. During project completion, a reconnection may be made by either excavation to waters occupied by ESA-listed salmonids or re-watering of these channel units.

Setback or Removal of Existing Berms, Dikes, and Levees

1) To the greatest degree possible, remove non-native fill material, originating from outside the floodplain of the action area, from the floodplain and dispose of at an upland site.
2) Use overburden or fill material that is native to the project area within the flood plain to create set-back dikes and fill anthropogenic holes, provided that this does not impede floodplain function. Place excavated natural materials instream, if possible, according to activity category "*Channel Reconstruction*" or "*Install Habitat Forming Natural Materials*" as appropriate. Assess sediment to be placed in-water for contaminants.
3) When necessary, loosen compacted soils once overburden material is removed.
4) Design features that minimize fish stranding potential in all projects that reconnect substantial new portions of the floodplain (greater than or equal to one acre). Clearly demonstrate in the design report how fish stranding potential would be minimized.
5) Breach berm, dike, or levee at the downstream end of the project and/or at the lowest elevation of the floodplain to ensure that flows will naturally recede back into the main channel, minimizing fish entrapment.
6) When a setback is required, setback locations should be prioritized to the outside of either the meander belt width or the channel meander zone margins

Protect Streambanks Using Bioengineering Methods

1) Without changing the location of the bank toe, restore damaged streambanks to a slope, pattern, and profile suitable for establishment of permanent woody vegetation. This may include sloping of unconsolidated bank material to a stable angle of repose or the use of benches in consolidated cohesive soils. The purpose of bank shaping is to provide a more stable platform for the establishment of riparian vegetation, while also reducing the depth to the water table, therefore promoting better plant survival.
2) Use self-sustaining vegetation in bioengineering bank stabilization methods to provide long term stabilization. Projects should ideally use plantings and soil bioengineering for bank stabilization. Large wood should be used for stabilization as a method of last resort. Large wood may be added to create complexity and interstitial habitats when feasible. Add large wood to create habitat complexity and interstitial habitats through use of various large wood sizes and configurations of the placements when feasible.
3) Focus the structural placement of large wood on providing channel boundary roughness for energy dissipation versus flow re-direction that may affect the stability of the opposite streambank.
4) Use large wood that is intact, hard, and un-decayed to partly decaying with untrimmed root wads to provide functional refugia habitat for fish. Decayed or fragmented wood found lying on the ground may be used for additional roughness and to add complexity to large wood placements, but do not use it for the primary structural components.
5) Wood that is already within the stream or suspended over the stream may be repositioned to allow for greater interaction with the stream.
6) Cable or chain would not be used for the anchoring of large wood. Manila, sisal or other biodegradable ropes may be used for lashing connections. If hydraulic conditions warrant use of structural connections, then rebar pinning or bolting may be used. Use structural connections minimally, and only to ensure structural longevity in highly energetic systems (high gradient systems with lateral confinement and a limited floodplain). Demonstrate the need for structural anchorage in the design documentation.
7) Do not use rock for streambank stabilization (except as ballast to stabilize large wood) unless it is necessary to prevent scouring or down-cutting of an existing flow control structure (*e.g.*, a culvert, bridge support, headwall, utility lines, or building). In such a case, rock may be used as the primary structural component for construction of vegetated riprap with large wood. Scour holes may be filled with rock to prevent damage to structural foundations but not so high as to extend above the adjacent bed of the river. This would not include scour protection for bridge approach fills.
8) Place rock so as not to impair natural stream flows into or out of secondary channels or riparian wetlands.
9) Extend riparian buffer strips associated with streambank protection from the bankfull elevation towards the floodplain a minimum distance of 35 feet.
10) Install fencing as necessary to prevent access and grazing damage to revegetated sites and riparian buffer strips.

Install Habitat-Forming Instream Structures (Large Wood, Small Wood, and Boulders)

Large Wood Structures

1) Large wood placements incorporated with bank protection and slope stability apply conservation measures from activity categories "*Protect Streambanks Using Bioengineering Methods*" and "*Headcut and Grade Stabilization*".
2) Design large wood placements to mimic the process and function of natural accumulations of large wood in the channel and address defined limiting factors.
3) Do not use cable or chain for large wood anchoring. Manila, sisal or other biodegradable ropes may be used for lashing connections. If hydraulic conditions warrant use of structural connections then rebar pinning or bolting may be used. Cut protruding ends of rebar flush with log or bend it over to prevent impaling fish, people, or wildlife. Do not pin structures to boulders in streams with recreational use. Use structural connections minimally and only to ensure structural longevity in highly energetic systems (high gradient systems with lateral confinement and limited floodplain). Include rationale and justification in the Basis of Design Report for the use of structural anchorage.
4) Use a licensed engineer to design installations of large wood that requires ballast, excavation, or structural connections unless Bonneville engineering review member confirms the project is low risk. Provide justifiable and demonstrated rationale in a design report (with structural stability calculations) for proposed structural anchorage.
5) Use large wood that is intact, hard, and un-decayed to partly decaying and should preferably include untrimmed root wads when available to provide functional refugia habitat for fish. Large wood includes whole trees with rootwad and limbs attached, pieces of trees with or without rootwads and limbs, and cut logs. Use no decayed or fragmented wood found lying on the ground or partially sunken in the ground as key pieces but may be incorporated to add habitat complexity.
6) Include in project design the Design stability requirements for the primary large-wood elements in the design report, including base, key, and anchorage members (logs larger than 15 feet long and greater than one foot in diameter). These pieces would comprise ~ 50% of the overall structure. Woven, racking, matrix, and recruited material would be transient and would dynamically interact with the fluvial system. If specific stability evaluation of a structure results in criteria more conservative than that presented above, then a risk – benefit analyses would be used to ascertain the appropriateness of the subject structure. This assessment would be used to determine the benefits to fish habitat and may result in modifying or forgoing the specific action.
7) Limit the use of rock to what is needed to anchor the large wood. Demonstrate justifiable need for rock ballast in the design report.
8) Use only wood piles for piling needs. Use no steel piling. Drive each piling as follows to minimize the use of force and resulting sound pressure:
   a. Use a vibratory head to drive the piles; an impact hammer would not be used
   b. Select areas with soft substrate rather than rocky hard substrate; avoid bedrock
9) Isolate the work area if possible to minimize acoustic disturbance.

Small Wood Structures

1) Complete all in-stream construction associated with small wood structures by hand or small machinery not to exceed 15,000 lbs. operating weight. Adhere to "*Large Wood Structures*" conservation measures if heavy equipment is required.

2) Construct small wood placements for floodplain reconnection in stream systems less than 4% stream gradient.
3) Demonstrate in the Basis of Design Report must how potential channel aggradation and associated channel widening, bank erosion, increased channel meandering, and decreased channel depth effects of structures have been addressed.
4) Construct structures to be porous, so they provide for a water surface differential of no more than one-foot at low flows, or otherwise provide a clear path for fish passage over, through or around the structure during low flows.
5) Install structures that would be overtopped to have crest elevations that extend no more than three feet above the stream bed. Cut vertical posts (if utilized) so as not to extend above the proposed crest elevation.
6) Drive vertical posts (if utilized) to a depth at least 1.5 times the expected scour depth of the waterway or a ratio of 1:2 for exposed – embedded length whichever is more conservative. Space posts a minimum 1.5 feet apart.
7) For incised channels, apply an adaptive management approach using lower elevation structures that trap sediment and aggrade the channel, with future and subsequent project phases rather than tall structures with excessive drop and increased risk of failure.
8) Use non-treated wood (*e.g.,* fence posts) from a materials source collected outside the riparian area for construction of all primary materials used in small wood placements.
9) Minimize the placement of inorganic material to the amount necessary to prevent under-scour of structure, and manage pore flow sufficient to ensure adequate over-topping flow and side flow to facilitate fish passage where required.
10) Use no cabling, wire, mortar or other materials that serves to affix the structure to the bed, banks, or upland.
11) Design structures so as to not unreasonably interfere with use of the waterway for navigation, fishing, or recreation.

Boulder Placements

1) Use boulders only where a biologic or geomorphic need has been identified. Provide rationale for boulder use in the Basis of Design Report.
2) Limit boulder placements to only address identified limiting factors in reaches of streambeds with predominantly coarse gravel or larger sediments.
3) Do not place boulders so as to exceed 25% of the cross-sectional area of the low-flow channel.
4) Do not install boulder placements with the purpose of shifting the stream flow to a single flow pattern in the middle or to the side of the stream.
5) Boulders would be machine-placed (no end dumping) and their in-stream stability is to be achieved by their size rather than by anchoring.
6) Install boulders in a low position in relation to channel dimensions so that they are completely overtopped during channel-forming flow events (approximately a 2-year flow event).

Riparian and Wetland Vegetation Planting

1) Design vegetation treatments using an experienced silviculturist, botanist, ecologist, or qualified technician.
2) Plant species that are the same as those that naturally occur in the project area.
3) Only certified weed-free plant materials would be used.

4) Acquire tree and shrub species as well as sedge and rush mats to be used as transplant material from outside the bankfull width, typically in abandoned floodplains, and where such plants are abundant, or salvaged from areas where excavation is planned.
5) Size and anchor sedge and rush mats to prevent their movement during high flow events.
6) Mimic natural species distribution when planting in riparian and floodplain areas.
7) Plantings shall utilize appropriate stock and be installed in a manner that maximizes access to groundwater sources to improve survival.
8) Plantings shall be installed during dormant periods with sufficient time for root development to improve survival (typically Fall/Winter).
9) Exclude livestock from the planting area. If necessary, install riparian exclusion fencing.

Channel Reconstruction

1) Detailed construction drawings would be required for all channel reconstruction actions.
    a. Construction drawings for channel reconstruction would identify, correct (to the extent possible), and account for (in the project development process), the conditions that lead to the degraded condition.
    b. Actions would be designed to mimic natural conditions for gradient, width, sinuosity and other hydraulic parameters.
    c. Structural elements would be designed to fit within the geomorphic context of the stream system.
    d. Projects would be designed to ensure that there is sufficient hydrology and that the action would be self-sustaining over time. Self-sustaining means the restored or created habitat would not require major or periodic maintenance but function naturally within the processes of the floodplain.
    e. The proposed action would be designed to prevent the creation of fish passage issues or post-construction stranding of juvenile or adult fish.
2) For designs that substantially fill the channel with unsorted alluvium using a valley bottom restoration approach such as "Stage Zero", demonstrate in the design report that watershed process will contribute to self-sustainability of the project and that the appropriate level of technical analysis and risk mitigation measures have been met through project planning and design.
3) Assess for contaminants all sediments that would be placed in water.

Install Habitat-Forming Materials (Sediment and Gravel)

1) Apply augmentation only in areas where the natural sediment and gravel supply has been eliminated, substantially reduced through anthropogenic disruptions, or used to initiate gravel accumulations or habitat forming processes in conjunction with other actions, such as simulated log jams and debris flows.
2) Use only gravel for stream placement that is of properly sized gradation for that stream and is clean alluvium with similar angularity as the natural bed material. When possible, use gravel of the same lithology as found in the watershed. Imported gravel must be free of invasive species and non-native seeds.
3) Acquire spawning gravel or sediment to be placed instream only from an upland source outside of the channel and riparian area, and that is of properly-sized gradation for that stream, clean, and if possible, non-angular.
4) Place spawning gravel or sediment in locations with sufficient energy to mobilize the material. After placement of gravel or sediment, allow the stream to naturally sort and distribute the material.

5) Do not place gravel directly on bars and riffles that are known spawning areas, which may cause fish to spawn on the unsorted and unstable gravel, thus potentially resulting in redd destruction.
6) Assess for contaminants all sediments that would be placed in water.

Introduction or Translocation of Beavers

1) The selection of beaver release sites would be guided by application of habitat suitability models or other criteria as discussed in the Beaver Restoration Handbook (USFWS 2017).
2) Beaver would be transplanted only where potential for landowner conflicts have been determined to be minimal and on lands of willing landowners.
3) Beavers would only be transplanted to locations where adequate food plants are present, and ponds suitable for protection from predators (greater than three feet deep) are naturally available or provided by previously constructed beaver dam analogues.
4) Artificially constructed lodges (USFWS 2017) and initial sources of food (cut willows or aspen) would be provided at release sites.
5) Capture, holding, transportation, and release of beaver would be guided by the methods discussed in the Beaver Restoration Handbook, (USFWS 2017).

Reducing Invasive Fish Species' Impacts to Native Species

1) Electrofishing actions for removal of non-native species would follow the Conservation Measures in Appendix B for "Work Area Isolation and Fish Salvage". The NMFS electrofishing guidelines (NMFS 2000).
2) Gill netting applications would evaluate the potential for bycatch of non-target fish and wildlife (*e.g.* ducks and mergansers) and use mesh sizes, net placement (depth from water surface/ height from bottom, etc.), and net color optimized to achieve capture effectiveness with protection of non-target species.
3) Chemical treatments (*e.g.* rotenone) would apply the following measures for protection of non-target species:
    a. Prior to applying chemical, target areas would be electrofished (following the NMFS electro fishing guidelines) to the degree practical to determine if protected fish species are present, and relocate any that are found.
    b. If post-treatment sampling indicates populations of aquatic insects have been lost from the treatment area, efforts would be made to re-establish the populations using a nearest neighbor approach, i.e. translocate individual insects from nearby, similar habitat.
    c. Follow established state protocols to prevent aquatic invasive species (e.g. zebra and quagga mussels, and Eurasian watermilfoil) from entering the drainage
    d. Treatments would be scheduled as late as possible in the season to avoid impacts to juvenile fish-dependent water bird species, if present.
    e. Sensitive wetlands would be identified, marked on the ground, and avoided during treatment.

Invasive Plant Control

Managing Vegetation Using Physical Control

1) Restrict ground-disturbing mechanical activity in established buffer zones adjacent to streams, lakes, ponds, wetlands and other identified sensitive habitats based on percent slope. For slopes less than 20%, apply a buffer width of 35 feet. Use no ground-disturbing mechanical equipment on slopes greater than 20%.
2) When possible, use manual control (*e.g.*, hand pulling, grubbing, and cutting) in sensitive areas to avoid adverse effects to listed species or water quality.
3) Dispose of all noxious weed material in a manner that would prevent its spread. Bag and burn noxious weeds that have developed seeds.

Managing Vegetation Using Herbicides

Herbicide application practices would be tightly constrained. The mitigation measures for this action that would be implemented are those listed as "Conservation Measures" specified in the Invasive Plant Control section of the most recent iteration of Bonneville's HIP consultation (see Section 2.1). The most recent iteration of that consultation is incorporated here by reference, and the relevant portions of it to this section are included in Appendix B, and constitute the mitigation measures for this category of action.

Juniper Removal

1) Remove juniper to natural stocking levels where juniper trees are expanding into neighboring plant communities to the detriment of other native riparian vegetation, soils, or streamflow.
2) Do not cut old-growth juniper, which typically has several of the following features: sparse limbs, dead limbed or spiked tops, deeply furrowed and fibrous bark, branches covered with bright-green arboreal lichens, noticeable decay of cambium layer at base of tree, and limited terminal leader growth in upper branches.
3) Felled trees may be left in place, lower limbs may be cut and scattered, or material may be piled and burned.
4) Where appropriate, juniper may be cut or removed with rootwads intact and placed into stream channels and floodplains to provide aquatic benefits. When removing juniper with rootwads attached, use methods that minimize soil disturbance and do not cause increased sedimentation or erosion into adjacent waters.
5) On steep or south-facing slopes, where ground vegetation is sparse, leave felled juniper in sufficient quantities to promote reestablishment of vegetation and prevent erosion.
6) If seeding is a part of the action, consider whether seeding would be most appropriate before or after juniper treatment.
7) When using heavy equipment, operate equipment in a manner that minimizes compaction and disturbance to soils and native vegetation to the extent possible. Establish equipment exclusion areas in areas along stream channels.
8) Juniper removal in areas dominated by invasive annual grasses would include subsequent treatments of herbicide to remove those annual grasses, and seeding to establish native grasses and shrubs.

Prescribed Burning

1) Maintain a 50 feet vegetative buffer adjacent to any fish-bearing stream.
2) Develop a burn plan that would be specific to each project's management objectives and site conditions. The plan would address the following:
    a. existing and desired future vegetative conditions, structure, and species composition
    b. prescribed fire type, severity, area, and timing of proposed burn
    c. measures for protection of soil structure and productivity
    d. measures to prevent destruction of vegetation providing shade and other ecological functions desired for retention
    e. measures necessary to protect Federal- or state-listed-listed plant species
3) Use firebreaks to prevent fire from spreading outside of the planned burn area. Use fire retardant chemicals sparingly, and not within 120 feet of surface waters.
4) Consider mowing an area 10- to 20-feet wide around the outside boundary of the burn area to help ensure fire control.
5) Restrict fire management vehicles to travel across non-native or resilient vegetation except during an emergency, and then for only the duration of the emergency.
6) Burn slash-piles when wildfire risk is low (usually in the winter or spring when soils are frozen or saturated).
7) Conduct treatments at any time of year when conditions are suitable, with consideration of migratory or ESA-listed bird breeding and nesting areas:
    a. March 1 – June 30: delay actions in sage grouse breeding areas until two hours after sunrise to avoid disturbing sage-grouse breeding activities
    b. May 15 – July 15: during the primary migratory bird nesting season, conduct actions to avoid breeding habitats; if it is impractical to avoid such habitats, minimize impacts by beginning treatments prior to the start of the nesting season and continuing daily activity to discourage bird nesting in the treatment area
    c. Do not fell trees with observed nests until after the nesting season

Piling Removal

1) The following steps would be used to minimize creosote release, sediment disturbance, and total suspended solids:
    a. Install a floating surface boom to capture floating surface debris.
    b. Keep all equipment (e.g., bucket, steel cable, vibratory hammer) out of the water; grip the piles above the waterline.
    c. Complete all work during low water and low current conditions.
    d. Dislodge pilings with a vibratory hammer whenever feasible; never intentionally break a pile by twisting or bending.
    e. Slowly lift the pile from the sediment and slowly lift it through the water column.
    f. Place the pile in a containment basin on a barge deck, pier, or shoreline without attempting to clean or remove any adhering sediment. A containment basin for the removed piles and any adhering sediment may be constructed of durable plastic sheeting with sidewalls supported by straw bales or another support structure to contain all sediment. Return flow may be directed back to the waterway.
    g. Fill the holes left by each piling with clean, native sediments.
    h. Dispose of all removed piles, floating surface debris, sediment spilled on work surfaces, and all containment supplies at a permitted upland disposal site.

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

Road and Trail Maintenance

1) Conduct road grading and shaping to maintain the existing designed drainage of the road unless modification is necessary to improve drainage problems that were not anticipated during the design phase.
2) Do not conduct road maintenance when surface material is saturated with water and erosion problems could result.
3) Do not apply dust-abatement additives and stabilization chemicals (typically magnesium chloride or calcium chloride salts) within 25 feet of water or a stream channel. Apply it so as to minimize the likelihood of entry into streams.
4) Have spill containment equipment available during chemical dust abatement application.
5) Use no petroleum-based products for dust abatement.
6) Avoid dust abatement applications during or just before wet weather and at stream crossings or other locations that could result in direct delivery to a water body (typically within 25 feet of a water body or stream channel).
7) Dispose of waste material generated from road maintenance activities and slides on stable non-floodplain sites approved by a geotechnical engineer or other qualified personnel.
8) Minimize disturbance of existing vegetation in ditches and at stream crossings to the greatest extent possible.
9) Promptly clean ditches and culverts of materials resulting from slides or other debris.
10) Haul material from slides and rock failures, including fine material of more than approximately ½ yard at one site, to disposal sites. Fine materials (1-inch or smaller) from slides, ditch maintenance, or blading may be worked into the road. Scattered clean rocks (1-inch or larger) may be raked or bladed off the road except within either 300 feet of perennial or 100 feet of intermittent streams.
11) When grading, do not leave berms along the outside edge of roads, unless an outside berm was specifically designed to be a part of the road, and low-energy drainage is provided.
12) To avoid slope destabilization and erosion acceleration, do not undercut ditch back-slopes.
13) When blading and shaping roads, do not side-cast excess material onto the fill. Haul all excess material that cannot be bladed into the surface to an appropriate site. Haul and prohibition of side-casting need not be required for organic material like trees, needles, branches, and clean sod; however, do not cast fine organics like sod and grass into water.
14) Move intact large wood (>30' in length and >20" in diameter), present on roads down-slope of the road, subject to site-specific considerations, and consultation with a natural resource specialist with experience in fish biology.
15) Conduct snowplowing in accordance with the following criteria:
    a. Use no chemical additives such as salt or de-icing in conjunction with snowplowing.
    b. Create drainage holes in snow berms to provide drainage.
    c. Leave a minimum of two inches of snow on gravel roads during plowing. Clear snow from paved roads down to the surface.

d. Do not blade gravel or surfacing material off of the road.
e. Do not deliberately side-cast snow into or over drainage structures.
f. Do not plowing on gravel roads during thaw periods when the road is wet.

Road and Trail Decommissioning

1) Revegetate all bare-soil surfaces to reduce surface erosion.
2) Re-contour the affected area to mimic natural floodplain contours and gradient to the extent possible.
3) Re-create surface drainage patterns, and place dissipaters, chutes, or rock at remaining culvert outlets.
4) Conduct activities during dry field conditions, generally May 15 – October 15, when the soil is more resistant to compaction and when soil moisture is low.
5) Dispose of slide and waste material in stable non-floodplain sites unless materials are intended to restore natural or near-natural contours and approved by a geotechnical engineer or other qualified personnel.

Road and Trail Construction, Widening, and Relocation

1) When paving new roadways, apply methods to prevent asphalt or road oils from entry into water or wetlands. Do not conduct extensive asphalt-laying during wet weather that might readily transfer oils via runoff to waterways.
2) Do not side-cast during broom operations within 100 feet of bridges, adjacent wetlands and surface waters, or as directed.
3) When asphalt surfacing is removed from the former roadways, gather and contain it in such a manner as to prevent entry into water or wetlands.
4) Minimize the placement of construction or demolition debris into water or wetlands.
5) Salvage organic matter, forest debris, and soils as is possible from clearing for new roads, and stockpile it for use in any restoration actions associated with the clearing.
6) Protect existing vegetation to the extent possible, and promptly rehabilitate disturbed areas.

In-Channel Nutrient Enhancement

1) In Oregon, acquire the required permits through the Oregon Department of Environmental Quality. Use only carcasses from the treated watershed or those that are certified disease-free by an Oregon Department of Fish and Wildlife (ODFW) pathologist.
2) In Washington, follow the direction In the WDFW publication, "Protocols and Guidelines for Distributing Salmonid Carcasses, Salmon Carcass Analogs, and Delayed Release Fertilizers to Enhance Stream Productivity in Washington State (WDFW 2004).
3) In all states follow the process and guidance in the publication: "Washington Department of Fish and Wildlife Habitat Technical Assistance: Nutrient Supplementation" (2004) for all nutrient enhancement actions.
4) Deposit only carcasses of species native to the watershed, and do so during the normal migration and spawning times, as would naturally occur in the watershed.
5) Do not apply nutrient enhancement to eutrophic or naturally oligotrophic systems, as determined by project sponsor and Bonneville.
6) Individually assess each waterway for available light, water quality, stream gradient, and life history of the fish present. Apply adaptive management to derive the maximum benefits of nutrient enhancement.

Irrigation, Water Delivery, and Water Use Actions

Converting Irrigation Water Delivery System to Drip or Sprinkler Irrigation

In the designs for converting irrigation water delivery system to drip or sprinkler irrigation:

1) identify the a net instream benefit will be achieved for all flows when the diversion is in use
2) quantify instream savings for all periods the diversion is in use and describe how water savings will be protected from other consumptive use
3) identify the approximate downstream extent of the flow benefit

Converting Water Conveyances from Open Ditch to Pipeline

In the designs for converting irrigation water delivery system to drip or sprinkler irrigation:

1) identify the a net instream benefit will be achieved for all flows when the diversion is in use
2) quantify instream savings for all periods the diversion is in use and describe how water savings will be protected from other consumptive use
3) identify the approximate downstream extent of the flow benefit

Converting from Instream Irrigation Diversions to Groundwater Wells

1) Apply the conservation measures for the activity categories "Dams, Water Control Structures, or Legacy Structures Removal".
2) Demonstrate and quantify in the designs the habitat benefits in terms of how the proposed action will improve instream flows considering both seasonality and aquatic species presence.
3) Locate new wells more than ¼ mile from the stream and in areas not hydrologically connected to the stream

Installing or Replacing Return-Flow Cooling Systems

1) Designs shall demonstrate and quantify habitat benefits.
2) Avoid disturbance to riparian vegetation.

Installing Irrigation Water Siphons

1) Apply the conservation measures for the activity categories "Dams, Water Control Structures, or Legacy Structures Removal"
2) Employ directional drilling to create siphon pathway whenever possible.
3) Employ trenching in dry stream beds only.
4) Allow no part of the siphon structure to block fish passage.
5) Locate siphons further outside of 1.5 times the bankfull width or set back a minimum of 10 feet from the bankfull delineation, whichever is greater.
6) Maintain a minimum cover over a siphon structure within the streambed of 2 times the design flow scour depth, or 3 feet, whichever is greater.
7) Construct waterways to a natural streambed configuration using stream simulation material upon completion
8) Maintain stream widths at bankfull width or greater.

9) Use the most recent versions of Natural Resource Conservation Service (NRCS) guidance[59] for these structures when developing the criteria, plans, specifications, and operation/ maintenance protocols.

Developing Livestock Watering Facilities

1) Apply the conservation measures for activity category "Convert from Instream Diversion to Groundwater Wells".
2) Demonstrate, in the designs, the habitat benefit (instream water savings and/or reduction of livestock in stream).
3) Screen all intakes for pumping and gravity-feed systems within habitat occupied by ESA-listed salmonids to avoid juvenile fish entrainment; and construct and operate the structure in accordance with NMFS' current fish screen criteria (NMFS 2011a or most recent version).
4) In areas where larval lamprey could be entrained, use screening by perforated plate, vertical bar, or interlocking bar screens. Do not use wire screening.
5) Use pipes less than 4 inches. If larger pipes are required, justify the need for the required size in the designs.
6) Do not site these structures on steep slopes.
7) Ensure that each livestock water development has a float valve or similar device limiting use to demand, and includes a return-flow system.
8) Include a fenced overflow area or similar means to minimize potential runoff and erosion.

Installing, Upgrading, or Maintaining Fish Exclusion Devices and Bypass Systems

1) Apply the conservation measures for activity category "Consolidate or Replace Existing Irrigation Diversion", or other activity category, if more fitting.
2) Design, construct, install, operate, and maintain all fish screens (including screens installed on temporary and permanent pump intakes) and fish bypass systems according to NMFS fish screen criteria, detailed in Anadromous Salmonid Passage Facility Design (NMFS 2011a or most recent version).
3) Provide fish exclusion or fish passage benefits during in-water maintenance upstream of screens
4) Avoid use of wire cloth for screening to reduce entrainment of larval lamprey; perforated plate, vertical bar or interlocking bar screens should be used instead (Rose and Mesa 2012).
5) Install, replace, upgrade, remove, and maintain diversion water intake and return points to prevent salmonids of all life stages from swimming into, or being entrained within, the diversion system.
6) All large wood and sediment recovered during cleaning and maintenance may be placed downstream of the diversion.

Fish, Hydrologic, Wildlife and Geomorphic Surveys

1) Application of drones would comply with applicable Federal Aviation Administration regulations.
2) Do not operate drones in Congressionally-designated Wilderness, Wild and Scenic River corridors, or National Recreation Areas.

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[59] Available on the NRCS website: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/engineering/?cid=stelprdb1042240

3) Do not operate drones on lands managed by the U.S. Forest Service, Bureau of Land Management, National Park Service, or U.S. Fish and Wildlife Service only under the terms of a special use authorization issued by the appropriate federal land management agency.
4) Do not operate drones within disturbance distances of wildlife protected by state or federal law (ESA-listed species; eagles, hawks, owls, etc.) except when permitted by the appropriate state or federal agency. Disturbances distances are:
    a. Non-breeding season - 150 feet for gasoline-powered drones; 100 feet for battery-powered drones
    b. Breeding season - 300 feet for gasoline-powered drones; 200 feet for battery-powered drones
5) Do not operate drones near persons, home sites, or private property where privacy may be an issue without prior notification and approval of the party potentially affected.

Riparian and Upland Habitat Improvements and Structures

1) Use wildlife-friendly[60] fence design wherever wire fencing is proposed for livestock exclusion.
2) Do not allow grazing within riparian-area fenced enclosures without a grazing management plan that uses flash grazing to control invasive species or otherwise promote growth of native riparian vegetation.
3) Plant in areas where the proposed plantings have historically occurred but at present are either scarce or absent.
4) Develop a vegetation/planting plan that is responsive to the biological and physical factors at the site. Include the following in all planting plans:
    a. Require the use of native species and the specify seed/plant source, seed/plant mixes, soil preparation, etc.
    b. Include vegetation management strategies that are consistent with local native succession and disturbance regimes.
    c. Consider the abiotic factors contributing to the sites' succession, i.e., weather and disturbance patterns, nutrient cycling, and hydrologic condition.
5) Plan tree felling so as not to create excessive streambank erosion or increase the likelihood of channel avulsion during high flows.
6) If these actions fall within the home ranges of species protected under the Endangered Species Act, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act or other federal act then apply appropriate timing and or equipment/distance restrictions as necessary.

Artificial Pond Development

1) Design artificial ponds that incorporate inflows and outflows connected to live streams to minimize potential adverse effects of that water diversion to the stream, and to minimize the potential for water quality concerns downstream from the pond's outflow.

[60] A wildlife-friendly fence is one designed to allow wildlife to safely see it, crawl under or through it, and jump or climb over it.

Appendix B General Mitigation Measures Applicable to all Actions

The following mitigation measures are primarily taken from Bonneville's HIP ESA consultation (see Section 2.1), though additional measures are included here for actions not covered in that consultation. These would be implemented by Bonneville on all projects that involve in-water or near water work as appropriate. Reclamation would implement these measures, as applicable, for Bonneville-funded projects; for projects funded by other agencies or entities, Reclamation would implement these measures or like measures with similar intent and outcome. Additional measures would be identified through site-specific analysis and consultations as discussed in Section 2.2.2.

Project Design and Site Preparation

Timing of in-water work

Formal recommendations published by state agencies such as the Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), Idaho Department of Fish and Game (IDFG), and Montana Fish Wildlife and Parks (MFWP), or informal recommendations from the appropriate state Fishery Biologist in regard to the timing of in-water work, would be followed.

Bull trout - In Bull Trout spawning and rearing areas, eggs, alevin, and fry are present nearly year round. In Bull Trout habitats designated as foraging, migration, and overwintering (FMO) habitats, juvenile and adult bull trout may be present seasonally. Some project locations may not have designated in-water work windows for bull trout, or if they do, they may differ from the in-water work windows for salmon and steelhead. If this is the case, the project sponsor would contact the appropriate USFWS field office to ensure that all reasonable implementation measures are considered and an appropriate in-water work window is used to minimize project effects.

Lamprey – To minimize disturbance to migrant adults, the project sponsor and/or their contractors would avoid working instream or river channels that contain Pacific lamprey from March 1 to July 1 in low- to mid-elevation reaches (<5,000 feet). In high-elevation reaches (>5,000 feet), the project sponsor would avoid working instream or river channels from March 1 to August 1. If either timeframe is incompatible with other objectives, the area would be surveyed for nests and lamprey presence, and avoided if possible. If lampreys are known to exist, the project sponsor would utilize best management practices (BMPs) for dewatering and salvage as outlined in USFWS 2010, or most recent guidance. Salvage should include salvage of larval lamprey from sediments.

Exceptions to ODFW, WDFW, MFWP, or IDFG in-water work windows would be require a variance from the conditions in the HIP programmatic consultation.

Contaminants

The project sponsor would complete a site assessment with the following elements to identify the type, quantity, and extent of any potential contamination for any action that involves excavation of more than 20 cubic yards of material:

1. A review of available records, such as former site use, building plans, and records of any prior contamination events;
2. A site visit to inspect the areas used for various industrial processes and the condition of the property;
3. Interviews with knowledgeable people, such as site owners, operators, and occupants, neighbors, or local government officials; and

4. A summary, stored with the project file that includes an assessment of the likelihood that contaminants are present at the site, based on items 4(a) through 4(c).

Site layout and flagging

Prior to construction, the project area would be clearly flagged to identify the following:

1. Sensitive resource areas, such as areas below ordinary high water (OHW), spawning areas, springs, and wetlands;
   a) Equipment entry and exit points;
   b) Road and stream crossing alignments;
   c) Staging, storage, and stockpile areas; and
   d) No-herbicide-application areas and buffers.

Temporary access roads and paths

1. Existing access roads and paths would be preferentially used whenever possible, and the number and length of temporary access roads and paths through riparian areas and floodplains would be minimized to lessen soil disturbance, soil compaction, and impacts to vegetation.
2. Vehicle use and human activities, including walking in areas occupied by terrestrial ESA- listed species, would be minimized.
3. Temporary access roads and paths would not be built on slopes where grade, soil, or other features suggest a likelihood of excessive erosion or failure. If slopes are steeper than 30%, the road would be designed by a civil engineer with experience in steep road design.
4. The removal of riparian vegetation during construction of temporary access roads would be minimized. When temporary vegetation removal is required, vegetation would be cut at ground level (not grubbed).
5. At project completion, all temporary access roads and paths would be de-compacted and reshaped to match the original contour; and the soil would be stabilized and revegetated.
6. Helicopter flight patterns would be established in advance, and located to avoid terrestrial ESA- listed species, including their occupied habitat and appropriate buffers, during sensitive life stages (i.e. nesting and critical breeding periods).

Temporary stream crossings

1. Existing stream crossings, fords, or bedrock would be used whenever possible.
2. If an existing stream crossing is not accessible, temporary crossings would be installed. Treated wood would not be used on temporary bridge crossings or in locations in contact with or over water.
3. For projects that require equipment and vehicles to cross in the wet:
   a) The location and number of all wet crossings would be approved by the Agency and clearly indicated on design drawings.
   b) Vehicles and machinery would cross streams at right angles to the main channel wherever possible.
   c) No stream crossings would occur 300 feet upstream or 100-feet downstream of an existing redd or spawning fish.

d) After completion, temporary stream crossings would be obliterated, and the banks restored.

Staging, storage, and stockpile areas

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

Equipment

Mechanized equipment and vehicles would be selected, operated, and maintained in a manner that minimizes adverse effects on the environment (*e.g.*, minimally-sized, low pressure tires; minimal hard-turn paths for tracked vehicles; temporary mats or plates within wet areas or on sensitive soils). All vehicles and other mechanized equipment would be:

1. Stored, fueled, and maintained in a vehicle staging area located 150 feet or more from any natural water body or wetland, or on an adjacent, established road area;
2. Refueled in a vehicle staging area located 150 feet or more from a natural waterbody or wetland, or in an isolated hard zone, such as a paved parking lot or adjacent, established road (this measure applies only to gas or diesel-powered equipment with tanks larger than five gallons);
3. Biodegradable lubricants and fluids would be used on equipment operating in the stream channel and live water.
4. Inspected daily for fluid leaks before leaving the vehicle staging area for operation within 150 feet of any natural water body or wetland; and
5. Thoroughly cleaned before operation below ordinary high water (OHW), and as often as necessary during operation, to remain free of grease.

Erosion control

Erosion control best management practices (BMPs) would be prepared and carried out, commensurate with the scope of the action that may include the following:

1. Temporary erosion control BMPs.
   a) Temporary erosion control BMPs would be in place before any substantial alteration of the action site, and would be appropriately installed downslope of any activity within the riparian buffer area until site rehabilitation is complete.
   b) If there is a potential for eroded sediment to enter the stream, sediment barriers would be installed and maintained for the duration of project implementation.

c) Temporary erosion control measures may include sedge mats, fiber wattles, silt fences, jute matting, wood fiber mulch with soil binder, or geotextiles and geosynthetic fabric. Biodegradable netting may be used so that they can decompose on site.

d) Soil stabilization utilizing wood fiber mulch and tackifier (hydro-applied) may be used to reduce erosion of bare soil if the materials are noxious-weed-free and nontoxic to aquatic and terrestrial animals, soil microorganisms, and vegetation.

e) Sediment would be removed from erosion control BMP once it has reached 1/3 of the exposed height of the BMP.

f) Once the site is stabilized following construction, temporary erosion control BMPs would be removed.

1. Emergency erosion control BMPs. The following materials for emergency erosion control would be available at the work site:

   a) A supply of sediment control materials; and

   b) An oil-absorbing floating boom whenever surface water is present.

Dust abatement

The project sponsor would determine the appropriate dust control measures by considering soil type, equipment usage, prevailing wind direction, and the effects caused by other erosion and sediment control measures. In addition, the following criteria would be followed:

1. Work would be sequenced and scheduled to reduce exposed bare soil subject to wind erosion.
2. Dust-abatement additives and stabilization chemicals (typically magnesium chloride, calcium chloride salts, or lignin sulfonate) would not be applied within 25 feet of a natural waterbody or wetland and would be applied so as to minimize the likelihood that they would enter streams. Applications of lignin sulfonate would be limited to a maximum rate of 0.5 gallons per square yard of road surface, assuming a 50:50 (lignin sulfonate to water) solution.
3. Application of dust abatement chemicals would be avoided during or just before wet weather and at stream crossings or other areas that could result in unfiltered delivery of the dust abatement chemicals to a waterbody (typically these would be areas within 25 feet of a natural waterbody or wetland; distances may be greater where vegetation is sparse or slopes are steep).
4. Spill containment equipment would be available during application of dust abatement chemicals.
5. Petroleum-based products would not be used for dust abatement.

Spill prevention, control, and counter measures

The following measures would be used to prevent accidental spills of fuel, lubricants, hydraulic fluid, or other contaminants into the riparian zone or directly into the water:

1. A description of hazardous materials that would be used, including inventory, storage, and handling procedures, would be available on-site.
2. Written procedures for notifying environmental response agencies would be posted at the work site.

3. Spill containment kits (including instructions for cleanup and disposal) adequate for the types and quantity of hazardous materials used at the site would be available at the work site.
4. Workers would be trained in spill containment procedures and would be informed of the location of spill containment kits.
5. Any waste liquids generated at the staging areas would be temporarily stored under an impervious cover, such as a tarpaulin, until they can be properly transported to, and disposed of, at a facility that is approved for receipt of hazardous materials.
6. Pumps used adjacent to water would use spill containment systems.

Invasive species control

The following measures would be followed to avoid introduction of invasive plants and noxious weeds into project areas:

1. Prior to entering the site, all vehicles and equipment would be power-washed, allowed to dry fully, and inspected to make sure no plants, soil, or other organic material adheres to the surface.
2. Watercraft, waders, boots, and any other gear to be used in or near water would be inspected for aquatic invasive species.
3. Wading boots with felt soles would not be used due to their propensity for aiding in the transfer of invasive species unless decontamination procedures are used.

Indian Trust Assets

Where effects to ITAs cannot be avoided by project design or other measures, mitigation would be proposed in a site-specific NEPA analysis.

Work Area Isolation & Fish Salvage

Work Area Isolation

Any work area requiring excavation or mobilization of sediment within the wetted channel would be isolated from the active stream whenever ESA-listed fish are reasonably certain to be present, or if the work area is less than 300-feet upstream from known ESA-listed fish spawning habitats. If the work area isolation practices would cause greater impacts than it would prevent, is located in deep or swiftly flowing water, or if fish can be effectively excluded by nets or screens, then a variance to not isolate the work area may be pursued.

When work area isolation is required, design plans would include all isolation elements, fish release areas, a pump to be used to dewater the isolation area, and, when fish are present, a fish screen that meets NMFS's fish screen criteria (NMFS 2011a[61], or most current). Wider mesh screens may be used after all fish have been removed from the isolated area. Work area isolation and fish capture activities take place during periods of the coolest air and water temperatures possible, normally early in the morning versus late in the day, and during conditions appropriate to minimize stress to fish species present.

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[61] NMFS. 2011. Anadromous salmonid passage facility design. Northwest Region. Available online at: http://www.habitat.noaa.gov/pdf/salmon_passage_facility_design.pdf

A fish biologist would determine how to remove ESA-listed fish, with least harm to the fish, before in-water work begins. This would involve either passive movement of fish out of the project's stream reach through slow dewatering, or actively removing the fish from the project reach. Should active removal be warranted, a fish biologist would clear the area of fish before the site is dewatered using one or more of a variety of methods including seining, dipping, or electrofishing, depending on specific site conditions.

Dependent upon site conditions, a fish biologist would conduct or supervise the following:

1. Slowly reduce water from the work area to allow some fish to leave the work area volitionally;
   a) If dewatered area contains large fine/ sandy sediment deposits, larval lamprey could be present, and potentially in large numbers. If so, consider electrofishing using lamprey electrofishing settings (which do not affect bony fish) prior to or during drawdown. See section further down on Lamprey Conservation Measures and Electrofishing guidelines.
2. Install block nets;
   a) Block nets would be installed at upstream and downstream locations and maintained in a secured position to exclude fish from entering the project area.
   b) Block nets would be secured to the stream channel bed and banks until fish capture and transport activities are complete. Block nets may be left in place for the duration of the project to exclude fish.
   c) If block nets remain in place more than one day, the nets would be monitored at least daily to ensure they are secured to the banks and free of organic accumulation. If the project is within bull trout spawning and rearing habitat, the block nets would be checked every four hours for fish impingement on the net. Less frequent intervals would be approved through a variance request.
   d) Nets would be monitored hourly anytime there is instream disturbance.
3. Capture fish through seining, and relocate to streams;
   a) While dewatering, any remaining fish would be collected by hand or dip nets.
   b) Seines with a mesh size to ensure capture of the residing ESA-listed fish would be used.
   c) Minnow traps may be left in place overnight and used in conjunction with seining.
4. Electrofishing would be used to capture and relocate fish not caught during seining, NMFS electrofishing guidelines would be used. This step is to be used as a last resort; after all passive techniques have been exhausted.
5. Continue to slowly dewater the stream reach;
6. Collect any remaining fish in cold-water buckets and relocate to the stream;
   a) Limit the time fish would be in a transport bucket, and release them as quickly as possible;
   b) The number of fish within a bucket would be limited, and fish would be of relatively comparable size to minimize predation;
   c) Aerators for buckets would be used, or the bucket's water would be frequently changed with cold, clear, water at 15 minute, or more-frequent, intervals.
   d) Buckets would be kept in shaded areas; or if in exposed areas, covered by a canopy.
   e) Dead fish would not be stored in transport buckets but would be left on the streambank to avoid mortality counting errors.

NMFS's Electrofishing Guidelines (NMFS 2000[62])

1. Initial Site Surveys and Equipment Settings
   a) In order to avoid contact with spawning adults or active redds, researchers would a careful visual survey of the area to be sampled before beginning electrofishing.
   b) Prior to the start of sampling at a new location, water temperature and conductivity measurements would be taken to evaluate electrofisher settings and adjustments.
   c) No electrofishing should occur when water temperatures are above 18°C or are expected to rise above this temperature prior to concluding the electrofishing survey.
   d) Whenever possible, a block net should be placed below the area being sampled to capture stunned fish that may drift downstream.
   e) Equipment must be in good working condition and operators should go through the manufacturer's preseason checks, adhere to all provisions, and record major maintenance work in a logbook.
   f) Each electrofishing session must start with all settings (voltage, pulse width, and pulse rate) set to the **minimums** needed to capture fish. These settings should be gradually increased only to the point where fish are immobilized and captured, and generally not allowed to exceed conductivity-based maxima.

Electrofishing Guidelines for ESA-listed Salmonids

	Initial Settings	Maximum Settings	
Voltage		Conductivity	Max Voltage
	100V	<100	1100 V
		100-300	800 V
		>300	400 V
Pulse Width	500 µS	5 mS	
Pulse Rate	30 Hz	70 Hz	

2. Electrofishing Technique
   a) Sampling should begin using straight DC. The power needs to remain on until the fish is netted when using straight DC. If fish capture is unsuccessful with initial low voltage, gradually increase voltage settings with straight DC.
   b) If fish capture is not successful with the use of straight DC, then set the electrofisher to lower voltages with PDC. If fish capture is unsuccessful with low voltages, increase pulse width, voltage, and pulse frequency (duration, amplitude, and frequency).
   c) Electrofishing should be performed in a manner that minimizes harm to the fish. Stream segments should be sampled systematically, moving the anode continuously in a herringbone pattern (where feasible) through the water. Care should be taken when fishing in areas with high fish concentrations, structure (*e.g.*, wood, undercut banks) and in shallow waters where most backpack electrofishing

[62] http://www.westcoast.fisheries.noaa.gov/publications/reference_documents/esa_refs/section4d/electro2000.pdf

for juvenile salmonids occurs. Voltage gradients may be high when electrodes are in shallow water where boundary layers (water surface and substrate) tend to intensify the electrical field.

d) Do not electrofish in one location for an extended period (*e.g.*, undercut banks) and regularly check block nets for immobilized fish.

e) Fish should not make contact with the anode. The zone of potential injury for fish is 0.5 m from the anode.

f) Electrofishing crews should be generally observant of the condition of the fish and change or terminate sampling when experiencing problems with fish recovery time, banding, injury, mortality, or other indications of fish stress.

g) Netters should not allow the fish to remain in the electrical field any longer than necessary by removing stunned fish from the water immediately after netting.

3. Sample Processing and Recordkeeping

a) Fish should be processed as soon as possible after capture to minimize stress. This may require a larger crew size.

b) All sampling procedures must have a protocol for protecting held fish. Samplers must be aware of the conditions in the containers holding fish; air pumps, water transfers, etc., should be used as necessary to maintain safe conditions. Also, large fish should be kept separate from smaller prey-sized fish to avoid predation during containment.

c) Fish should be observed for general condition and injuries (*e.g.*, increased recovery time, dark bands, and visually observable spinal injuries). Each fish should be completely revived before releasing at the location of capture. A plan for achieving efficient return to appropriate habitat should be developed before each sampling session. Also, every attempt should be made to process and release ESA-listed specimens first.

d) Pertinent water quality (*e.g.*, conductivity and temperature) and sampling notes (*e.g.*, shocker settings, fish condition/injuries/mortalities) should be recorded in a logbook to improve technique and help train new operators. It is important to note that records of injuries or mortalities pertain to the entire electrofishing survey, including the fish sample work-up.

e) The anode would not intentionally contact fish.

f) Electrofishing should not be conducted when the water conditions are turbid and visibility is poor. For example, when the sampler cannot see the stream bottom in one foot of water.

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

Bull Trout Electrofishing Mitigation Measures

In areas potentially occupied by bull trout, follow the guidelines in NMFS's Electrofishing Guidelines (NMFS 2000[63]), as described above, with the following additional restrictions:

1. For salvage operations in known bull trout spawning and rearing habitat[64], electrofishing would only occur from May 1 to July 31. In FMO habitats, electrofishing may occur any time of year.
2. Bull trout are very temperature sensitive and generally should not be electrofished or otherwise handled when temperatures exceed 15°C in spawning and rearing habitats.
3. Salvage/ electrofishing activities should take place during periods of the coolest air and water temperatures possible, normally early in the morning versus late in the day, and during conditions appropriate to minimize stress to fish species present.

Dewatering

Dewatering, when necessary, would be conducted over a sufficient period of time to allow species to naturally migrate out of the work area and would be limited to the shortest linear extent practicable.

1. Diversion around the construction site may be accomplished with a cofferdam and a by-pass culvert or pipe, or a lined, non-erodible diversion ditch. Where gravity feed is not possible, a pump may be used, but must be operated in such a way as to avoid repetitive dewatering and re-watering of the site. Impoundment behind the cofferdam must fill slowly through the transition, while constant flow is delivered to the downstream reaches.
2. All pumps would have fish screens to avoid juvenile fish impingement or entrainment, and would be operated in accordance with NMFS's current fish screen criteria (NMFS 2011a[65], or most recent version). If the pumping rate exceeds three cubic feet per second (cfs), a NMFS Engineering review would be necessary. If the screen is in an isolated area with no fish (salmonids or larval lamprey), a larger mesh screen may be used.
3. Dissipation of flow energy at the bypass outflow would be provided to prevent damage to riparian vegetation and/or stream channel.
4. Seepage water would be pumped to a temporary storage and treatment site or into upland areas to allow water to percolate through soil or to filter through vegetation prior to reentering the stream channel.
5. In areas occupied by larval lamprey, to the extent possible, salvage using guidance set forth in USFWS 2010[66] or most recent guidance.

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[63] http://www.westcoast.fisheries.noaa.gov/publications/reference_documents/esa_refs/section4d/electro2000.pdf

[64] Bull Trout Spawning and Rearing habitat is not foraging, migrating, and overwintering (FMO) habitats.

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

[66] USFWS. 2010. Best management practices to minimize adverse effects to Pacific lamprey. Available online at: http://www.fws.gov/pacific/Fisheries/sphabcon/lamprey/pdf/Best%20Management%20Practices%20for%20Pacific%20Lamprey%20April%202010%20Version.pdf

6. In areas occupied by native freshwater mussels, to the extent possible, salvage using guidance developed by the Xerces Society (Blevins et al. 2018)[67].

Bull Trout Electrofishing Mitigation Measures

In areas potentially occupied by bull trout, follow the guidelines in NMFS's Electrofishing Guidelines (NMFS 2000[68]), as described above, with the following additional restrictions:

7. For salvage operations in known bull trout spawning and rearing habitat[69], electrofishing would only occur from May 1 to July 31. In FMO habitats, electrofishing may occur any time of year.
8. Bull trout are very temperature sensitive and generally should not be electrofished or otherwise handled when temperatures exceed 15°C in spawning and rearing habitats.

Salvage/ electrofishing activities should take place during periods of the coolest air and water temperatures possible, normally early in the morning versus late in the day, and during conditions appropriate to minimize stress to fish species present.

Salvage of Native Fish, Lamprey8 and Mussels9

In addition to Conservation Recommendations for salmonids, additional efforts will be employed to salvage other native species. The following guidelines are draft from the U.S. Fish and Wildlife Service, with assistance from the Xerces Society, and would be used as appropriate and to the extent possible.

1) Conduct native mussel and lamprey presence/absence; approximate numbers for salvage to aid in planning for salvage. Pre-select site where salvaged mussels will be relocated.
2) Suggested drawdown: this order should be adjusted for site-specific conditions and numbers of species and individuals. For example, if only a small number of mussels or very limited larval lamprey habitats are present, it may be most efficient to salvage only during drawdown. If drawdown occurs during cool, wet weather, with the area re-watered within 24-48 hours, mussels and larval lamprey may survive in the sediments, and not require salvage. Conversely, if conditions are warm or hot, lamprey can expire within a couple of hours. Depending on site and circumstances, other adjustments may also be necessary. A generalized order prior to drawdown would be:
    a) Salvage freshwater mussels by hand, locating by snorkeling or wading. If mussels are numerous (or staff is limited), it may be necessary to do this step in the days before drawdown, as relocation/placement may be time consuming.
    b) Salvage larval lamprey by e-fisher under watered conditions with lamprey-specific settings.
    c) Salvage bony fish after lamprey with nets or by e-fisher with appropriate settings.
    d) If there are sufficient numbers of people and equipment, some people can be dry-shocking dewatered areas, while others are removing remaining mussels, and others are salvaging salmon.

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[67] Blevins et al. 2018. Conserving the Gems of Our Waters: Best Management Practices for Protecting Native Western Freshwater Mussels, available on line at https://xerces.org/wp-content/uploads/2018/01/2018-001_Freshwater_Mussel_BMPs_XercesSociety.pdf

[68] http://www.westcoast.fisheries.noaa.gov/publications/reference_documents/esa_refs/section4d/electro2000.pdf

[69] Bull Trout Spawning and Rearing habitat is not foraging, migrating, and overwintering (FMO) habitats.

3) Continue salvage of larval lamprey and freshwater mussels by hand during and after drawdown, as water recedes and lamprey continue to emerge from sediments, and overlooked mussels become visible. Larval lamprey may emerge hours after dewatering occurs.
4) To encourage larval lamprey emergence, "Dry shock" in areas of fine/sandy deposits that are likely to have high larval lamprey densities.
5) Hold all fish in buckets, fine mesh baskets or tanks with adequate temperatures, space and oxygen. Release all fish throughout the salvage process in appropriate habitats to minimize stress, thermal shock and predation risk. Hold mussels in coolers as described below and relocate mussels in a pre-selected appropriate habitat; placement of each individual would be needed to allow mussels to re-establish/burrow into the new habitat.

Electrofishing settings for larval Lamprey

1) Electrofishing would be performed in a manner that minimizes harm to fishes. Handling techniques would be applied as described in NMFS Electrofishing Guidelines are protective of lamprey. If there is a conflict between conservation measures for ESA-listed salmonids and lamprey/mussels protections towards the ESA-listed fish would be prioritized.
2) Generally three types of electrofishers would be suitable for larval lamprey sampling:
   a) AbP-2 "Wisconsin" electrofisher (ETS Electrofishing, Verona, WI)
   b) Smith-Root LR-24 model electrofisher with lamprey settings;
   c) Smith Root Apex Backpack electrofisher with lamprey settings.
3) Electrofishers used for larval lamprey sampling would be set with two wave forms, a lower frequency "tickle" wave form to coax larval lampreys out of the substrate and a higher frequency "stun" wave form to immobilize larval lampreys for netting.
4) Effective sampling involves this 2-stage method (Table below):
   a) First stage: would use 125V direct current with a 25 percent duty cycle applied at a slow rate of 3 pulses per second, to induce larval lampreys to emerge from the sediment. At low water temperature (<10C°), voltage would likely need to be raised (150- 200V) to maintain its effectiveness (voltage would be gradually increased to find the appropriate setting to avoid the risk of electronarcosis).
   b) A pattern of 3 slow pulses would be used followed by a skipped pulse (bursted pulse) to help larval lampreys to emerge.
   c) Second stage: immediately after larval lampreys emerge, a fast pulse setting of 30 pulses per second would be used to immobilize and net them.

Electrofishing Guidelines for Larval Lampreys

	Bursted Slow Pulse Primary Wave Form	Standard Fast Pulse Secondary Wave Form
Voltage	125v	125v
Pulse Frequency	3 Hz	30 Hz
Duty Cycle	25%	25%
Burst Pulse Train	3:1	-
Maximum duration/set	60-90 seconds	-

5) Exposing larval lampreys to extended periods of electrofishing would be avoided as it has been linked to electronarcosis. Recovery from electronarcosis takes about 15 minutes.

6) Dip nets would be used to capture larval lampreys where they are readily visible. Where not visible, seines may be effective. Using fine mesh nets to “sweep” the water (“blind-netting”) may increase the number of small larvae collected.
7) Within each reach, electrofishing would be conducted in a downstream to upstream direction (for the purpose of reducing turbidity/maintaining visibility) with one person operating the electrofisher and at least one person netting larval lampreys. Each reach would be thoroughly and slowly sampled (60-90 sec/m), with more effort directed at suitable lamprey rearing habitat and less effort in areas with hard substrates or high water velocity.
8) Using the 2-stage method described above, the electrofisher would mainly be operated in the lower frequency output mode to irritate larval lampreys out of the substrate. When necessary, the higher frequency mode would be activated for capturing emergent larval lampreys.
9) Multiple electrofishing passes would be made to ensure a more complete removal of larval lampreys. A fifteen-minute break between passes would be taken to reduce the chance of electronarcosis. Some research indicated on average, only 30% lamprey emerge per pass, thus the need for multiple passes.
10) Post-Drawdown: Larval lamprey may continue to emerge from sediments after drawdown. The following “Dry- Shocking” Guidelines may be used to encourage larvae to emerge from the sediments so they can be salvaged.
    a) During and after dewatering, dewatered areas where lamprey may be burrowed would be shocked, aka “dry-shocking.” Depositional areas of fine and sandy sediment would be dry-shocked for larval lamprey. Juveniles (eyed migrants) and adults are sometimes found buried in rockier areas, and those areas would also be shocked if other these life stages may be present.
    b) Dry-shocking would be applied to square meter at a time, with the anodes about one meter apart and tickle-pulsed for 60 to 90 seconds. Emerged lamprey would be removed once the shocking has stopped before moving on to the next square meter. Depending on local conditions, 60 seconds of shocking may be sufficient; in other areas 90 seconds would be needed. In cold temperatures, it may be beneficial to raise the voltage to increase efficiency. A general guideline would be to increase voltage to 150-175 V at temperatures less than 100C. If emergence is really slow (or on the last salvage pass prior to complete dewatering), the voltage may be increased to 200 V initially, and up to 400 V if lower voltage was not effective (dry shocking only).

Fish Salvage Notice

Monitoring and recording of fish presence, handling, and mortality would occur for the duration of the isolation, salvage, electrofishing, dewatering, and re-watering operations. Once operations are completed, a salvage report would document procedures used, any fish injuries or deaths (including numbers of fish affected), and causes of any deaths.

Construction and Post-Construction Mitigation Measures

Fish passage

Fish passage would be provided for any adult or juvenile fish likely to be present in the project area during construction, unless passage did not exist before construction, or the stream is naturally impassable at the time of construction. If the provision of temporary fish passage during construction would increase negative effects on ESA-listed species or their habitat, a variance can be requested from the NMFS Branch Chief and the USFWS Field Office Supervisor. Pertinent information, such as the species affected, length of stream reach affected, proposed time for the passage barrier, and alternatives considered would be included in the variance request.

Construction and discharge water

1. Surface water may be diverted to meet construction needs, but only if developed sources are unavailable or inadequate.
2. Diversions would not exceed 10% of the available flow.
3. All construction discharge water would be collected and treated using the best available technology suitable for site conditions.
4. Treatments to remove debris, nutrients, sediment, petroleum hydrocarbons, metals and other pollutants likely to be present would be provided.
5. Concrete wash water would be contained and not allowed to enter flowing or standing waters.

Minimize time and extent of disturbance

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

Operations that could damage or destroy habitat for nesting migratory birds would not be conducted during the springtime nesting season (generally March through June, depending on latitude and elevation) without surveys to identify and protect nesting sites prior to operations.

Seasonal and distance restrictions would be implemented around known raptor nests during construction to minimize impacts to nesting raptors following guidelines in Romin and Muck, 1999.

Cessation of work

Operations would cease under the following conditions:

1. High flow conditions that may result in inundation of the project area, except for efforts to avoid or minimize resource damage
2. When allowable water quality impacts, as defined by the state CWA Section 401 water quality certification or turbidity monitoring protocol (Appendix D), have been exceeded
3. Upon the identification of cultural resources that were previously unknown (i.e., a "post-review discovery") or in the case when human remains or other cultural items as defined under NAGPRA are found during construction.

Site restoration

When construction is complete:

1. All streambanks, soils, and vegetation would be cleaned up and restored as necessary using stockpiled large wood, topsoil, and native channel material.
2. All project-related waste would be removed.
3. All temporary access roads, crossings, and staging areas would be de-compacted and re-contoured. When necessary for revegetation and infiltration of water, compacted areas of soil would be loosened.
4. All disturbed areas would be rehabilitated in a manner that results in similar or improved conditions relative to pre-project conditions. This would be achieved through redistribution of stockpiled materials, seeding, and/or planting with local native seed mixes or plants.

Revegetation

Long-term soil stabilization of disturbed sites would be accomplished with reestablishment of native vegetation using the following criteria:

1. Planting and seeding would occur prior to or at the beginning of the first growing season after construction.
2. Use a mix of species, appropriate to the site that would achieve establishment, shade, and erosion control objectives. These would, preferably be forb, grass, shrub, or tree species native to the project area or region.
3. Vegetation, such as willow, sedge and rush mats, would be salvaged from disturbed or abandoned floodplains, stream channels, or wetlands, and replanted at the site in appropriate locations.
4. Invasive species would not be used.
5. Short-term stabilization measures may include the use of non-native sterile seed mix (when native seeds are not available), weed-free certified straw, jute matting, and other similar techniques.
6. Surface fertilizer would not be applied within 50 feet of any stream channel, waterbody, or wetland.
7. Fencing would be installed as necessary to prevent access to revegetated sites by livestock or unauthorized persons.
8. Re-establishment of vegetation in disturbed areas would achieve at least 70% of pre-project conditions within three years.
9. Invasive plants would be removed or controlled until native plant species are well-established (typically three years post-construction).

Site access

The project sponsor would retain the right of reasonable access to the site in order to monitor the success of the project over its life.

Public Safety

Safety and traffic-control measures (such as signage and flaggers) would be utilized where project operations on public roads have potential to affect traffic flow or motorist safety.

Implementation monitoring

Project sponsor staff or their designated representative would provide implementation monitoring to demonstrate that:

1. General mitigation measures are adequately followed
2. Effects to listed species are not greater than predicted
3. Turbidity monitoring is being conducted in accordance with the turbidity monitoring protocol (Appendix D).

CWA Section 401 water quality certification

The project sponsor or designated representative would complete and record water quality observations to ensure that in-water work is not degrading water quality. During construction, CWA Section 401 water quality certification provisions provided by the Oregon Department of Environmental Quality, Washington Department of Ecology, or Idaho Department of Environmental Quality would be followed.

Staged Re-watering Plan

When appropriate, the project sponsor would implement a staged re-watering plan for projects that involve introducing streamflow into recently excavated channels under the activity categories "*Improve Secondary Channel and Floodplain Interactions*" or "*Channel Reconstruction*".

1) The newly-excavated channel would be pre-washed before re-watering. Turbid wash water would be detained and pumped to the floodplain or into a reach with sediment capture devices, rather than discharging into fish-bearing waters.
2) The new channel would be prepared for water by installing seine nets at the upstream end to prevent fish from moving downstream into the new channel until 2/3 of total streamflow would be available in that channel. Starting in the early morning, 1/3 of the flow would be introduced into the new channel over a period of 1-2 hours.
3) Turbidity would be monitored while reintroducing streamflow into a dewatered stream reach, using the Turbidity Monitoring Protocol in Appendix D.
4) Preparation for introduction of the second 1/3 of the flow into the new channel (up to a total of 2/3) would be made by installing seine nets at the upstream end of the old channel to prevent fish, larval lamprey, and freshwater mussels from moving into a partially-dewatered channel. The second 1/3 of the flow would be introduced over the next 1-2 hours. Fish would then be salvaged from the old channel, so the old channel would be fish-free before dropping below 1/3 of the flow. Fish may be temporarily blocked from moving downstream into either channel until 2/3 of the flow has been transitioned to the new channel. This blockage to downstream fish passage would be expected to persist for roughly 12 to 14 hours, but fish may still be able to volitionally move out of the channel in the downstream direction. Turbidity would be monitored as in #3 above.
5) With the second 1/3 of flow being introduced over 2 hours, and turbidity being within 10% of the background level, seine nets would then be removed from the new channel, and fish would be allowed to move downstream into the channel.
    a. The final 1/3 of flow would be introduced once 100% of the flow is in the new channel. Flow would be blocked by installing plugs in the old channel and removing seine nets from the old channel.
    b. Additional efforts to salvage larval lamprey emerging from fine sediment deposits would be conducted after the flow is gone and possibly for a few hours after flow is gone, as the larvae would continue to emerge.

Appendix C Mitigation Measures for Invasive Plant Control

The Agencies provide funding to various project sponsors and partners to develop, implement, and monitor projects of various types. Some projects' permit requirements, landowner stipulations, or state and county weed management requirements necessitate the application of herbicide to portions of the project area. When this is mandated, the herbicide application is conducted by licensed applicators following state and county herbicide application best practices and guidelines. If herbicide application is required on Reclamation lands, D&S ENV 01-01 and 01-02 would be followed.

Mitigation Measures for All Applications of Herbicide

1. **Herbicide applicator qualifications.** Herbicides would be applied only by an appropriately licensed applicator using an herbicide specifically targeted for a particular plant species that would cause the least impact to non-target species. The applicator would be responsible for preparing and carrying out the herbicide transportation and safety plan shown below.
2. **Herbicide transportation and safety plan.** The applicator would prepare and carry out an herbicide safety/spill response plan, Pesticide Use Proposal, or Agency equivalent documentation to reduce the likelihood of spills or misapplication, take remedial actions in the event of spills, and fully report the event. At a minimum, the plan would:
3. Address spill prevention and containment;
4. Estimate and limit the daily quantity of herbicides to be transported to treatment sites;
5. Require that impervious material be placed beneath mixing areas in such a manner as to contain small spills associated with mixing/refilling;
6. Require a spill cleanup kit be readily available for herbicide transportation, storage and application;
7. Outline reporting procedures, including reporting spills to the appropriate regulatory agency;
8. Require that equipment used in herbicide storage, transportation, and handling are maintained in a leak proof condition;
9. Address transportation routes so that hazardous conditions are avoided to the extent possible;
10. Specify mixing and loading locations away from waterbodies so that accidental spills do not contaminate surface waters;
11. Require that spray tanks be mixed or washed further than 150 feet of surface water;
12. Disposal of herbicide containers would be in accordance with appropriate state and federal laws;
13. Identify sites that may only be reached by water travel and limit the amount of herbicide that may be transported by watercraft; and
14. Instruct all individuals involved, including any contracted applicators, on the plan.

15. **Herbicides.** The Agencies propose to use the herbicides in Table 16 in the typical application rates for invasive plant control (usually less than the maximum label rate shown in the table below).

Table 16 Allowable Herbicides

Active Ingredient	Typical Products	Maximum Label Application Rate (ai/ac)
2,4-D (amine)	Amine 4® Weedar 64® Riverdale AM-40®	4.0 lbs
Aminopyralid	Milestone®	0.375 lb
Chlorsulfuron	Telar XP®	3.0 oz
Clethodim	Select®	0.50 lb
Clopyralid	Transline®	0.5 lb
Dicamba	Banvel® Vanquish®	8.0 lbs
Glyphosate	Rodeo® Glypro® Accord® Aquamaster® Aquaneat® Foresters®	3.75 lbs
Imazapic	Plateau®	0.189 lb
Imazapyr	Habitat® Arsenal® Chopper®	1.5 lbs
Metsulfuron methyl	Escort XP®	4.0 oz
Picloram	Tordon 22K® Tordon K®	1 lb
Sethoxydim	Poast® Vantage®	0.375 lb
Sulfometuron methyl	Oust XP®	2.25 oz
Triclopyr (TEA)	Garlon 3A® Tahoe 3A® Triclopyr 3A® Triclopyr 3SL®	9.0 lbs
Fluroxypyr (upland only)	Vista ®	20 oz (upland only)

16. Use of 2,4-D: As a result of the national consultation on herbicides[70], use of this herbicide would comply with all relevant reasonable and prudent alternatives from the 2011 Biological Opinion (NMFS 2011b):
17. Do not apply when wind speeds are below two mph or exceed 10 mph, except when winds in excess of 10 mph would carry drift away from salmonid-bearing waters.
18. Do not apply when a precipitation event, likely to produce direct runoff to salmonid bearing waters from the treated area, is forecasted by NOAA/NWS (National Weather Service) or other similar forecasting service within 48 hours following application.
19. **Adjuvants.** The Agencies propose to use the adjuvants in Table 17 in the typical application rates for invasive plant control.

Table 17 Allowable Adjuvants

Adjuvant Type	Trade Name
Colorants	Dynamark™ U.V. (red)
	Aquamark™ Blue
	Dynamark™ U.V. (blu)
	Hi-Light® (blu)
Surfactants	Activator 90®
	Agri-Dex®
	Bond®
	Bronc-Max®
	Competitor®
	Class Act®
	Entry II®
	Hasten®
	LI 700®
	Liberate®
	R-11®
	Super Spread MSO®
	Syl-Tac®
Drift Retardants	41-A®
	Valid®
	Compadre®

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

20. Polyethoxylated tallow amine (POEA) surfactant and herbicides that contain POEA (*e.g.*, Roundup®) are not allowed for use.
21. **Herbicide carriers.** Herbicide carriers (solvents) are limited to water or specifically labeled vegetable oil.
22. **Herbicide mixing.** Herbicides would be mixed more than 150 feet from any natural waterbody to minimize the risk of an accidental discharge and no more than three different herbicides may be mixed for any one application.
23. **Herbicide application methods.** Liquid or granular forms of herbicides to be applied by a licensed applicator as follows:
24. **Broadcast spraying** – hand held nozzles attached to back pack tanks or vehicles, or vehicle-mounted booms;
25. **Spot spraying** – hand-held nozzles attached to backpack tanks or vehicles, hand-pumped spray, or squirt bottles to spray herbicide directly onto small patches or individual plants;
26. **Hand/selective** – wicking and wiping, basal bark, fill ("hack and squirt"), stem injection, and cut-stump.
27. **Emergent Knotweed Application.** No aquatic application of chemicals is covered by this consultation except for treating emergent knotweed. Only aquatic labeled glyphosate formulations would be used. The only application methods for emergent knotweed are stem injection (formulation up to 100% for emergent stems greater than 0.75 inches in diameter), wicking or wiping (diluted to 50% formulation), and hand-held spray bottle application of glyphosate (up to the percentage allowed by label instructions when applied to foliage using low-pressure hand-held spot spray applicators).
28. **Water Transportation.** Most knotweed patches are expected to have overland access; however, some sites may be reached only by water travel (*e.g.*, wading, inflatable raft, kayak, etc.). The following measures would be used to reduce the risk of a spill during water transport:
29. No more than 2.5 gallons of glyphosate would be transported per person or raft, and typically, it would be one gallon or less.
30. Glyphosate would be carried in one gallon or smaller plastic containers. The containers would be wrapped in plastic bags and then sealed in a dry-bag. If transported by raft, the dry-bag would be secured to the watercraft.
31. **Minimization of herbicide drift and leaching.** Herbicide drift and leaching would be minimized as follows:
32. Do not spray when wind speeds exceed 10 mph or are less than two mph;
33. Be aware of wind directions and potential for herbicides to affect aquatic habitat area downwind;
34. Keep boom or spray as low as possible to reduce wind effects;
35. Increase spray droplet size whenever possible by decreasing spray pressure, using high flow rate nozzles, using water diluents instead of oil, and adding thickening agents;
36. Do not apply herbicides during temperature inversions, or when ground temperatures exceed 80 degrees Fahrenheit;
37. Do not spray when rain, fog or other precipitation is falling or is imminent. Wind and other weather data would be monitored and reported for all broadcast applications.

Table 18 identifies the proposed buffer and wind speed restrictions (to be used in the absence of more stringent label instructions and restrictions).

38. During application, applicators would monitor weather conditions hourly at sites where spray methods are being used.

Table 18 Required Herbicide Buffer Widths (from bankfull elevation) and Maximum/Minimum Wind Speeds (Mph)

Active Ingredient	Broadcast Application[71]		Backpack Sprayer/Bottle[72] Spot Spray Foliar/Basal		Hand Application[73] Wicking/ Wiping/ Injection
	Min buffer (ft.)	Max/ Min wind speed (mph)	Min buffer (ft.)	Max/ Min wind speed (mph)	Min buffer (ft.)
2,4-D (amine)	100	10/2	50	5/2	15
Aminopyralid	100	10/2	15	5/2	0
Chlorsulfuron	100	10/2	15	5/2	0
Clethodim	**Not Allowed**	**Not Allowed**	50	5/2	50
Clopyralid	100	10/2	15	5/2	0
Dicamba	100	10/2	15	5/2	0
Glyphosate (aquatic)	100	10/2	15	5/2	0
Glyphosate	100	10/2	100	5/2	100
Imazapic	100	10/2	15	5/2	0
Imazapyr	100	10/2	15	5/2	0
Metsulfuron	100	10/2	15	5/2	0
Picloram	100	8/2	100	5/2	100
Sethoxydim	100	10/2	50	5/2	50
Sulfometuron	100	10/2	15	5/2	0
Triclopyr (TEA)	**Not Allowed**	**Not Allowed**	50	5/2	0 for cut-stump application; 15 feet for other applications

71 Ground-based only broadcast application methods via truck/ATV with motorized low-pressure, high-volume sprayers using spray guns, broadcast nozzles, or booms

72 Spot and localized foliar and basal/stump applications using a hand-pump backpack sprayer or field-mixed or pre-mixed hand-operated spray bottle

73 Hand applications to a specific portion of the target plant using wicking, wiping, or injection techniques; herbicides do not touch the soil during the application process

Active Ingredient	Broadcast Application[71]		Backpack Sprayer/Bottle[72] Spot Spray Foliar/Basal		Hand Application[73] Wicking/ Wiping/ Injection
Fluroxypyr	300	10/2	300	5/2	300
Herbicide Mixtures	100	Most conservative of listed herbicides	15	Most conservative of listed herbicides	Most conservative of listed herbicides

ESA-Listed Terrestrial Species

On sites where ESA-listed **terrestrial wildlife** may occur (within one mile of habitat where ESA-listed terrestrial wildlife occur), herbicide use would be limited to the chemicals and application rates as shown in Table 19, below. Staff would avoid any potential for direct spraying of wildlife, or immediate habitat in use by wildlife for breeding, feeding, or sheltering.

Table 19 Maximum Application Rates (per discrete application) within one mile of habitat where ESA-listed terrestrial species Occur (lb/ac)

Active Ingredient	Mammals	Birds	Invertebrates
2,4 –D	**Not Allowed**	**Not Allowed**	**Not Allowed**
Aminopyralid	0.22	0.11	**Not Allowed**
Chlorsulfuron	0.083	0.083	**Not Allowed**
Clethodim	**Not Allowed**	**Not Allowed**	**Not Allowed**
Clopyralid	0.375	0.375	0.375
Dicamba	**Not Allowed**	**Not Allowed**	**Not Allowed**
Glyphosate	2.0	2.0	2.0
Imazapic	0.189	0.189	**Not Allowed**
Imazapyr	1.0	1.0	**Not Allowed**
Metsulfuron	0.125	0.125	**Not Allowed**
Picloram	**Not Allowed**	**Not Allowed**	**Not Allowed**
Sethoxydim	0.3	0.3	0.3
Sulfometuron	**Not Allowed**	**Not Allowed**	**Not Allowed**
Triclopyr (TEA)	**Not Allowed**	**Not Allowed**	**Not Allowed**

Mitigation Measures Specific to Aerial Applications of Herbicide

1. Herbicides would be applied within the designated area only.
2. Aerial applications would occur along evenly-spaced, straight and regular paths of flight.
3. A Differentially Correctable Global Positioning System (DGPS) would be utilized for tracking of herbicide application and data collection. The system would be sufficiently sensitive to provide immediate deviation indications, and would be capable of determining a differentially corrected location with an error of no more than one to two meters in the horizontal plane. The guidance system would be capable of updating current position at a rate of a minimum of one time per second with differential correction covering the complete operational area, and the signal being accurately recorded at least 90% of the operational time.
4. Wind velocities for aerial chemical applications of herbicides must be six mph or less in all instances.
5. Pilots would meet certification requirements of the Federal Aviation Administration Regulations for this type of work. Agencies would coordinate appropriate public notifications according to each agency's policy.
6. Notify adjacent landowners prior to treatment.
7. Avoid aerial spraying during periods of adverse weather conditions (snow or rain imminent, fog, or air turbulence)
8. Make helicopter applications at a target airspeed of 40 to 50 miles per hour (mph), and at about 30 to 45 feet above ground.
9. Turn off application equipment at the completion of spray runs and during turns to start another spray run.
10. Use appropriate herbicide-free buffer zones for herbicides not labeled for aquatic use based on risk assessment guidance, with minimum widths from water of 100 feet for aerial, 25 feet for vehicle, and 10 feet for hand spray applications.
11. Proposals to boom or aerially spray herbicides within 200 feet of streams that are within 1,000 feet upstream from a public water supply intake, or spot apply herbicides within 100 feet of streams that are within 500 feet upstream from a public water supply intake, would include coordination with the state's department of environmental quality and the municipality to whom the intake belongs.
12. Use appropriate herbicide-free buffer zones for herbicides not labeled for aquatic use based on risk assessment guidance, with minimum widths from water of 100 feet for aerial, 25 feet for vehicle, and 10 feet for hand spray applications.
13. Limit the aerial application of chlorsulfuron and metsulfuron methyl to areas with difficult land access, where no other means of application are possible.
14. Do not apply sulfometuron methyl aerially. (MM)

Appendix D Turbidity Monitoring Protocol

The project implementer would complete and record the following water quality observations. If the geomorphology of the project area (*e.g.*, silty or claylike materials) or the nature of the action (*e.g.*, large amounts of bare earth exposure) would preclude the successful compliance with these triggers, Bonneville would be notified in advance of the likelihood and additional recommendations would be sought.

1) Take a background turbidity measurement approximately 100 feet upstream from the project area using a recently-calibrated turbidimeter. Record the observation, location, and time of the background measurement before monitoring at the downstream point, known as the **measurement compliance point**. If the background turbidity is less than 20 NTU, then use visual observations.
2) Take a second sample or observation, immediately after each **measurement compliance point**, approximately:
    a) 50 feet downstream for streams that are less than 30 feet wide;
    b) 100 feet downstream for streams between 30 and 100 feet wide;
    c) 200 feet downstream for streams greater than 100 feet wide; and
    d) 300 feet from the discharge point or nonpoint source for locations subject to tidal or coastal scour.
    e) Record the downstream observation, location, and time.
3) Turbidity would be measured (steps 1-2) every **four hours** while work is being implemented.
4) An exceedance occurs whenever the both of the following conditions are exceeded:
    a) Downstream turbidity exceeds 40 NTU**,**
    b) Downstream turbidity exceeds 10% above background
5) If an exceedance occurs then adjustments or corrective measures must be taken in order to reduce turbidity. The NMFS staff biologists of the area can be consulted to provide technical assistance.
6) If exceedances occur for more than **two consecutive monitoring intervals** (after eight hours), the activity would stop until the turbidity level returns to background.
7) If at any time, monitoring, inspections, or observations/samples show that the turbidity controls are ineffective, immediately mobilize work crews to repair, replace, or reinforce controls as necessary.

Appendix E Wildlife Habitats and Closely-Associated Species

This appendix provides the list of species that are closely associated to each habitat type as discussed in Section 3.3.5.1.2. The page numbers for each species list by habitat type are shown in the table below.

Wildlife-habitat types		Page number for species listing
Forest	Montane mixed conifer Forest	E-2
	Eastside (interior) Mixed Conifer Forest	E-3
	Lodgepole Pine Forest and Woodlands	E-4
	Ponderosa Pine Forest and Woodlands	E-4
	Upland Aspen Forest	E-5
Alpine	Subalpine Parkland	E-5
	Alpine Grasslands and Shrublands	E-6
Grasslands, Shrub-Steppe, Agriculture	Western Juniper and Mountain Mahogany Woodlands	E-6
	Eastside (Interior) Canyon Shrubland	E-7
	Eastside (Interior) Grasslands	E-8
	Shrub-steppe	E-9
	Dwarf Shrub-steppe	E-10
	Desert Playa and Salt Scrub	E-11
	Agriculture and Pastures Mixed Environs	E-12
Wetlands and Riparian	Herbaceous Wetlands	E-14
	Montane Coniferous Wetlands	E-17
	Eastside (Interior) Riparian Wetlands	E-18

Montane mixed conifer forest

	Species	Animal class	Activity	Comments
1	Tailed frog	Amphibian	Feeds	Requires clear, cold steep-gradient streams for breeding.
2	Barrow's goldeneye	Bird	Reproduces	Nests in tree cavities near ponds or lakes.
3	Bufflehead	Bird	Reproduces	Nests in tree cavities near ponds or lakes.
4	Evening grosbeak	Bird	Feeds and breeds	None noted
5	Fox sparrow	Bird	Feeds and breeds	None noted
6	Golden-crowned kinglet	Bird	Feeds and breeds	None noted
7	Gray jay	Bird	Feeds and breeds	None noted
8	Green-tailed towhee	Bird	Feeds and breeds	None noted
9	Hermit warbler	Bird	Feeds and breeds	None noted
10	Olive-sided flycatcher	Bird	Feeds and breeds	None noted
11	Pine grosbeak	Bird	Feeds and breeds	None noted
12	Varied thrush	Bird	Feeds and breeds	None noted
13	Western tanager	Bird	Feeds and breeds	None noted
14	White-winged crossbill	Bird	Feeds and breeds	None noted
15	Allen's chipmunk	Mammal	Feeds and breeds	None noted
16	American marten	Mammal	Feeds and breeds	None noted
17	Big brown bat	Mammal	Feeds and breeds	Requires snags, caves, mines, rock crevices, or bridges for breeding and roosting.
18	Bushy-tailed woodrat	Mammal	Feeds and breeds	None noted
19	Cascade golden-mantled ground squirrel	Mammal	Feeds and breeds	None noted
20	Coast mole	Mammal	Feeds and breeds	None noted
21	Columbian ground squirrel	Mammal	Feeds and breeds	None noted
22	Columbian mouse	Mammal	Feeds and breeds	None noted
23	Common porcupine	Mammal	Feeds and breeds	None noted
24	Fisher	Mammal	Feeds and breeds	None noted
25	Golden-mantled ground squirrel	Mammal	Feeds and breeds	None noted
26	Heather vole	Mammal	Feeds and breeds	None noted
27	Long-legged myotis	Mammal	Feeds and breeds	Uses caves or mines as hibernacula. Uses hollow trees, loose bark or rock crevices for maternity colonies.
28	Masked shrew	Mammal	Feeds and breeds	
29	Mountain beaver	Mammal	Feeds and breeds	None noted
30	Northern flying squirrel	Mammal	Feeds and breeds	None noted
31	Snowshoe hare	Mammal	Feeds and breeds	None noted
32	Southern red-backed vole	Mammal	Feeds and breeds	None noted
33	Townsend's chipmunk	Mammal	Feeds and breeds	None noted
34	Trowbridge's shrew	Mammal	Feeds and breeds	None noted
35	Water shrew	Mammal	Feeds and breeds	Lead a semi-aquatic life and require cold, clear water in small streams or ponds with abundant cover in the form of rocks, overhanging banks, etc.

Eastside (interior) mixed conifer forest

	Species	Animal Class	Activity	Comments
1	Barred owl	bird	Feeds and Breeds	none noted
2	Blue grouse	bird	Feeds and Breeds	none noted
3	Flammulated owl	bird	Feeds and Breeds	Requires a ponderosa pine component.
4	Fox sparrow	bird	Feeds and Breeds	none noted
5	Golden-crowned kinglet	bird	Feeds and Breeds	none noted
6	Green-tailed towhee	bird	Feeds and Breeds	none noted
7	Northern goshawk	bird	Feeds and Breeds	none noted
8	Northern pygmy-owl	bird	Feeds and Breeds	none noted
9	Northern saw-whet owl	bird	Feeds and Breeds	none noted
10	Olive-sided flycatcher	bird	Feeds and Breeds	none noted
11	Spotted owl	bird	Feeds and Breeds	none noted
12	Varied thrush	bird	Feeds and Breeds	none noted
13	Western tanager	bird	Feeds and Breeds	none noted
14	Allen's chipmunk	mammal	Feeds and Breeds	none noted
15	American marten	mammal	Feeds and Breeds	none noted
16	Big brown bat	mammal	Feeds and Breeds	Requires snags, caves, mines, rock crevices, or bridges for breeding and roosting.
17	Bushy-tailed woodrat	mammal	Feeds and Breeds	none noted
18	California myotis	mammal	Feeds and Breeds	Uses rock crevices, hollow trees, mines or caves for breeding.
19	Cascade golden-mantled ground squirrel	mammal	Feeds and Breeds	none noted
20	Coast mole	mammal	Feeds and Breeds	none noted
21	Columbian ground squirrel	mammal	Feeds and Breeds	none noted
22	Common porcupine	mammal	Feeds and Breeds	none noted
23	Deer mouse	mammal	Feeds and Breeds	none noted
24	Fisher	mammal	Feeds and Breeds	none noted
25	Golden-mantled ground squirrel	mammal	Feeds and Breeds	none noted
26	Heather vole	mammal	Feeds and Breeds	none noted
27	Long-legged myotis	mammal	Feeds and Breeds	Uses caves or mines as hibernacula. Uses hollow trees, loose bark or rock crevices for maternity colonies.
28	Lynx	mammal	Feeds and Breeds	none noted
29	Masked shrew	mammal	Feeds and Breeds	none noted
30	Northern flying squirrel	mammal	Feeds and Breeds	none noted
31	Northern pocket gopher	mammal	Feeds and Breeds	none noted
32	Pygmy shrew	mammal	Feeds and Breeds	none noted
33	Red squirrel	mammal	Feeds and Breeds	none noted
34	Red-tailed chipmunk	mammal	Feeds and Breeds	none noted
35	Silver-haired bat	mammal	Feeds and Breeds	Uses trees, bark crevices, and snags for summer roosts; if present in winter, may use caves, mines, or rock crevices for hibernacula.
36	Snowshoe hare	mammal	Feeds and Breeds	none noted
37	Southern red-backed vole	mammal	Feeds and Breeds	none noted
38	Townsend's chipmunk	mammal	Feeds and Breeds	none noted

Lodgepole pine forest and woodlands

	Species	Animal Class	Activity	Comments
1	Black-backed Woodpecker	bird	Feeds and Breeds	Reach highest densities in recently burned forests or areas of bark beetle infestations.
2	Great Gray Owl	bird	Feeds and Breeds	none noted
3	Northern Goshawk	bird	Feeds and Breeds	none noted
4	Pine Grosbeak	bird	Feeds and Breeds	none noted
5	Three-toed Woodpecker	bird	Feeds and Breeds	Reach highest densities in recently burned forests or areas of bark beetle infestations.
6	American Marten	mammal	Feeds and Breeds	none noted
7	Common Porcupine	mammal	Feeds and Breeds	none noted
8	Deer Mouse	mammal	Feeds and Breeds	none noted
9	Heather Vole	mammal	Feeds and Breeds	none noted
10	Lynx	mammal	Feeds and Breeds	none noted
11	Masked Shrew	mammal	Feeds and Breeds	none noted
12	Northern Pocket Gopher	mammal	Feeds and Breeds	none noted
13	Red Squirrel	mammal	Feeds and Breeds	none noted
14	Snowshoe Hare	mammal	Feeds and Breeds	none noted
15	Southern Red-backed Vole	mammal	Feeds and Breeds	none noted

Ponderosa pine forest and woodlands

	Species	Animal class	Activity	Comments
1	Acorn woodpecker	Bird	Feeds and breeds	Requires an oak component.
2	Blue grouse	Bird	Feeds and breeds	Does not use lowland oak component.
3	Cassin's vireo	Bird	Feeds and breeds	None noted
4	Flammulated owl	Bird	Feeds and breeds	None noted
5	Fox sparrow	Bird	Feeds and breeds	None noted
6	Great gray owl	Bird	Feeds and breeds	None noted
7	Northern goshawk	Bird	Feeds and breeds	None noted
8	Northern saw-whet owl	Bird	Feeds and breeds	None noted
9	Pygmy nuthatch	Bird	Feeds and breeds	Appears to be restricted to stands with mature ponderosa pine in Oregon and Washington.
10	Western bluebird	Bird	Feeds and breeds	None noted
11	Western tanager	Bird	Feeds and breeds	None noted
12	White-breasted nuthatch	Bird	Feeds and breeds	None noted
13	White-headed woodpecker	Bird	Feeds and breeds	None noted
14	Big brown bat	Mammal	Feeds and breeds	Requires snags, caves, mines, rock crevices, or bridges for breeding and roosting.
15	Cascade golden-mantled ground squirrel	Mammal	Feeds and breeds	None noted
16	Columbian ground squirrel	Mammal	Feeds and breeds	None noted
17	Common porcupine	Mammal	Feeds and breeds	None noted
18	Deer mouse	Mammal	Feeds and breeds	None noted
19	Dusky-footed woodrat	Mammal	Feeds and breeds	None noted
20	Golden-mantled ground squirrel	Mammal	Feeds and breeds	None noted
21	Long-legged myotis	Mammal	Feeds and breeds	Uses caves or mines as hibernacula. Uses hollow trees, loose bark or rock crevices for maternity colonies.
22	Northern pocket gopher	Mammal	Feeds and breeds	None noted
23	Silver-haired bat	Mammal	Feeds and breeds	Uses trees, bark crevices, and snags for summer roosts; if present in winter, may use caves, mines, or rock crevices for hibernacula.
24	Western gray squirrel	Mammal	Feeds and breeds	Requires an oak component.
25	Western pocket gopher	Mammal	Feeds and breeds	None noted
26	Yellow-pine chipmunk	Mammal	Feeds and breeds	None noted

Upland aspen forest

	Species	Animal class	Activity	Comments
1	Northern saw-whet owl	Bird	Feeds and breeds	None noted
2	Red-naped sapsucker	Bird	Feeds and breeds	None noted
3	Common porcupine	Mammal	Feeds and breeds	None noted
4	Least chipmunk	Mammal	Feeds and breeds	None noted

Subalpine parkland

	Species	Animal class	Activity	Comments
1	Cascades frog	Amphibian	Feeds and breeds	Requires bogs or ponds with cold springs for breeding.
2	Barrow's goldeneye	Bird	Reproduces	Nests in tree cavities near ponds or lakes.
3	Clark's nutcracker	Bird	Feeds and breeds	None noted
4	Evening grosbeak	Bird	Feeds and breeds	None noted
5	Fox sparrow	Bird	Feeds and breeds	None noted
6	Lincoln's sparrow	Bird	Feeds and breeds	None noted
7	Olive-sided flycatcher	Bird	Feeds and breeds	None noted
8	Ruby-crowned kinglet	Bird	Feeds and breeds	None noted
9	American pika	Mammal	Feeds and breeds	Requires talus slopes or boulder fields adjacent to meadows.
10	Belding's ground squirrel	Mammal	Feeds and breeds	None noted
11	Cascade golden-mantled ground squirrel	Mammal	Feeds and breeds	None noted
12	Columbian ground squirrel	Mammal	Feeds and breeds	None noted
13	Hoary marmot	Mammal	Feeds and breeds	Requires talus slopes or boulder fields in close proximity to moist meadows.
14	Long-legged myotis	Mammal	Feeds	May hibernate in this habitat in caves or mines.
15	Olympic marmot	Mammal	Feeds and breeds	Requires talus slopes or boulder fields in close proximity to moist meadows.
16	Red fox	Mammal	Feeds and breeds	Cascades red fox and rocky mountain red fox.
17	Rocky mountain bighorn sheep	Mammal	Feeds and breeds	None noted
18	Western jumping mouse	Mammal	Feeds and breeds	None noted
19	Wolverine	Mammal	Feeds and breeds	None noted

Alpine grasslands and shrublands

	Species	Animal class	Activity	Comments
1	American pipit	Bird	Feeds and breeds	None noted
2	Black rosy-finch	Bird	Feeds and breeds	None noted
3	Golden-crowned sparrow	Bird	Feeds and breeds	British Columbia-common at some sites and Washington
4	Gray-crowned rosy-finch	Bird	Feeds and breeds	None noted
5	White-tailed ptarmigan	Bird	Feeds and breeds	None noted
6	American pika	Mammal	Feeds and breeds	Requires talus slopes or boulder fields adjacent to meadows.
7	Belding's ground squirrel	Mammal	Feeds and breeds	None noted
8	Bushy-tailed woodrat	Mammal	Feeds and breeds	None noted
9	Cascade golden-mantled ground squirrel	Mammal	Feeds and breeds	None noted
10	Columbian ground squirrel	Mammal	Feeds and breeds	None noted
11	Heather vole	Mammal	Feeds and breeds	None noted
12	Hoary marmot	Mammal	Feeds and breeds	Requires talus slopes or boulder fields in close proximity to moist meadows.
13	Mountain goat	Mammal	Feeds and breeds	Require areas of rugged terrain such as steep, rocky cliffs, ledges, or talus.
14	Olympic marmot	Mammal	Feeds and breeds	Requires talus slopes or boulder fields in close proximity to moist meadows.
15	Red fox	Mammal	Feeds and breeds	Cascades red fox and rocky mountain red fox.
16	Rocky mountain bighorn sheep	Mammal	Feeds and breeds	None noted
17	Water vole	Mammal	Feeds and breeds	None noted
18	Western jumping mouse	Mammal	Feeds and breeds	None noted
19	Wolverine	Mammal	Feeds and breeds	None noted

Western juniper and mountain mahogany woodlands

	Species	Animal class	Activity	Comments
1	Ash-throated flycatcher	Bird	Feeds and breeds	None noted
2	Black-throated gray warbler	Bird	Feeds and breeds	Unknown if species uses this habitat in Washington.
3	Gray flycatcher	Bird	Feeds and breeds	None noted
4	Juniper titmouse	Bird	Feeds and breeds	None noted
5	Loggerhead shrike	Bird	Feeds and breeds	None noted
6	Long-eared owl	Bird	Feeds and breeds	Typically nests in the abandoned nests of other corvids, raptors or squirrels.
7	Pinyon jay	Bird	Feeds and breeds	None noted
8	Red-tailed hawk	Bird	Feeds and breeds	None noted
9	Western kingbird	Bird	Feeds and breeds	None noted
10	Bushy-tailed woodrat	Mammal	Feeds and breeds	None noted
11	Deer mouse	Mammal	Feeds and breeds	None noted
12	Desert woodrat	Mammal	Feeds and breeds	None noted
13	Golden-mantled ground squirrel	Mammal	Feeds and breeds	None noted
14	Great basin pocket mouse	Mammal	Feeds and breeds	None noted
15	Nuttall's (mountain) cottontail	Mammal	Feeds and breeds	None noted
16	Pinon mouse	Mammal	Feeds and breeds	None noted
17	Western small-footed myotis	Mammal	Feeds and breeds	Requires cliffs, rimrock, boulders, or talus for breeding.

Eastside (interior) canyon shrubland

	Species	Animal class	Activity	Comments
1	Lazuli bunting	Bird	Feeds and breeds	None noted
2	Long-eared owl	Bird	Feeds and breeds	Typically nests in the abandoned nests of other corvids, raptors or squirrels.
3	Northern shrike	Bird	Feeds	None noted
4	Big brown bat	Mammal	Feeds and breeds	Requires snags, caves, mines, rock crevices, or bridges for breeding and roosting.
5	Bushy-tailed woodrat	Mammal	Feeds and breeds	None noted
6	Deer mouse	Mammal	Feeds and breeds	None noted
7	Golden-mantled ground squirrel	Mammal	Feeds and breeds	None noted
8	Montane vole	Mammal	Feeds and breeds	None noted
9	Nuttall's (mountain) cottontail	Mammal	Feeds and breeds	None noted
10	Pallid bat	Mammal	Feeds and breeds	Requires rock cliffs, caves or mines for breeding.
11	Rocky mountain bighorn sheep	Mammal	Feeds and breeds	None noted
12	Western pipistrelle	Mammal	Feeds and breeds	Requires cliffs, rimrock, caves or mines for breeding and roosting.
13	Western small-footed myotis	Mammal	Feeds and breeds	Requires cliffs, rimrock, boulders, or talus for breeding.

Eastside (interior) grasslands

	Species	Animal class	Activity	Comments
1	Burrowing owl	Bird	Feeds and breeds	None noted
2	Chukar	Bird	Feeds and breeds	None noted
3	Eastern kingbird	Bird	Feeds	None noted
4	Ferruginous hawk	Bird	Feeds and breeds	Uses isolated trees, cliffs, or ground for nesting.
5	Grasshopper sparrow	Bird	Feeds and breeds	None noted
6	Horned lark	Bird	Feeds and breeds	None noted
7	Long-billed curlew	Bird	Feeds and breeds	Uses this habitat where adjacent to wetlands or irrigated areas.
8	Northern bobwhite	Bird	Feeds and breeds	None noted
9	Northern shrike	Bird	Feeds	None noted
10	Prairie falcon	Bird	Feeds and breeds	Needs cliffs for nesting.
11	Red-tailed hawk	Bird	Feeds and breeds	Requires cliffs, rimrock, rocky outcrops or isolated trees for nesting in this habitat.
12	Sage grouse	Bird	Feeds and breeds	None noted
13	Savannah sparrow	Bird	Feeds and breeds	None noted
14	Say's phoebe	Bird	Feeds and breeds	Needs cliffs or rimrock for nesting.
15	Sharp-tailed grouse	Bird	Feeds and breeds	None noted
16	Swainson's hawk	Bird	Feeds and breeds	Requires isolated trees for nesting; may use cliffs.
17	Upland sandpiper	Bird	Feeds and breeds	Likely extirpated from this habitat in Washington.
18	Vesper sparrow	Bird	Feeds and breeds	None noted
19	Western kingbird	Bird	Feeds and breeds	Needs isolated trees or utility poles for nesting.
20	Western meadowlark	Bird	Feeds and breeds	None noted
21	American badger	Mammal	Feeds and breeds	None noted
22	Belding's ground squirrel	Mammal	Feeds and breeds	None noted
23	Columbian ground squirrel	Mammal	Feeds and breeds	None noted
24	Deer mouse	Mammal	Feeds and breeds	None noted
25	Montane vole	Mammal	Feeds and breeds	None noted
26	Northern pocket gopher	Mammal	Feeds and breeds	None noted
27	Nuttall's (mountain) cottontail	Mammal	Feeds and breeds	None noted
28	Pronghorn antelope	Mammal	Feeds and breeds	None noted
29	Townsend's pocket gopher	Mammal	Feeds and breeds	None noted
30	Washington ground squirrel	Mammal	Feeds and breeds	None noted
31	Western pipistrelle	Mammal	Feeds and breeds	Requires cliffs, rimrock, caves or mines for breeding and roosting.
32	Western small-footed myotis	Mammal	Feeds and breeds	Requires cliffs, rimrock, boulders, or talus for breeding.
33	White-tailed jackrabbit	Mammal	Feeds and breeds	None noted

Shrub-steppe

	Species	Animal class	Activity	Comments
1	Brewer's sparrow	Bird	Feeds and breeds	None noted
2	Burrowing owl	Bird	Feeds and breeds	None noted
3	Chukar	Bird	Feeds and breeds	None noted
4	Ferruginous hawk	Bird	Feeds and breeds	Uses isolated trees, cliffs, or ground for nesting.
5	Lark sparrow	Bird	Feeds and breeds	None noted
6	Loggerhead shrike	Bird	Feeds and breeds	None noted
7	Long-billed curlew	Bird	Feeds and breeds	Uses this habitat where adjacent to wetlands or irrigated areas.
8	Long-eared owl	Bird	Feeds and breeds	Typically nests in the abandoned nests of other corvids, raptors or squirrels.
9	Northern shrike	Bird	Feeds	None noted
10	Prairie falcon	Bird	Feeds and breeds	Needs cliffs for nesting.
11	Red-tailed hawk	Bird	Feeds and breeds	Requires cliffs, rimrock, rocky outcrops or isolated trees for nesting in this habitat.
12	Sage grouse	Bird	Feeds and breeds	Sagebrush obligate species.
13	Sage sparrow	Bird	Feeds and breeds	A sagebrush obligate species.
14	Sage thrasher	Bird	Feeds and breeds	None noted
15	Say's phoebe	Bird	Feeds and breeds	Needs cliffs or rimrock for nesting.
16	Sharp-tailed grouse	Bird	Feeds and breeds	Historically very important habitat type in Oregon.
17	Swainson's hawk	Bird	Feeds and breeds	Requires isolated trees for nesting; may use cliffs.
18	Vesper sparrow	Bird	Feeds and breeds	None noted
19	Western meadowlark	Bird	Feeds and breeds	None noted
20	Willet	Bird	Feeds and breeds	Requires wetlands for feeding and brood rearing, but can be several hundred meters away.
21	American badger	Mammal	Feeds and breeds	None noted
22	Belding's ground squirrel	Mammal	Feeds and breeds	None noted
23	Black-tailed jackrabbit	Mammal	Feeds and breeds	None noted
24	Bushy-tailed woodrat	Mammal	Feeds and breeds	None noted
25	Dark kangaroo mouse	Mammal	Feeds and breeds	None noted
26	Deer mouse	Mammal	Feeds and breeds	None noted
27	Desert woodrat	Mammal	Feeds and breeds	None noted
28	Great basin pocket mouse	Mammal	Feeds and breeds	None noted
29	Kit fox	Mammal	Feeds and breeds	None noted
30	Least chipmunk	Mammal	Feeds and breeds	None noted
31	Little pocket mouse	Mammal	Feeds and breeds	None noted
32	Merriam's shrew	Mammal	Feeds and breeds	None noted
33	Northern grasshopper mouse	Mammal	Feeds and breeds	None noted
34	Nuttall's (mountain) cottontail	Mammal	Feeds and breeds	None noted
35	Ord's kangaroo rat	Mammal	Feeds and breeds	None noted
36	Pallid bat	Mammal	Feeds and breeds	Requires rock cliffs, caves or mines for breeding.
37	Piute ground squirrel	Mammal	Feeds and breeds	None noted
38	Pronghorn antelope	Mammal	Feeds and breeds	None noted
39	Pygmy rabbit	Mammal	Feeds and breeds	Found only in productive, dense sage habitat with deep soil (more than 50 cm).
40	Sagebrush vole	Mammal	Feeds and breeds	None noted
41	Townsend's ground squirrel	Mammal	Feeds and breeds	None noted
42	Washington ground squirrel	Mammal	Feeds and breeds	None noted
43	Western harvest mouse	Mammal	Feeds and breeds	None noted
44	Western pipistrelle	Mammal	Feeds and breeds	Requires cliffs, rimrock, caves or mines for breeding and roosting.
45	Western small-footed myotis	Mammal	Feeds and breeds	Requires cliffs, rimrock, boulders, or talus for breeding.
46	White-tailed Antelope Squirrel	mammal	Feeds and Breeds	none noted
47	Wild Burro	mammal	Feeds and Breeds	none noted

Dwarf shrub steppe

	Species	Animal class	Activity	Comments
1	Long-billed curlew	Bird	Feeds and breeds	Uses this habitat where adjacent to wetlands or irrigated areas.
2	Sage grouse	Bird	Feeds and breeds	Potentially critical early brooding habitat; sagebrush obligate species.
3	Sage thrasher	Bird	Feeds and breeds	None noted
4	Say's phoebe	Bird	Feeds and breeds	Needs cliffs or rimrock for nesting.
5	Vesper sparrow	Bird	Feeds and breeds	None noted
6	Western meadowlark	Bird	Feeds and breeds	None noted
7	Willet	Bird	Feeds and breeds	Requires wetlands for feeding and brood rearing, but can be several hundred meters away.
8	Bushy-tailed woodrat	Mammal	Feeds and breeds	None noted
9	California bighorn sheep	Mammal	Feeds and breeds	Uses this habitat if near steep, rugged terrain.
10	Canyon mouse	Mammal	Feeds and breeds	None noted
11	Deer mouse	Mammal	Feeds and breeds	None noted
12	Desert woodrat	Mammal	Feeds and breeds	None noted
13	Kit fox	Mammal	Feeds and breeds	None noted
14	Merriam's ground squirrel	Mammal	Feeds and breeds	None noted
15	Merriam's shrew	Mammal	Feeds and breeds	None noted
16	Northern grasshopper mouse	Mammal	Feeds and breeds	None noted
17	Nuttall's (mountain) cottontail	Mammal	Feeds and breeds	None noted
18	Ord's kangaroo rat	Mammal	Feeds and breeds	None noted
19	Pallid bat	Mammal	Feeds and breeds	Requires rock cliffs, caves or mines for breeding.
20	Piute ground squirrel	Mammal	Feeds and breeds	None noted
21	Pronghorn antelope	Mammal	Feeds and breeds	None noted
22	Sagebrush vole	Mammal	Feeds and breeds	None noted
23	Townsend's ground squirrel	Mammal	Feeds and breeds	None noted

Desert playa and salt scrub

	Species	Animal Class	Activity	Comments
1	American avocet	bird	Feeds and breeds	none noted
2	Black-necked stilt	bird	Feeds and breeds	none noted
3	Dunlin	bird	Feeds	none noted
4	Long-billed curlew	bird	Feeds and breeds	none noted
5	Long-billed dowitcher	bird	Feeds	none noted
6	Marbled godwit	bird	Feeds	none noted
7	Sage grouse	bird	Feeds and breeds	Desert playa, not the salt scrub shrublands, is the critical post brood-rearing habitat.
8	Snowy plover	bird	Feeds and breeds	none noted
9	Western sandpiper	bird	Feeds	none noted
10	Willet	bird	Feeds and breeds	none noted
11	Wilson's phalarope	bird	Feeds	none noted
12	Black-tailed jackrabbit	mammal	Feeds and breeds	none noted
13	Bushy-tailed woodrat	mammal	Feeds and breeds	none noted
14	Chisel-toothed kangaroo rat	mammal	Feeds and breeds	Closely associated with shadscale.
15	Dark kangaroo mouse	mammal	Feeds and breeds	none noted
16	Great basin pocket mouse	mammal	Feeds and breeds	none noted
17	Least chipmunk	mammal	Feeds and breeds	none noted
18	Little pocket mouse	mammal	Feeds and breeds	none noted
19	Nuttall's (mountain) cottontail	mammal	Feeds and breeds	none noted
20	Pallid bat	mammal	Feeds	none noted
21	Piute ground squirrel	mammal	Feeds and breeds	none noted
22	Pronghorn antelope	mammal	Feeds and breeds	none noted
23	Townsend's ground squirrel	mammal	Feeds and breeds	none noted
24	White-tailed antelope squirrel	mammal	Feeds and breeds	none noted
25	Long-nosed leopard lizard	reptile	Feeds and breeds	none noted
26	Night snake	reptile	Feeds and breeds	none noted
27	Western ground snake	reptile	Feeds and breeds	none noted

Agriculture and Pastures mixed environs

	Species	Animal Class	Activity	Comments
1	American Crow	bird	Feeds and Breeds	none noted
2	American Golden-Plover	bird	Feeds	Found in well-grazed coastal pastures.
3	American Pipit	bird	Feeds	Winter only.
4	American Widgeon	bird	Feeds and Breeds	Uses this habitat for nesting only where adjacent to wetlands.
5	Barn Owl	bird	Feeds and Breeds	Requires buildings, cliffs, caves, rimrock, or tree cavities for nesting.
6	Barn Swallow	bird	Feeds and Breeds	Can nest anywhere buildings, bridges, or overhanging cliffs occur in close proximity to water.
7	Black-bellied Plover	bird	Feeds	Found in well-grazed coastal pastures.
8	Black-billed Magpie	bird	Feeds and Breeds	none noted
9	Blue-winged Teal	bird	Feeds and Breeds	Uses this habitat for nesting only where adjacent to wetlands.
10	Bobolink	bird	Feeds and Breeds	none noted
11	Brewer's Blackbird	bird	Feeds and Breeds	none noted
12	Brown-headed Cowbird	bird	Feeds and Breeds	none noted
13	Buff-breasted Sandpiper	bird	Feeds	Closely grazed fields and plowed fields.
14	Canada Goose	bird	Feeds	none noted
15	Cattle Egret	bird	Feeds	none noted
16	Cinnamon Teal	bird	Feeds	none noted
17	Common Snipe	bird	Feeds and Breeds	Uses wet meadows.
18	Dunlin	bird	Feeds	Associated with water in this habitat; roosting.
19	European Starling	bird	Feeds and Breeds	none noted
20	Grasshopper Sparrow	bird	Feeds and Breeds	none noted
21	Gray Partridge	bird	Feeds and Breeds	Best habitats occur where extensive hedgerows and cereal grains are available.
22	Great Blue Heron	bird	Feeds	Critical overwintering habitat on the Westside.
23	Greater White-fronted Goose	bird	Feeds	none noted
24	House Finch	bird	Feeds and Breeds	none noted
25	House Sparrow	bird	Feeds and Breeds	none noted
26	Killdeer	bird	Feeds and Breeds	Also a critical wintering habitat.
27	Lazuli Bunting	bird	Feeds and Breeds	Closely associated with this habitat type only in western Oregon and Washington.
28	Loggerhead Shrike	bird	Feeds and Breeds	none noted
29	Long-billed Curlew	bird	Feeds and Breeds	Uses this habitat where adjacent to wetlands or irrigated areas.
30	Long-billed Dowitcher	bird	Feeds	none noted
31	Mourning Dove	bird	Feeds and Breeds	none noted
32	Northern Bobwhite	bird	Feeds and Breeds	Best habitats occur where extensive hedgerows are available.
33	Northern Shrike	bird	Feeds	none noted
34	Pacific Golden-Plover	bird	Feeds	Found in well-grazed coastal pastures.
35	Red-tailed Hawk	bird	Feeds and Breeds	none noted
36	Ring-necked Pheasant	bird	Feeds and Breeds	Best habitats occur where extensive hedgerows are available.
37	Rock Dove	bird	Feeds and Breeds	none noted
38	Ross's Goose	bird	Feeds	none noted
39	Sandhill Crane	bird	Feeds and Breeds	Also includes staging areas; must have roosting areas within the range.
40	Savannah Sparrow	bird	Feeds and Breeds	none noted
41	Short-eared Owl	bird	Feeds and Breeds	none noted
42	Snow Goose	bird	Feeds	none noted
43	Solitary Sandpiper	bird	Feeds	Occurs near bodies of water (creeks, small ponds, wetlands) in this habitat.
44	Swainson's Hawk	bird	Feeds and Breeds	none noted

	Species	Animal Class	Activity	Comments
45	Trumpeter Swan	bird	Feeds	Feeds in flooded fields.
46	Tundra Swan	bird	Feeds	Feeds in flooded fields.
47	Vesper Sparrow	bird	Feeds and Breeds	none noted
48	Western Meadowlark	bird	Feeds and Breeds	Closely associated with this habitat type on the Westside only.
49	Whimbrel	bird	Feeds	none noted
50	White-tailed Kite	bird	Feeds and Breeds	none noted
51	Willet	bird	Feeds and Breeds	Requires wetlands for feeding and brood rearing, but can be several hundred meters away.
52	Belding's Ground Squirrel	mammal	Feeds and Breeds	none noted
53	Big Brown Bat	mammal	Feeds and Breeds	Requires snags, caves, mines, rock crevices, buildings or bridges for breeding and roosting.
54	Botta's (Pistol River) Pocket Gopher	mammal	Feeds and Breeds	none noted
55	Brazilian Free-tailed Bat	mammal	Feeds and Breeds	Requires buildings for breeding.
56	Bushy-tailed Woodrat	mammal	Feeds and Breeds	none noted
57	California Vole	mammal	Feeds and Breeds	none noted
58	Camas Pocket Gopher	mammal	Feeds and Breeds	none noted
59	Deer Mouse	mammal	Feeds and Breeds	none noted
60	Eastern Fox Squirrel	mammal	Feeds and Breeds	none noted
61	European Rabbit	mammal	Feeds and Breeds	none noted
62	Gray-tailed Vole	mammal	Feeds and Breeds	none noted
63	House Mouse	mammal	Feeds and Breeds	none noted
64	Montane Vole	mammal	Feeds and Breeds	none noted
65	Northern Pocket Gopher	mammal	Feeds and Breeds	none noted
66	Raccoon	mammal	Feeds and Breeds	none noted
67	Virginia Opossum	mammal	Feeds and Breeds	none noted
68	White-tailed Deer (Eastside)	mammal	Feeds and Breeds	none noted

Herbaceous wetlands

	Species	Animal Class	Activity	Comments
1	Bullfrog	amphibian	Feeds and Breeds	Requires warm-water ponds, marshes, or river/stream backwaters for breeding.
2	Columbia Spotted Frog	amphibian	Feeds and Breeds	Rare or absent where predatory fish or bullfrogs occur. Requires shallow water in wet meadows or stream/pond edges with abundant aquatic vegetation for breeding.
3	Great Basin Spadefoot	amphibian	Feeds and Breeds	Requires ponds or temporary rain-filled depressions for breeding.
4	Long-toed Salamander	amphibian	Feeds and Breeds	Rare or absent where predatory fish are occur. Requires ponds, shallow lake edges, seasonal pools (like elk wallows) or slow streams for breeding.
5	Northern Leopard Frog	amphibian	Feeds and Breeds	Requires ponds or lake edges with dense aquatic and emergent vegetation for breeding.
6	Northwestern Salamander	amphibian	Feeds and Breeds	Requires ponds or stream backwaters for breeding.
7	Oregon Spotted Frog	amphibian	Feeds and Breeds	Rare or absent where predatory fish or bullfrogs occur. Requires shallow water in wet meadows or stream/pond edges with abundant aquatic vegetation for breeding.
8	Pacific Chorus (Tree) Frog	amphibian	Feeds and Breeds	Requires ponds, seasonal pools, temporary rain-filled depressions or slow streams for breeding.
9	Red-legged Frog	amphibian	Feeds and Breeds	Requires cool-water ponds, lake edges or slow streams for breeding.
10	Rough-skinned Newt	amphibian	Feeds and Breeds	Requires ponds or stream backwaters with abundant aquatic vegetation for breeding.
11	Tiger Salamander	amphibian	Feeds and Breeds	Rare or absent where predatory fish occur. Requires warm ponds or shallow lake edges for breeding.
12	Western Toad	amphibian	Feeds and Breeds	Requires ponds or shallow lake edges for breeding.
13	Woodhouse's Toad	amphibian	Feeds and Breeds	Requires warm, shallow water in ponds, lakes, or slow streams for breeding.
14	American Avocet	bird	Feeds and Breeds	none noted
15	American Bittern	bird	Feeds and Breeds	none noted
16	American Black Duck	bird	Feeds and Breeds	none noted
17	American Coot	bird	Feeds and Breeds	none noted
18	American Widgeon	bird	Feeds and Breeds	none noted
19	Baird's Sandpiper	bird	Feeds	none noted
20	Barn Swallow	bird	Feeds	Can nest anywhere buildings, bridges, or overhanging cliffs occur in close proximity to water.
21	Black Tern	bird	Feeds and Breeds	none noted
22	Black-crowned Night-heron	bird	Feeds	Requires shrubs or trees for nesting.
23	Black-necked Stilt	bird	Feeds and Breeds	none noted
24	Blue-winged Teal	bird	Feeds and Breeds	none noted
25	Bufflehead	bird	Feeds	Nests in tree cavities near ponds or lakes.
26	Canada Goose	bird	Feeds and Breeds	none noted
27	Canvasback	bird	Feeds and Breeds	none noted
28	Caspian Tern	bird	Feeds	none noted
29	Cattle Egret	bird	Feeds	Requires shrubs or trees for nesting.
30	Cinnamon Teal	bird	Feeds and Breeds	none noted
31	Clark's Grebe	bird	Feeds and Breeds	Nests placed on a floating platform of fresh and decaying vegetation in shallow water.
32	Common Loon	bird	Feeds and Breeds	Nests in emergent vegetation at lake edges. No nesting confirmed in Oregon.
33	Common Snipe	bird	Feeds and Breeds	none noted
34	Common Yellowthroat	bird	Feeds and Breeds	none noted

	Species	Animal Class	Activity	Comments
35	Dunlin	bird	Feeds	none noted
36	Eared Grebe	bird	Feeds and Breeds	Nests placed on a floating platform of fresh and decaying vegetation in shallow water.
37	Forster's Tern	bird	Feeds and Breeds	none noted
38	Franklin's Gull	bird	Feeds and Breeds	Breeds at Malheur Lake, Oregon.
39	Gadwall	bird	Feeds and Breeds	none noted
40	Great Blue Heron	bird	Feeds	Requires trees for nesting.
41	Great Egret	bird	Feeds	Requires tall shrubs or trees for nesting.
42	Greater White-fronted Goose	bird	Feeds	none noted
43	Greater Yellowlegs	bird	Feeds	Has bred at least four times at Downy Lake, Wallowa County, Oregon.
44	Green Heron	bird	Feeds	Requires shrubs or trees for nesting.
45	Green-winged Teal	bird	Feeds and Breeds	none noted
46	Horned Grebe	bird	Feeds and Breeds	Nests placed on a floating platform of fresh and decaying vegetation in shallow water.
47	Least Bittern	bird	Feeds and Breeds	Rare breeder in Oregon; does not occur in Washington.
48	Least Sandpiper	bird	Feeds	none noted
49	Lesser Scaup	bird	Feeds and Breeds	none noted
50	Lesser Yellowlegs	bird	Feeds	none noted
51	Lincoln's Sparrow	bird	Feeds and Breeds	none noted
52	Long-billed Dowitcher	bird	Feeds	none noted
53	Mallard	bird	Feeds and Breeds	none noted
54	Marsh Wren	bird	Feeds and Breeds	none noted
55	Mute Swan	bird	Feeds and Breeds	This is an introduced species which breeds only in urban wetlands.
56	Northern Pintail	bird	Feeds and Breeds	none noted
57	Northern Rough-winged Swallow	bird	Feeds	Requires burrows in dirt banks, usually next to water, for nesting.
58	Northern Shoveler	bird	Feeds and Breeds	none noted
59	Pectoral Sandpiper	bird	Feeds	none noted
60	Pied-billed Grebe	bird	Feeds and Breeds	Nests placed on a floating platform of fresh and decaying vegetation in shallow water.
61	Redhead	bird	Feeds and Breeds	none noted
62	Red-necked Grebe	bird	Feeds and Breeds	Nests placed on a floating platform of fresh and decaying vegetation in shallow water.
63	Red-winged Blackbird	bird	Feeds and Breeds	none noted
64	Ross's Goose	bird	Feeds	none noted
65	Ruddy Duck	bird	Feeds and Breeds	none noted
66	Sandhill Crane	bird	Feeds and Breeds	none noted
67	Short-eared Owl	bird	Feeds and Breeds	none noted
68	Snow Goose	bird	Feeds	none noted
69	Snowy Egret	bird	Feeds	Requires tall shrubs or trees for nesting.
70	Solitary Sandpiper	bird	Feeds	none noted
71	Sora	bird	Feeds and Breeds	none noted
72	Swamp Sparrow	bird	Feeds	none noted
73	Tree Swallow	bird	Feeds	Requires snags not far from open water for nesting.
74	Tricolored Blackbird	bird	Feeds and Breeds	none noted
75	Trumpeter Swan	bird	Feeds and Breeds	none noted
76	Tundra Swan	bird	Feeds	none noted
77	Virginia Rail	bird	Feeds and Breeds	none noted
78	Western Grebe	bird	Feeds and Breeds	Nests placed on a floating platform of fresh and decaying vegetation in shallow water.
79	Western Sandpiper	bird	Feeds	none noted
80	White-faced Ibis	bird	Feeds and Breeds	none noted
81	Willet	bird	Feeds and Breeds	none noted

	Species	Animal Class	Activity	Comments
82	Wilson's Phalarope	bird	Feeds and Breeds	none noted
83	Yellow Rail	bird	Feeds and Breeds	none noted
84	Yellow-headed Blackbird	bird	Feeds and Breeds	none noted
85	American Beaver	mammal	Feeds and Breeds	none noted
86	Deer Mouse	mammal	Feeds and Breeds	none noted
87	Long-tailed Vole	mammal	Feeds and Breeds	none noted
88	Meadow Vole	mammal	Feeds and Breeds	none noted
89	Mink	mammal	Feeds	none noted
90	Montane Vole	mammal	Feeds and Breeds	none noted
91	Moose	mammal	Feeds	none noted
92	Muskrat	mammal	Feeds and Breeds	none noted
93	Northern Bog Lemming	mammal	Feeds and Breeds	Cold, wet bogs above 5000 feet.
94	Northern River Otter	mammal	Feeds and Breeds	none noted
95	Nutria	mammal	Feeds and Breeds	none noted
96	Pallid Bat	mammal	Feeds	none noted
97	Raccoon	mammal	Feeds	none noted
98	Townsend's Vole	mammal	Feeds and Breeds	none noted
99	Western Harvest Mouse	mammal	Feeds and Breeds	none noted
100	Yuma Myotis	mammal	Feeds	none noted
101	Common Garter Snake	reptile	Feeds and Breeds	none noted
102	Painted Turtle	reptile	Feeds	none noted
103	Red-eared Slider Turtle	reptile	Feeds	none noted
104	Snapping Turtle	reptile	Feeds	none noted
105	Western Pond Turtle	reptile	Feeds	none noted

Montane coniferous wetlands

	Species	Animal class	Activity	Comments
1	Common garter snake	Reptile	Feeds and breeds	None noted
2	Northwestern salamander	Amphibian	Feeds and breeds	Requires ponds or stream backwaters for breeding.
3	Long-toed salamander	Amphibian	Feeds and breeds	Rare or absent where predatory fish are occur. Requires ponds, shallow lake edges, seasonal pools (like elk wallows) or slow streams for breeding.
4	Rough-skinned newt	Amphibian	Feeds and breeds	Requires ponds or stream backwaters with abundant aquatic vegetation for breeding.
5	Western toad	Amphibian	Feeds and breeds	None noted
6	Pacific chorus (tree) frog	Amphibian	Feeds and breeds	Requires ponds, seasonal pools, temporary rain-filled depressions or slow streams for breeding.
7	Bufflehead	Bird	Feeds and breeds	Nests in tree cavities.
8	Evening grosbeak	Bird	Feeds and breeds	None noted
9	Water shrew	Mammal	Feeds and breeds	Lead a semi-aquatic life and require cold, clear water in small streams or ponds with abundant cover in the form of rocks, overhanging banks, etc.
10	Yuma myotis	Mammal	Feeds and breeds	More closely associated with water than other bat species. Uses caves, mines, loose bark and bark crevices typically close to water.
11	Big brown bat	Mammal	Feeds and breeds	Requires snags, caves, mines, rock crevices, or bridges for breeding and roosting.
12	Snowshoe hare	Mammal	Feeds and breeds	None noted
13	Deer mouse	Mammal	Feeds and breeds	None noted
14	Southern red-backed vole	Mammal	Feeds and breeds	None noted
15	Long-tailed vole	Mammal	Feeds and breeds	None noted
16	Water vole	Mammal	Feeds and breeds	None noted
17	Pacific jumping mouse	Mammal	Feeds and breeds	None noted

Eastside (Interior) Riparian Wetlands

	Species	Animal class	Activity	Comments
1	Bullfrog	Amphibian	Feeds and breeds	Requires warm-water ponds, marshes, or river/stream backwaters for breeding.
2	Columbia spotted frog	Amphibian	Feeds and breeds	Rare or absent where predatory fish or bullfrogs occur. Requires shallow water in wet meadows or stream/pond edges with abundant aquatic vegetation for breeding.
3	Great basin spadefoot	Amphibian	Feeds and breeds	Requires ponds or temporary rain-filled depressions for breeding.
4	Long-toed salamander	Amphibian	Feeds and breeds	Rare or absent where predatory fish are occur. Requires ponds, shallow lake edges, seasonal pools (like elk wallows) or slow streams for breeding.
5	Northern leopard frog	Amphibian	Feeds and breeds	Requires ponds or lake edges with dense aquatic and emergent vegetation for breeding.
6	Pacific chorus (tree) frog	Amphibian	Feeds and breeds	Requires ponds, seasonal pools, temporary rain-filled depressions or slow streams for breeding.
7	Tailed frog	Amphibian	Feeds and breeds	Requires clear, cold steep-gradient streams for breeding.
8	Tiger salamander	Amphibian	Feeds and breeds	Rare or absent where predatory fish occur. Requires warm ponds or shallow lake edges for breeding.
9	Western toad	Amphibian	Feeds and breeds	None noted
10	Woodhouse's toad	Amphibian	Feeds and breeds	Requires warm, shallow water in ponds, lakes, or slow streams for breeding.
11	American black duck	Bird	Feeds and breeds	None noted
12	American dipper	Bird	Feeds and breeds	None noted
13	American redstart	Bird	Feeds and breeds	None noted
14	Bank swallow	Bird	Feeds and breeds	Requires burrows in dirt banks, usually next to water, for nesting.
15	Barn swallow	Bird	Feeds and breeds	Can nest anywhere buildings, bridges, or overhanging cliffs occur in close proximity to water.
16	Belted kingfisher	Bird	Feeds and breeds	None noted
17	Black-billed magpie	Bird	Feeds and breeds	None noted
18	Black-crowned night-heron	Bird	Feeds and breeds	Occur in wide bottomlands, not narrow canyons.
19	Blue grouse	Bird	Feeds and breeds	None noted
20	Bullock's oriole	Bird	Feeds and breeds	None noted
21	Cedar waxwing	Bird	Feeds and breeds	None noted
22	Cliff swallow	Bird	Feeds and breeds	Can nest anywhere rimrock, overhanging cliffs, buildings or bridges occur in close proximity to water.
23	Common merganser	Bird	Feeds and breeds	Nests in tree cavities near large lakes or rivers.
24	Common yellowthroat	Bird	Feeds and breeds	None noted
25	Cordilleran flycatcher	Bird	Feeds and breeds	None noted
26	Double-crested cormorant	Bird	Feeds and breeds	None noted
27	European starling	Bird	Feeds and breeds	Requires snags or trees with cavities or buildings with crevices for nesting. Most likely to use this habitat where adjacent to agriculture or urban habitats.
28	Fox sparrow	Bird	Feeds and breeds	None noted
29	Gray catbird	Bird	Feeds and breeds	None noted
30	Great blue heron	Bird	Feeds and breeds	None noted
31	Great egret	Bird	Feeds and breeds	More common in broad flood plains; does not occur in narrow riparian corridors as a breeder.
32	Harlequin duck	Bird	Feeds and breeds	None noted
33	Hooded merganser	Bird	Feeds and breeds	Nests in tree cavities.
34	Lazuli bunting	Bird	Feeds and breeds	None noted
35	Lincoln's sparrow	Bird	Feeds and breeds	None noted
36	Long-eared owl	Bird	Feeds and breeds	Typically nests in the abandoned nests of other corvids, raptors or squirrels.

	Species	Animal class	Activity	Comments
37	Mallard	Bird	Feeds and breeds	None noted
38	Mourning dove	Bird	Feeds and breeds	None noted
39	Northern rough-winged swallow	Bird	Feeds and breeds	Requires burrows in dirt banks, usually next to water, for nesting.
40	Northern waterthrush	Bird	Feeds and breeds	None noted
41	Pygmy nuthatch	Bird	Feeds and breeds	Uses this habitat where ponderosa pine occurs.
42	Red-eyed vireo	Bird	Feeds and breeds	Range of red-eyed vireo overlaps that of large black cottonwood groves.
43	Red-naped sapsucker	Bird	Feeds and breeds	None noted
44	Ring-necked pheasant	Bird	Feeds and breeds	None noted
45	Ruffed grouse	Bird	Feeds and breeds	None noted
46	Sharp-tailed grouse	Bird	Feeds	In Oregon this was historically very important overwintering habitat.
47	Snowy egret	Bird	Feeds and breeds	Requires tall shrubs or trees for nesting.
48	Solitary sandpiper	Bird	Feeds	None noted
49	Spotted sandpiper	Bird	Feeds and breeds	None noted
50	Tree swallow	Bird	Feeds and breeds	Requires snags not far from open water for nesting.
51	Veery	Bird	Feeds and breeds	None noted
52	Warbling vireo	Bird	Feeds and breeds	None noted
53	Western screech-owl	Bird	Feeds and breeds	None noted
54	Willow flycatcher	Bird	Feeds and breeds	None noted
55	Wood duck	Bird	Feeds and breeds	Nests in tree cavities.
56	Yellow warbler	Bird	Feeds and breeds	None noted
57	Yellow-billed cuckoo	Bird	Feeds and breeds	Not known from eastside Washington (even historically); in Oregon species may still occur in a few scattered locations.
58	Yellow-breasted chat	Bird	Feeds and breeds	None noted
59	American beaver	Mammal	Feeds and breeds	None noted
60	Big brown bat	Mammal	Feeds and breeds	Requires snags, caves, mines, rock crevices, or bridges for breeding and roosting.
61	Bushy-tailed woodrat	Mammal	Feeds and breeds	None noted
62	Deer mouse	Mammal	Feeds and breeds	None noted
63	Long-legged myotis	Mammal	Feeds and breeds	Uses caves or mines as hibernacula. Uses hollow trees, loose bark or rock crevices for maternity colonies.
64	Long-tailed vole	Mammal	Feeds and breeds	None noted
65	Meadow vole	Mammal	Feeds and breeds	None noted
66	Mink	Mammal	Feeds and breeds	None noted
67	Muskrat	Mammal	Feeds and breeds	None noted
68	Northern river otter	Mammal	Feeds and breeds	None noted
69	Pacific jumping mouse	Mammal	Feeds and breeds	None noted
70	Pallid bat	Mammal	Feeds and breeds	Requires rock cliffs, caves or mines for breeding.
71	Raccoon	Mammal	Feeds and breeds	None noted
72	Snowshoe hare	Mammal	Feeds and breeds	None noted
73	Southern red-backed vole	Mammal	Feeds and breeds	None noted
74	Water shrew	Mammal	Feeds and breeds	Lead a semi-aquatic life and require cold, clear water in small streams or ponds with abundant cover in the form of rocks, overhanging banks, etc.
75	Water vole	Mammal	Feeds and breeds	None noted
76	Western harvest mouse	Mammal	Feeds and breeds	None noted
77	Western jumping mouse	Mammal	Feeds and breeds	None noted
78	Western pipistrelle	Mammal	Feeds and breeds	Requires cliffs, rimrock, caves or mines for breeding and roosting.
79	Western small-footed myotis	Mammal	Feeds and breeds	Requires cliffs, rimrock, boulders, or talus for breeding.
80	White-tailed deer (eastside)	Mammal	Feeds and breeds	None noted
81	Yuma myotis	Mammal	Feeds and breeds	More closely associated with water than other bat species. Uses caves, mines, loose bark and bark crevices typically close to water.

Appendix F - Introduced Fish Species in the Columbia Basin

Introduced fish species, approximate time of introduction, and present status (ISAB 2008)

Year*	Species	Present status
1880s		
1876	American shad, *Alosa sapidissima*	Established
1881	Common carp, *Cyprinus carpio*	Established and stocked
1883	Brown bullhead, *Ameiurus nebulosus*	Established and stocked
1885	Tench, *Tinca tinca*	Established
1890	Largemouth bass, *Micropterus salmoides*	Established and stocked
1890	White crappie, *Pomoxis annularis*	Not established from the introduction
1890	Green sunfish, *Lepomis cyanellus*	Established
1890	Grass pickerel, *Esox americanus vermiculatus*	Established
1890	Bluegill, *Lepomis macrochirus*	Established and stocked
1892	Warmouth, *Lepomis gulosus*	Established
1892	Channel catfish, *Ictalurus punctatus*	Established
1893	Pumpkinseed, *Lepomis gibbosus*	Established
1893	Black crappie, *Pomoxis nigromaculatus*	Established
1893	Rock bass, *Ambloplites rupestris*	Established
1893	Yellow perch, *Perca flavescens*	Established
1894	Brook trout, *Salvelinus fontinalis*	Established
1895	Yellowstone cutthroat trout, *Onchorhynchus clarki lewisi*	Stocked
1899	Lake whitefish, *Coregonus clupeaformis*	Established
1900s-1920s		
1900	Lake trout, *Salvelinus namaycush*	Established
1905	Yellow bullhead, *Ameiurus natalis*	Established
1905	Black bullhead, *Ameiurus melas*	Established
1920	Rainbow trout, *Oncorhynchus mykiss*	Established
1923	Brown trout, *Salmo trutta*	Established
1924	Smallmouth bass *Micropterus dolomieui*	Established
1930s-1960s		
1936	Golden trout, *Oncorhynchus aquabonita*	Established
1936	Striped Bass, *Morone saxatilis*	Established
1942	Goldfish, *Carrasius auratus*	Established
1945?	Arctic grayling, *Thymallus arcticus*	Established
1950s	Walleye, *Stizostedion vitreum vitreum*	Established
1968	Lahontan cutthroat trout, *Oncorhynchus clarki henshawi*	Stocked
1970s-1980s		
1970	Northern pike, *Esox lucius*	Established
1970	Mosquitofish, *Gambusia affinis*	Established
1972	Tadpole madtom, *Noturus gyrinus*	Established
1975?	Flathead catfish, *Pylodictis olivaris*	Established
1988	Tiger muskellunge, *Esox lucius X Esox masquinongy*	Stocked
1990s-2000		
1990s	Grass carp, *Ctenopharyngodon idella*	Stocked
1990s	Banded killifish, *Fundulus diaphanus*	Established
1990s	Brook stickleback, *Culaea inconstans*	Established

1996	Atlantic salmon, *Salmo salar*	Unknown
1990s	Golden shiner, *Notemigonus crysoleucas*	Established
1990s	Fathead minnow, *Pimephales promelas*	Established
1997?	Oriental weatherfish, *Misgurnus anguillicaudatus*	Established

*This timing column is specific to Washington State but is presented as representative of the entire Columbia Basin

BONNEVILLE POWER ADMINISTRATION
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