United States Department of Agriculture

US Forest Service

March 2019

Upper Sandy River Watershed Restoration Action Plan

Mt. Hood National Forest
Zigzag Ranger District

Upper Sandy River Watershed Restoration Action Plan

Prepared by
Olivia Guthrie, U.S.D.A. Forest Service
Catherine Dillon, U.S.D.A. Forest Service
Nicholas Floyd, U.S.D.A. Forest Service
Greg Wanner, U.S.D.A. Forest Service

Reviewed by
Bill Westbrook, U.S.D.A. Forest Service
Todd Parker, U.S.D.A. Forest Service

Developed from
Upper Sandy Watershed Analysis
Sandy River Basin Workgroup Products:
Anchor Habitat Assessment and Aquatic Habitat Restoration Strategy

March 2019

Mt. Hood National Forest
Zigzag Ranger District
Zigzag, Oregon

Reviewed and Approved by: _____ Date: 3/6/19

Richard Periman
Forest Supervisor
Mt. Hood National Forest

Executive Summary

Restoration of the Sandy River basin is a high priority for federal, state, and local government agencies, as well as various non-profit organizations. In 2004, a collaborative stakeholder group known as the Sandy River Basin Working Group (SRBWG is a core group of the Sandy River Basin Partners[1]) convened to identify disproportionally important habitat (anchor habitat) within the Sandy River basin that is important for the persistence and restoration of federally listed salmon and steelhead populations. Many of the partners in the SRBWG had already been working together through the 1999 Sandy River Basin Agreement. The effort to identify anchor habitat resulted in the publication of "Salmon and Steelhead Conservation: An assessment of anchor habitat on the Sandy River, Oregon" published by Oregon Trout (SRBWG 2006). The Upper Sandy 6th field watershed, including the Sandy River, Lost Creek, Clear Fork and Muddy Fork was rated as one of the highest priority subwatershed in the Sandy River basin for recovery of wild stocks of threatened Chinook salmon, coho salmon, and winter steelhead by the interagency Sandy River Basin Partners. Restoration in the Still Creek watershed, another high priority subwatershed, will be successfully completed in 2019 by a collaborative effort within the Sandy River Basin Partners.

The Sandy River basin anchor habitat process is fundamental in focusing restoration efforts of several of the major contributors to salmonid recovery in the Sandy River basin. Multiple entities spend over $2 million in the basin annually to restore aquatic habitat. While independent jurisdictions have prioritization schemes to guide investments in restoration activities, no single, comprehensive basin-wide strategy had been developed. These expenditures, for the most part, were made on a project-by-project, site-by-site basis by each responsible entity without coordination of the timing, sequencing, priority, and geographic focus of other participating entities. With the anchor habitat work as a foundation, the Sandy River Aquatic Habitat Restoration Strategy was published (SRBWG 2007). Participating entities could now coordinate future investments in aquatic habitat restoration in a manner that leveraged limited resources where they provide the greatest benefits to the long-term recovery and healthy functioning habitat in the basin.

The Upper Sandy River Watershed Restoration Action Plan (WRAP) is an update to the 2007 Sandy River Basin Aquatic Habitat Restoration Strategy (SRBWG 2007) under the guidance of the national 2010 Watershed Condition Framework (WCF) (USDA 2010) – a comprehensive approach for proactively implementing integrated restoration in priority watersheds on national forests and grasslands. The WCF is comparable to the Sandy River Basin Aquatic Habitat Restoration Strategy in that it contains similar prioritization, identification of integrated suites of activities to improve watershed condition, and tracking of progress. The 2007 Sandy River restoration strategy and this WRAP provide greater detail to the 1996 Upper Sandy Watershed Analysis (which includes the Upper Sandy 6th field watershed) by presenting a specific list of projects, timelines, and costs that restoration specialists, decision makers, and grant writers may use in promoting an interagency approach to improving aquatic resources in the Upper Sandy watershed (UDSA 1996). This Upper Sandy River WRAP adjusts, updates, and adds essential projects to improve the subwatershed condition class, which addresses an outcome-based performance measure of progress toward restoring the productivity and resilience of the Upper Sandy watershed.

[1] Sandy River Basin Partners (SRBP) include: Clackamas County, Columbia Land Trust, METRO, Multonomah County, National Marine Fisheries Service, The Nature Conservancy, Northwest Steelheaders, Oregon Department of Fish and Wildlife, Portland Water Bureau, Sandy River Basin Watershed Council, The Freshwater Trust, USDA, Mt. Hood National Forest, USDI, Bureau of Land Management, and Western Rivers Conservancy.

The goal of the Upper Sandy River WRAP is to provide an operational scale tool for restoring the watershed by strategically focusing investments in essential watershed improvement projects and conservation practices at the 6th field watershed scale that tiers to the larger Sandy River Basin Restoration Strategy, which all the Sandy River Basin Partners are heavily invested in. Working with our partners, implementation of the WRAP will strategically invest nearly 4.1 million dollars in the Upper Sandy watershed over the next five years. This investment is designed to accelerate the recovery of naturally functioning conditions within stream channels and riparian areas to restore production of juvenile and adult coho salmon, spring Chinook salmon, winter steelhead, cutthroat trout, and pacific lamprey, among other native aquatic species. The series of projects proposed as "Essential Projects" are intended to accomplish these goals by restoring riparian health and vigor by restoring floodplain resiliency with coarse woody debris and large wood floodplain structures designed to protect recovering pioneer riparian vegetation during peak flow events. Stream channels and aquatic habitat will be rehabilitated by installing large wood structures in specific locations along Lost Creek, Cast Creek, Clear Fork and their tributaries that would give the most benefit to increasing aquatic habitat diversity and resiliency. A rapid response approach will be used to remove invasive plants that are now attempting to get established. Addressing under-sized culverts will reduce road-related sediment from entering the streams. Implementation of these prioritized actions will have the following outcomes and performance based accomplishments:

- Restore natural watershed processes, including riparian function, in-channel habitat, reduce road related impacts, and eradication of invasive plants to recover/improve production of ESA listed salmon and steelhead.
- Both passive and active management of these aquatic-riparian systems to restore the dynamics of aquatic-riparian ecosystems and manage for resilience.
- Improve water quality in the Upper Sandy River watershed by improving riparian forest health through additional shading to surface waters and through a reduction in sediment delivery from road-related impacts.
- Manage National Forest System (NFS) lands to protect, restore, and maintain water quality so that Federal and State water quality goals and water quality standards are met or exceeded in accordance with applicable laws and regulations.
- Provide educational engagement opportunities for local private landowners, the local community and the general public to learn about watershed restoration.
- Provide jobs to local contractors, material suppliers, and the sport fishing industry.
- Maintain and strengthen partnership between the Mt. Hood National Forest, the coalition of Sandy River Basin Partners, and private landowners.

Partners within the Sandy River basin fully support these proposed essential projects and are working with the Mt. Hood National Forest to achieve these outcomes to promote watershed recovery of the entire basin.

Contents

Background

The Sandy River basin is located on the western slopes of the Cascade mountain range of north-central Oregon, just east of the Portland metropolitan area. Originating on Mt. Hood, Oregon's tallest mountain at 11,239 feet, the Sandy River flows west and then north for 56 miles, entering the Columbia River near the City of Troutdale. The river and its tributaries drain an area of 325,000 acres (508 square miles). Portions of the cities of Gresham, Troutdale and Sandy occupy part of the basin, as do the communities of Brightwood, Welches, Wemme, Rhododendron, Zigzag, and Government Camp.

The Sandy River basin contains several species of native salmon and steelhead, all of which are federally listed under the Endangered Species Act. Despite its proximity to a major concentration of human development, most of the Sandy River's headwaters are protected by federally designated wilderness areas, congressionally reserved areas, or congressionally designated wild and scenic river corridors. The Salmon River, Little Sandy River, Still Creek, Cedar Creek, Gordon Creek, Bull Run River, and Zigzag River are all major tributaries to the Sandy River. Roughly 73 percent of the basins area is in federal management, 25 percent in private ownership (including industrial lands for commercial timber management), and two percent in state, city, and county ownership (USDA and USDI 1994). The Sandy River is a 4th field watershed and is divided into six 5th field watersheds. The 5th field watersheds include: the Lower Sandy River, Middle Sandy River, Upper Sandy River, Bull Run River, Zigzag River, and Salmon River.

The Sandy River basin supports several species of anadromous salmonids, including spring and fall Chinook (*Oncorhynchus tshawytscha*), coho (*Oncorhynchus kisutch*), and winter steelhead (*Oncorhynchus mykiss*). These salmon and steelhead populations, which historically numbered in the tens of thousands, have experienced significant declines during the last century (Taylor 1998). Within the last decade, the federal government and state of Oregon have listed all of these populations for protection under the state or federal Endangered Species Act (ESA).

Restoration of abundant salmon and steelhead populations and the habitat that supports them is a high priority for federal, state, and local government agencies, as well as various nonprofit organizations. In January of 2004, a collaborative stakeholder group now known as the Sandy River Basin Working Group (SRBWG) convened to identify anchor habitat within the Sandy River basin that is significant for the persistence and restoration of salmon and steelhead populations. Many of the partners had already been working together through the 1999 Sandy River Basin Agreement. In 2004, the SRBWG gathered during a series of meetings and workshops to evaluate the basin and identify key reaches of habitat. This identification would form the foundation of a technically sound strategy for restoring salmon and steelhead habitat based on the best technical information available and professional judgment. This effort resulted in the publication of the "Salmon and Steelhead Conservation: An assessment of anchor habitat on the Sandy River, Oregon" published by Oregon Trout (SRBWG 2006).

The anadromous fish restoration strategy developed by the SRBWG focused on the remaining, relatively intact riverine habitat in the Sandy River basin that currently supports a disproportionate share of wild salmon and steelhead. This approach to restoration has been termed a habitat-based approach, a "refugia" approach, or an anchor habitat approach. These terms are synonymous. Anchor habitat is defined as "*distinct stream reaches that currently harbor specific life history stages of salmon and steelhead to a greater extent than the stream system at large*" (SRBWG 2006). The SRGWB crafted the anchor habitat definition from a survey of existing prioritizations and previous anchor habitat work. These areas of habitat are identified by the actual distribution of fish and can be crucial for their

persistence during periods of environmental adversity. Restoration priorities should begin with identifying centers of productivity and downstream habitats that are critical for maintaining existing populations and life histories of key species (Frissell 1994, 1998).

The Sandy River basin anchor habitat process exists to coordinate and focus restoration efforts of several of the major contributors to salmonid recovery in the Sandy River basin. According to conservative estimates, multiple entities and jurisdictions spend over $2 million in the basin, on average, to restore aquatic habitat conditions for salmon and steelhead. While independent jurisdictions have prioritization schemes to guide investments in restoration activities, no single, comprehensive basin-wide strategy had been developed. These expenditures, for the most part, had been made on a project-by-project, site-by-site basis by each responsible entity without coordination of the timing, sequencing, priority, and geographic focus of actions based on species' needs or actions of other participating entities. With the completion of the Sandy River Aquatic Habitat Restoration Strategy, participating entities could now coordinate future investments in aquatic habitat restoration in a manner that leverages limited resources where they provide the greatest benefits to the long-term recovery and healthy functioning of salmon and steelhead habitat in the basin (SRBWG 2007).

Agencies and organizations that fund aquatic habitat restoration activities often require an overall basin-wide strategy that is closely linked to a comprehensive assessment. These funding entities also require partnerships, cost-leveraging, and demonstrable on-the-ground results. At a broad state-wide or regional scale, many of the funding agencies and organizations are developing their own policies and criteria to focus aquatic habitat restoration investments where there is a demonstrated need, articulated priorities, and clear restoration benefit. Funding for aquatic habitat restoration actions has become increasingly scarce and highly competitive in recent years, especially within public land management agencies. As a result, there has been a greater emphasis placed on funding high priority restoration actions in priority basins at the state-wide and regional scales. This shift is occurring for three reasons: 1) to demonstrate accountability and accomplish high priority restoration actions for whole watersheds in priority basins, 2) to focus available funding in a partnering and cost-leveraging manner, and 3) to achieve tangible, aggregated restoration benefits where they are most needed for rebuilding salmon and steelhead populations at the watershed-scale as opposed to a "shotgun approach" where many different restoration actions are implemented over a broad landscape making it difficult to detect a restoration benefit. With this paradigm shift occurring and a recognized need for a more cohesive, comprehensive, and collaborative approach that builds upon the breadth and diversity of existing partnerships, all of the participating entities in the basin readily supported the development of such a strategy for the Sandy River basin.

Specifically, the Sandy River Aquatic Habitat Restoration Strategy:

- Identifies priority watersheds in the basin (at the 5th, 6th, and 7th field scales) that provide the cornerstones for addressing freshwater habitat restoration needs of Sandy River basin salmon and steelhead populations.
- Establishes the hierarchy, or sequence, in which actions should be pursued in order to achieve maximum resource benefits.
- Describes the factors limiting salmon and steelhead abundance, productivity, spatial distribution, and diversity. Many of these factors also limit water quality.
- Defines specific restoration actions (and types of restoration actions where they are not known site-specifically) in priority watersheds necessary to address limiting factors.

The Collaborative Partners of the Sandy River Basin

Several species of salmon and steelhead have been listed as threatened under the Endangered Species Act (ESA) in the Sandy River basin since the late 1990s. The ESA listings spurred an effort in 1999 to bring entities in the basin together in a collaborative manner to work toward salmon and steelhead recovery. The original group was founded by six of today's 14 partners: The City of Portland, Portland General Electric (PGE), National Marine Fisheries Service (NMFS), Oregon Department of Fish and Wildlife (ODFW), U.S. Fish and Wildlife Service (USFWS), and U.S. Forest Service (USFS). Several other entities joined the effort and collectively completed several significant accomplishments furthering conservation and recovery efforts for salmon and steelhead populations in the basin. In chronology, these accomplishments include:

- Multi-party negotiations, which began in the late 1990s, led to a 2002 settlement agreement for PGE's decommissioning of the Marmot and Little Sandy dams in 2007 and 2008, respectively (PGE 2002a and PGE 2002b).
- In 2001, ODFW revised the Sandy Basin Fish Management Plan. The plan revision established changes in hatchery practices and fish harvest that met the requirements of the Federal Energy Regulatory Commission (FERC) (ODFW 2001).
- In 2004, a basin-wide salmon and steelhead habitat assessment was completed, by a group of local fisheries biologists known as the Sandy Tech Team, using the Ecosystem Diagnosis and Treatment modal (EDT) (City of Portland 2004).
- In 2004, the City of Portland's Water Bureau's municipal water supply operations in the Bull Run River watershed were brought into compliance under Section 10 of the ESA (SRBP 2004).
- The Sandy River Basin Total Maximum Daily Load Assessment was completed by the Oregon Department of Environmental Quality in 2005 (ODEQ 2005).
- In 2006, the Sandy River Basin Anchor Habitat Assessment for Salmon and Steelhead Populations was completed by the SRBWG in coordination with the Sandy River Basin Partners. The assessment identified the most important segments of rivers and streams within the basin for the restoration of salmon and steelhead populations (SRBWG 2006).
- Based on the anchor habitat assessment, the Sandy River Basin Aquatic Habitat Restoration Strategy was completed in 2007. Concurrent Watershed Restoration Action Plans (WRAP) are derived from this foundation as well (SRBWG 2006, 2007, USDA 2011).
- In 2011, the Still Creek Watershed Restoration Action Plan was completed as an update to the 2007 Sandy River Basin Aquatic Habitat Restoration Strategy under the guidance of the 2010 Watershed Condition Framework (WCF). The WCF is a comprehensive approach for proactively implementing integrated restoration in priority watersheds on national forests and grasslands. The WCF is comparable to the Sandy River Basin Aquatic Habitat Restoration Strategy in that it contains similar prioritization and identification of integrated suites of activities to improve watershed condition, and tracking of progress (USDA 2010). The Still Creek WRAP provided an operational scale tool for restoring the watershed by strategically focusing investments in essential watershed improvement projects and conservation practices at the 6th field watershed scale that tiers to the larger Sandy River basin restoration strategy. Implementation of the Still Creek restoration occurred between 2012 and 2017 (USDA 2011).

The following organization contributed to the development of the Sandy River Aquatic Habitat Restoration Strategy: Association of Northwest Steelheaders, Sandy Chapter, Bureau of Land Management (BLM), Salem District, City of Portland Water Bureau, Clackamas County Department of Transportation and Development, East Multnomah County Soil and Water Conservation District,

National Marine Fisheries Service, Oregon Department of Fish and Wildlife (ODFW), North Willamette Region, The Freshwater Trust (formally Oregon Trout), Sandy River Watershed Council, The Nature Conservancy, U.S. Fish and Wildlife Service (USFWS), and Mt. Hood National Forest.

Current Effort – Watershed Restoration Action Plan (WRAP)
Current efforts are focused on the Upper Sandy River Watershed Restoration Action Plan outlined in this document. Similar to the Still Creek WRAP, the Upper Sandy River 6th field WRAP provides an operational scale tool for restoring the watershed within the conservation methods and practices tiered to the broader Sandy River basin restoration strategy. This WRAP tiers to the 1996 Upper Sandy 5th Field Watershed Analysis (WA) (USDA 1996) – per direction under the Aquatic Conservation Strategy (ACS) of the 1994 Northwest Forest Plan (USDA and USDI, 1994) and follows the 2011 WCF transition WRAP report format (USDI 2011).

Summary

Watershed Name and HUC

Upper Sandy River (HUC12 number 170800010101)

General Location

The Upper Sandy 6th field watershed (HUC12) serves as the headwaters of the greater Sandy River basin. The Sandy River drains off the western flank of Mt Hood for 56 miles before entering the Columbia River near the city of Troutdale. The river and its tributaries drain an area of 325,000 acres (508 square miles). The Sandy River's mouth is within 20 miles of downtown Portland, Oregon and much of the watershed is within an hour's drive of the metropolitan area. Still Creek, the Salmon River, Little Sandy River, Cedar Creek, Gordon Creek, Bull Run River, and Zigzag River are major tributaries to the Sandy River. The 5th field watersheds (HUC10) within the Sandy River basin include: the Lower Sandy River, Middle Sandy River, Upper Sandy River, Bull Run River, Zigzag River, and Salmon River. The Upper Sandy 6th field watershed, Figure 1, is located within the Upper Sandy 5th field watershed, Figure 2. It is also known as the Headwaters Upper Sandy River 6th field. In this report the watershed restoration area will be referred to as the Upper Sandy 6th field watershed.

Total Watershed Area

Total acres: 22,225 acres
National Forest area within watershed: 99 percent

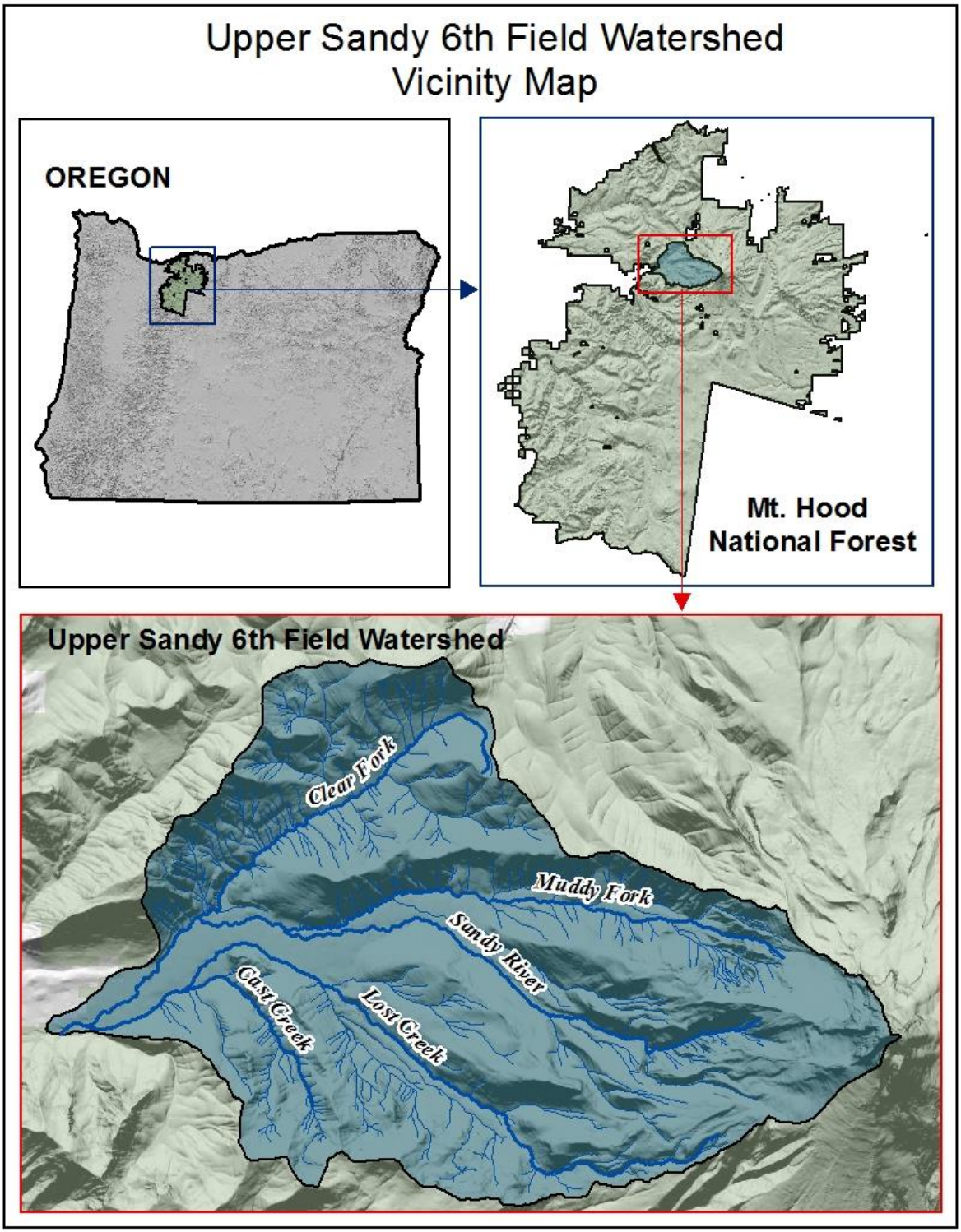

Figure 1. Upper Sandy 6th field watershed vicinity map.

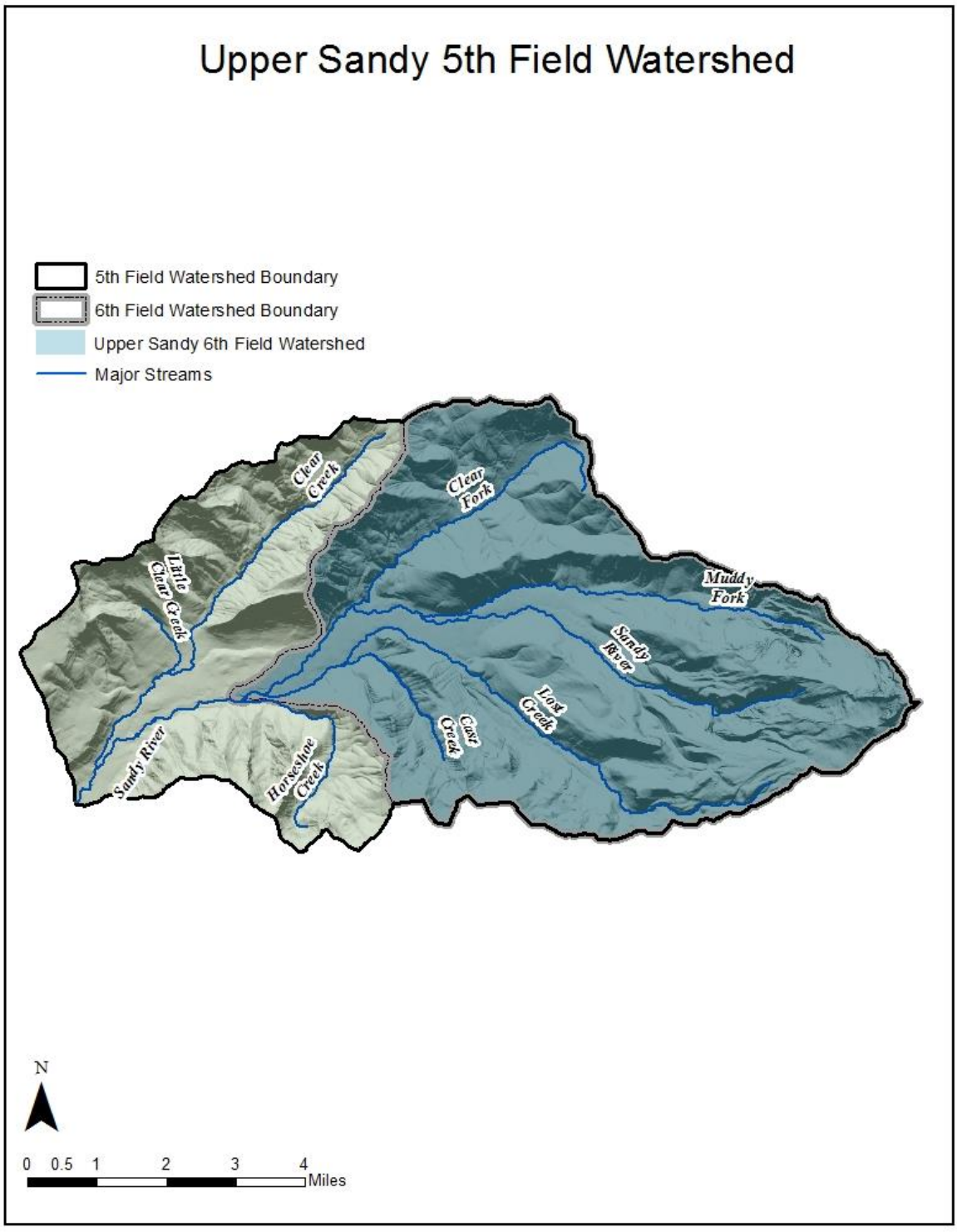

Figure 2. Map of the Upper Sandy 5th field watershed, including Upper Sandy 6th field watershed.

Watershed Characterization

General Physiography

The Sandy River basin consists of five fifth-field HUC watersheds: the Upper Sandy River, Middle Sandy River, Lower Sandy River, Bull Run River, and Salmon River. The Upper Sandy 5th field watershed is approximately 34,166 acres in size and is located in the upper portion of the Sandy River basin. The Upper Sandy 6th field watershed encompasses 22,225 of the total acres of the Upper Sandy 5th field, which includes the Clear Fork Sandy River watershed. Major tributaries within the Upper Sandy River watershed include the Muddy Fork, Lost Creek and the Upper Sandy River. Three small lakes are located in the upper watershed: Burnt, Cast, and Dumbbell (USDA 1996).

The Sandy River basin drains approximately 508 square miles (325,000 acres) within the lower Columbia portion of the much larger Columbia River basin, eventually continuing its 56 mile northwesterly course to the Columbia River. The Sandy River originates from the glaciers located on the western slopes of Mt Hood, which has an elevation of 11,239 ft. The Upper Sandy 6th field watershed ranges in elevation from 1,300 to 10,000 feet. Reid, Sandy and Zigzag Glaciers feed the headwaters of the glacial tributaries, which include the Upper Sandy River, Muddy Fork, and Lost Creek. The main non-glacial tributary in the Upper Sandy 6th field is the Sandy River Clear Fork, which is a groundwater fed, rain dominated system (USDA 1996).

At about 2,000 ft. in elevation the headwaters span out across a broad, flat plain known as Old Maid Flats. This region has been partially filled in with glacial deposition. In gentle gradient areas such this, the Sandy River has been known to change its course, often rapidly. The Old Maid Flats area exhibits a unique array of soil conditions and relatively rare botanical communities, which are especially rare in the Pacific Northwest. These include lodgepole pine, *Pinus contorta,* and associate plants along with edible mushrooms rare elsewhere within the Mt Hood National Forest (USDA 1996).

Land Use

Historically, the Sandy River watershed was most likely used by one or more groups of Native Americans for hunting, fishing, and gathering. Although information is scanty, Native Americans continued to use the area through the 1800's, especially to gather huckleberries, fish and game. In addition, native people gathered cedar bark for baskets, clothing, bandages and other items. The watershed is still used by Native Americans for traditional use, but at much lower levels than historically (USDA 1996).

From approximately 1772 to 1840, limited exploration and fur trapping occurred within the watershed due to the bountiful trapping opportunities in the Willamette Valley. In 1843, the great immigration to the Oregon territory began. The Barlow Road was constructed in 1845, which basically was a one-way to the west route that delivered pioneer emigrants to the rich agricultural lands of the Willamette River Valley. Some, however, chose to settle lands in the Upper Sandy River watershed along the trail. These early homesteads were minimal in size and scope to the watershed ecosystem (USDA 1996).

By 1880, the Willamette Valley was becoming increasingly settled and people started to look towards the Cascades to provide some of their needs. In addition to logging and shepherding, residents of the Willamette Valley recognized the recreational potential of the Cascades. The Zigzag Ranger District was established in 1907, with the creation of the Oregon National Forest (renamed Mt Hood National Forest). The ranger district location was purposely set up along the major thoroughfare of the Barlow Road. By the 1920s the demand for recreation had greatly increased due to the completion of the Mt

Hood Loop Highway. The efforts of the Civilian Conservation Corps (CCC) and the Works Progress Administration (WPA) during the Depression-era of the 1930s further solidified the Sandy River basin as an area with dense recreational opportunities, with the construction of CCC and WPA campgrounds, trails, and buildings (USDA 1996).

In 1988, 24.9 miles of the Upper Sandy River was designated a National Wild and Scenic River System. This included the 12.4 miles that reach from the headwaters to the Mt Hood National Forest boundary. As stated in the Upper Sandy National Wild and Scenic River Management Plan, *"The Wild and Scenic River Act directs managing agencies to develop a management plan for the protection and/or enhancement of the outstanding remarkable values for the designated river and associated corridor. The outstanding remarkable values for the upper Sandy River include scenery, recreation, fisheries, geology, and botany"* (USDA 1994). These designations and their meaning under the Wild and Scenic Act are pertinent to fish production and habitat within the basin since fisheries are identified as an outstandingly remarkable value (ORV) for each of the reaches designated, and the act mandates managing agencies to develop measures to protect and/or enhance the ORVs associated with the designated river and associated corridor (SRBP 2005).

Today the Sandy River basin, including the Upper Sandy 6th field watershed, is a popular recreation destination, less than a one hour drive from the Portland Metropolitan area and surrounding communities. There are many recreational uses that directly and indirectly affect the Sandy River including; fishing, camping, hiking, biking, swimming, and skiing. Old Maid Flats has three designated campgrounds, McNeil, Lost Lake, and Riley Horse Campground, as well as dispersed camping throughout the area. It is also has several popular hiking trails such as Ramona Falls Trail 797, Burnt Lake Trail 722, and the Zigzag Mountain Trail 775.

Lolo Pass Road (FS Road 18) and Bonneville Power Administration (BPA) access roads are the only major access into the Upper Sandy 6th field watershed. Lolo Pass Road connects the Zigzag and Hood River Ranger Districts, although the greatest use to the area comes from the Zigzag Ranger District side. The Forest Service roads that encompass the Upper Sandy 6th field watershed are a combination of approximately 32 miles of paved and gravel roads, none of which are maintained for winter travel. The main use of these roads is for recreational activities. Approximately 19 miles of road have been decommissioned to address water quality and quantity issues and reduce habitat degradation.

Economic influence within the Upper 6th field watershed is tourism dependent. Local communities are increasingly providing a variety of recreational facilities and services such as motels, stores and restaurants to meet the needs of the area's visitors, part-time and permanent residents. The Upper Sandy is popular for camping, hiking, equestrian use, Nordic sports, and berry and mushroom gathering.

National Forest system lands located within the Upper Sandy 6th field watershed are designated as Wilderness Area (A1), Wild & Scenic River Corridor (B1), Late Successional Reserves (LSR), Key Site Riparian Area (A9), Riparian Reserves, Scenic Viewshed (B2), Bull Run -Research Natural Area Expansion (DA3), Bull Run-Physical Drainage (DA1), Wood Product Emphasis (C1), and Special Interest Area (A4) under the Mt. Hood National Forest Land Resource Management Plans (LRMP), as amended by the Northwest Forest Plan (USDA and USDI 1994). See Table 1 and Figure 3. Specific management direction for each of these land allocations can be found in the Mt. Hood National Forest LRMP (USDA 1990) and the Record of Decision (ROD) for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl, i.e., Northwest Forest Plan (USDA and USDI 1994).

Table 1. Summary of Acres by Land Allocation

Land Allocation	Acres in Allocation
Wilderness Area (A1)	15,230
Wild & Scenic River Corridor (B1)	817
Late Successional Reserves (LSR)	220
Key Site Riparian Area (A9)	16
Riparian Reserves	2,105
Scenic Viewshed (B2)	1,595
Bull Run -Research Natural Area Expansion (DA3)	3
Bull Run-Physical Drainage (DA1)	2,040
Wood Product Emphasis (C1)	2,495
Special Interest Area (A4)	30
Private Land	26

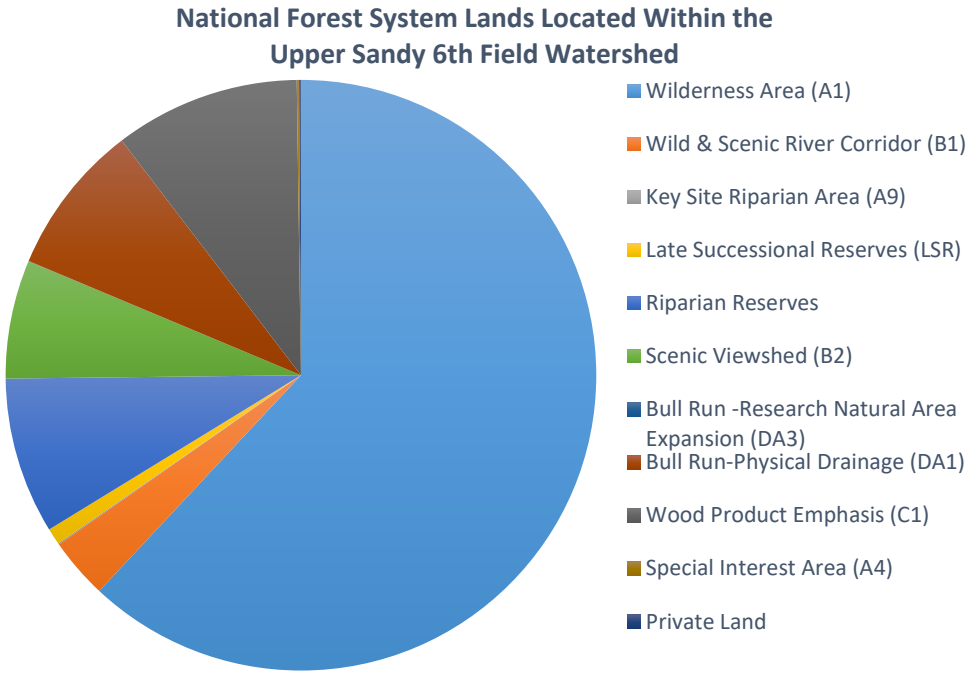

Figure 3. Mt. Hood National Forest LRMP Land Allocations within the Upper Sandy 6th Field Watershed.

Restoration Goals, Objectives and Opportunities

General Overview of Concerns

General threats within the Upper Sandy 6th field watershed include threats to riparian structure and function, and threats to aquatic/riparian species habitat. The following list details specific issues of concern and is followed by a general approach to resolve the issues within the Upper Sandy watershed.

- Issue of Concern: Water Quality

  Water quality is degraded in the Upper Sandy watershed as a result of sediment delivery to streams via roads. The road surfaces and drainage network cause chronic sediment delivery to stream channels. Sediment delivery and bank erosion is also a result of heavily impacted riparian areas associated with developed campgrounds and dispersed camping sites, which results in reduced ground cover, shrubs, and young trees. Glacial runoff, unstable channels, and flood damage are also water quality concerns, especially in the Upper Sandy River and Muddy Fork. There is a lack of marine derived nutrients within the freshwater ecosystem of the Upper Sandy watershed.
- Issue of Concern: Habitat Fragmentation

  Undersized culverts are present within the Upper Sandy watershed which results in fragmented habitat due to poor passage conditions.
- Issue of Concern: Large Woody Debris

  Lack of large wood has led to decreased channel sinuosity, modified channel slope, reduced floodplain roughness, decreased pool densities, reduced off channel habitat, and has caused a reduction of spawning gravel retention. Lack of large woody debris is one of the most significant issues within the Upper Sandy watershed. Dominant tree species within the floodplain have been converted from conifer to deciduous species as a result of the 1964 flood events, historic fires, and hazard tree removal/clearing in campgrounds and dispersed camping areas. This conversion reduces the long term large wood delivery potential along channels within the watershed. Portions of the Upper Sandy watershed have stunted trees, a product of the eruption of Mt. Hood in the late 18th century, which reduces the potential for instream large woody debris.
- Issue of Concern: Channel Conditions

  Large Woody Debris density is low and has resulted is reduced habitat complexity levels in certain stream reaches within the Upper Sandy watershed. Some of these streams also have a lack of floodplain connectivity, off channel habitats, reduced slack water hiding cover, little retention of sediment and nutrients, and little pool habitat. These conditions have resulted in impaired channel shape and function.
- Issue of Concern: Road Maintenance

  There are six culverts and three bridges in the Upper Sandy watershed that result in road related sediments entering the channel. The location of the road also intercepts debris torrents resulting in excess delivery of sediment to streams. There is a high density of roads in the watershed, a majority of which are close to streams.
- Issue of Concern: Riparian Vegetation

  Dominant tree species within the floodplain project areas have been converted from conifer to deciduous species by the 1964 flood events, the Mt. Hood eruption in the late 18th Century, historic fires, hazard tree removal/clearing for developed campgrounds and dispersed camping areas, and through past timber harvest activities.
- Issue of Concern: Soil Erosion

The watershed has several riparian areas that are heavily impacted as a result of dispersed camping sites. These areas have reduced ground cover, shrubs, and young trees resulting in increased bank erosion and sediment delivery.

- Issue of Concern: Terrestrial Invasives
  Past and present activities have introduced numerous invasive plants to the Upper Sandy watershed.

Proposed restorative work to address concerns:

The largest limiting factor for salmonid production in the Upper Sandy watershed is the lack of isolated side channels and off channel habitats (SRBWG 2007). Channelization and large wood removal from flood events and human activities, led to incision of the Upper Sandy River and tributaries, isolation of side channels, which became inaccessible to native fish. Rearing areas for anadromous salmonids have been exponentially reduced leading to an overall decrease in production. The removal of large wood further reduced habitat complexity of stream in the watershed, through loss of pool habitats, lack of gravel sorting structures, and reduced floodplain inundation. Tables 2 and 3 show attributes and indicators of watershed issues that need to be addressed.

General on-the-ground activities needed to address the above concerns (in terms of both watershed function and biological integrity/salmonid production) include the excavation of inlets to historic side channels and the addition of large wood to side channels/main channel at a rate of 125 to 250 pieces per river mile. The lack of large wood gives rise to several of the issues of concern listed above. Addition of wood will significantly improve channel complexity, in channel conditions, and flood plain roughness. Conifer trees (i.e., western red cedar and Douglas fir) need to be planted to raise levels to 225 trees per acre throughout the riparian corridor not only to restore riparian function, but serve as a long term source for large wood recruitment.

Integrated restoration including instream restoration, riparian plantings, invasive plant removal, and road restoration will all be accomplished over a 5-year period that collectively benefits the whole watershed. For specific projects and details, see “Specific Project Activities (Essential Projects)" section of this document.

Important Ecological Values

- High priority subwatershed in the Sandy River basin for recovery of wild stocks of threatened Chinook salmon, coho salmon, and winter steelhead as rated by the interagency Sandy River Basin Partners group.
- Upper Sandy subwatershed contains aquatic threatened and endangered species and designated critical habitat.
- Anchor habitat for Chinook salmon, coho salmon, and winter steelhead (see SRBWG 2006).

Current Condition Class

Upper Sandy Watershed Condition score: 1.8.

Watershed condition scores less than or equal to 1.66 equates to Functioning Properly; greater than 1.66 to 2.33 equates to Functioning at Risk; 2.33 to 3.0 equates to Impaired or Functioning at Unacceptable Risk. The Upper Sandy watershed current condition is classified as Functioning at Risk.

2010 Watershed Condition Ratings for the Upper Sandy 6th field watershed: Aquatic biota condition – Poor; Riparian/wetland vegetation condition – Fair; Water quality condition – Good; Water quantity condition – Good; Aquatic habitat condition – Poor; Road and trail condition – Poor; Soil condition – Fair; Forest cover condition – Good; Forest health condition – Good; Terrestrial invasive species condition – Fair; Rangeland vegetation condition – Not applicable; Fire effects/fire regime condition – Good.

Key Watershed Issues

Table 2. Attributes/Indicator with FS to control affect

ATTRIBUTES/INDICATOR	REASON FOR RATING
1.2 Water Quality	• Sediment delivery to streams. FS roads causing chronic sediment delivery to stream channels. • Heavily impacted riparian areas associated with dispersed camping sites with severely reduced ground cover, shrubs, and young trees resulting in increased bank erosion and sediment delivery. • Lack of marine-derived nutrients in freshwater ecosystems.
3.1 Habitat Fragmentation	Undersized culverts result in fragmented habitats due poor passage conditions.
3.2 Large Woody Debris	• Lack of large wood has led to decreased sinuosity, modified channel slope, lack of floodplain roughness, decreased pool densities, less off channel habitat, and reduction of spawning gravel retention. • Dominant tree species within the floodplain project areas have been converted from conifer to deciduous species as a result of the 1964 flood events and hazard tree removal/clearing in developed campgrounds, dispersed camping areas, and private residences.
3.3 Channel	LWD density and habitat complexity levels are low. Lack of floodplain connectivity, off channel habitats, reduced slack water hiding cover, little retention of sediment and nutrients, little pool habitat. Impaired channel shape and function.
5.1 Riparian/Wetland Vegetation Condition	Dominant tree species within the floodplain project areas have been converted from conifer to deciduous species from 1964 flood events, hazard tree removal/clearing, and through past timber harvest methods.
6.2 Road Maintenance	• High percentage of roads near streams resulting in road related sediments entering channel. • Location of road intercepting debris torrents resulting in excess delivery of sediment to streams resulting from catastrophic fill failure at stream crossings.
7.2 Soil Erosion	Heavily impacted riparian areas associated with dispersed camping sites with severely reduced ground cover, shrubs, and young, stunted trees resulting in increased bank erosion and sediment delivery.
11.1 Terrestrial Invasives	Past and present activities have introduced numerous invasive plants to the Upper Sandy watershed.

Table 3. Attributes/Indicator beyond FS control to affect – other parties needed to address

ATTRIBUTES/INDICATOR	REASON FOR RATING
1.2 Water Quality	Sediment delivery to streams –BPA access roads causing chronic sediment delivery to stream channels.
4.2, 4.3 Native/Exotic Species	High percentage of hatchery anadromous fish competing with and reducing fitness levels of wild populations.
6. Roads/Trails	Sediment delivery to streams –BPA access roads causing chronic sediment delivery to stream channels.

Watershed Characteristics and Conditions

General

The Upper Sandy 5th field watershed is located on the west side of Oregon's Cascade Range, south of the Columbia River. The watershed is located on the western slope of Mt. Hood in north central Oregon, with elevations ranging from 1,300 to 10,000 feet. It encompasses 34,186 acres.

The Upper Sandy River 5th field watershed is comprised of the following stream systems: Clear Creek, Little Clear Creek, Horseshoe Creek, Cast Creek, Lost Creek, Muddy Fork, and Upper Sandy River. These headwaters make up the Upper Sandy 6th field watershed within the Upper Sandy 5th field watershed. The Upper Sandy River originates from the Reid, Sandy, and Zigzag Glaciers of Mt. Hood, where it carves its way through volcanic debris before spanning out in the broad, flat plain know as Old Maid Flats, which is characterized by glacial deposition known as Lahar. The main non-glacial tributary in the Upper Sandy 6th field is the Sandy River Clear Fork, which is a groundwater fed, rain dominated system. From Old Maid Flats the river continues on its 56 mile course to join the Columbia River.

Climate

The Sandy River basin has a maritime climate, generally characterized by seasonal mild temperatures and wet winters. Approximate annual precipitation within the Upper Sandy 5th field watershed ranges from 130 inches at its highest elevations to 90 inches in the upper Lost Creek drainage. The heaviest precipitation occurs November through January and the lowest precipitation occurs July through August. Mt. Hood sustains a year-round snowpack at its highest elevations. This directly affects stream discharge into the Sandy River, Muddy Fork, and Lost Creek by providing water storage over the winter, which then contributes cold water flow during the summer. Overall, this improves base summer flows and moderates water temperatures (SRBP 2005).

The Climate Change vulnerability assessment resources for national forests & grasslands in the Pacific Northwest indicate increases decreases in summer baseflows and increases in peak streamflows based on the bullets below.

- Regional-scale maps of the intrinsic geohydrologic sensitivity of summer streamflow to changes in the magnitude and timing of recharge from precipitation or snowmelt

- The USFS-PNW Research Station and the PNW Region developed geodatabases that characterize the sensitivity of landscapes to changes in peak flows due to climate warming across Oregon and Washington (Safeeq et al. 2015).

Topography

The topography of the Sandy River basin varies, with high gradient relief in the upper reaches of the basin, moderate gradients in the middle reaches, and relatively low gradients in the lower reaches. According to the Oregon Department of Fish and Wildlife (ODFW), the average gradient in the upper basin is about 288 feet per mile (5.5 percent slope), but may exceed 1,000 feet per mile (19 percent slope) in the upper elevations (ODFW 2002).

Geomorphology

Geographic features of the Sandy River basin have been formed by a sequence of volcanic eruptions, uplifting, bedrock deformations, weathering, and erosion; more volcanic eruptions; glaciation; and finally, more weathering and erosion. These geologic processes have left behind a mixed and highly varied combination of bedrock covered by equally varied surficial materials (USFS 1979). The predominant rock types in the basin are volcanics and their weathered or altered products. Lava flows and pyroclastic rocks make up most of the bedrock found in the basin. Rock types include andesite, basalt, tuff, tuff breccia, and breccia (SRBP 2005).

The ongoing influence of past volcanic events which produced volcanic mudflows (lahars) combined with the influence of Mt Hood glaciers have resulted in conditions of naturally high sediment loading in the Sandy River. One such major laharic event occurred in the late 1700s and created the Old Maid Flat area (SRBW 2005). The mudflow deposits in Old Maid Flat are a mix of sand, gravel, boulders, and cobble. Soils are young and poorly developed. The vegetation on Old Maid Flats reflects the droughty and nutrient limited nature of these deposits (UDSA 1996).

Fire

Fire has played a significant role in the Upper Sandy watershed for the two centuries. Historic records (1873 to 1920) indicate that nearly three-fourths of the entire watershed was burnt by a stand-replacing fire (USDA 1996). From 1900 to 1995, a total of 52 fires were recorded to occur in the Upper and Middle Sandy River watersheds: 27 fires were recorded to occur from 1908-1959, and 25 fires were recorded to occur from 1960-1995. Of the 25 fires from 1960-1995, none were over 10 acres in size (SRBP 2005). Thirty-four fires were recorded between 1996 and 2016 in the Upper Sandy 5th field watershed. The majority of these fires were human-caused, with one fire reaching 11 acres in size. Since 1920, fire has only impacted 13 percent of the watershed.

Vegetation

Three main vegetation zones occur within the watershed of the Upper Sandy: Western Hemlock (*Tsuga Heterophylla*) - 66 percent, Pacific Silver Fir (*Abies amabilis*) - 23 percent, and Mountain Hemlock (*Tsuga mertensiana*) - 6 percent. In addition, small areas of Alpine and Subalpine zones (5 percent) occur near timberline. The Western Hemlock zone occupies the lower elevations of the Upper Sandy watershed. This zone occurs on warm, moist sites and tends to be the most productive in terms of rapid tree growth. Douglas-fir (*Pseudotsuga menziesii*) and Western Hemlock (*Tsuga Heterophylla*) are common species in this zone. The Pacific Silver Fir zone is concentrated on the upper slopes and ridges in the upper half of the watershed, while the Mountain Hemlock zone occurs on the flanks of Mt Hood and Zigzag Mountains at elevations averaging over 4,000 feet. Common plants associated with the Pacific Silver Fir and Mountain Hemlock zones indicate regions with naturally cooler temperatures. Plant

species include huckleberry (*Vaccinium*), beargrass (*Xerophyllum tenax*), rhododendron (*Rhododendron sp.*), and alpine azalea (*Loiseleuria procumbens*) (USDA 1996).

Approximately, 51 percent of the watershed is in mid-seral stands that are dominated by the Western Hemlock zone. Early-seral forest occupy 24 percent of the watershed and occur within all vegetation zones within natural ranges of variability. Late-seral forest occupy 21 percent of the watershed, which is within natural ranges of variability for all forest zones with the exception of the Western Hemlock zone. This is in no doubt due to the influence of the Old Maid Flats area that is prevalent in the Western Hemlock zone. The lahar influenced landscape that occurs in the Old Maid Flats area has resulted in a unique array of soil conditions and relatively rare botanical communities, which are especially rare in the Pacific Northwest. These include lodgepole pine (*Pinus contorta*), and associate plants along with edible mushrooms rare elsewhere within the Mt Hood National Forest. It should be noted that large conifer stands of old growth trees (200 years+) occur on only seven percent of the watershed in isolated patches and canyon bottoms providing habitat for old-growth related species of plants and animals. Five percent of the seral stands are considered non-vegetation – rock, snow, ice (USDA 1996).

Aquatic

The Upper Sandy watershed supports both anadromous and resident species salmonids. This includes four federally listed species: winter-run steelhead trout (*Oncorhynchus mykiss)*, fall and spring-run Chinook salmon (*Oncorhynchus tshawytscha*) and coho salmon (*Onchorhyncus kisutch*) (SRBP 2005). The distribution of the four listed anadromous fish species in the Upper Sandy watershed is shown in Figure 4. The watershed also supports resident rainbow trout (*Onchorhynchus mykiss*), cutthroat trout (*Oncorhynchus clarkii*), sculpin (*Cottus spp.*), Pacific lamprey (*Lampetra tridentata*), dace (*Rhinichthys sp.*) and mountain whitefish (*Prosopium williamsoni*) (USDA 1996). The Sandy River is an important watershed for Lower Columbia River fish recovery efforts due to its geographic location and potential contribution to region-wide fish recovery (SRBP 2005). In addition, the Upper Sandy watershed has been documented to contain a diversity of increasingly rare and genetically important native fish stock (USDA 1996).

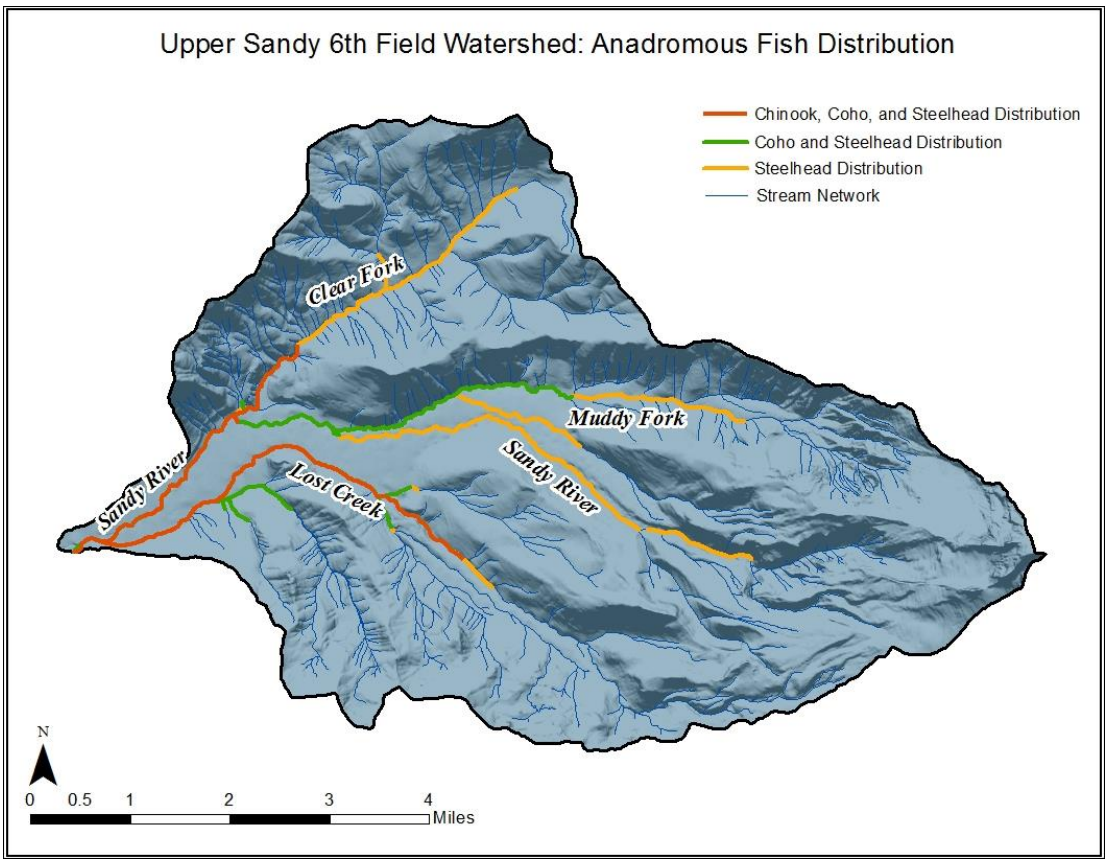

Figure 4. Distribution of Anadromous Fish in the Upper Sandy 6th Field Watershed. Update in coho distribution in the Clear Fork. Juvenile coho were identified immediately upstream of Gowan Creek in the Clear Fork (August 2018; Wanner, personal communication).

The removal of the Marmot Dam in 2007 by PGE, in collaboration with MHNF and multiple community partners, opened up historic fish habitat in the Upper Sandy watershed. Fish habitat conditions and changes to physical attributes of the stream channel are being monitored by the USFS, PGE, and other partners. The Zigzag Ranger District is involved in the monitoring of salmon smolt (pre and post dam removal) in the upper basin above the formal Marmot Dam site to gain an estimation of annual salmonid production in the upper basin (USDA 2017).

Habitat conditions for salmonids range from low to high quality within the watershed. Habitat surveys have identified a wide diversity of habitat types, ranging from low gradient, wide meandering river channels to small, high-gradient glacier-fed creeks. In many areas within the watershed, fish habitat has been degraded. Large floods in the past 50 years scoured channels and swept much of the large woody material out of the system. In the aftermath of these floods, the U.S. Army Corps of Engineers, Forest Service, other public agencies, and private individuals removed any remaining large logs and boulders from sections of the Upper Sandy River, Clear Fork, and Lost Creek. Past surveys indicate that fish populations could benefit from habitat-creating stream restoration, which builds upon and enhances the restoration features that were constructed in the past (USDA Stream Inventory Level II Surveys 1992, 1996, 1996).

Throughout the Upper Sandy 6th field watershed and the larger Upper Sandy 5th field watershed, water quality concerns with turbidity, sediment, erosion and stream structure (i.e., large wood) exist. For the

most part, these concerns are associated with unstable channels, heavily impacted riparian areas, and the continued effects from stream cleanout efforts.

Special Habitats and Species of Concern

The Upper Sandy River watershed includes habitat for several species of concern, all of which are tied to the Endangered Species Act, National Forest Management Act (NFMA) regulations, or Forest Service Policy. This sensitive species list includes: Harlequin Duck (*Histrionicus histrionicus*), Cope's giant salamander (*Dicamptodon copei*), and the red-legged Frog (*Rana aurora*). (USDA 1996) The Sandy River functions as a migration flyway for Harlequin ducks between its nesting habitat on generally higher elevation rivers and streams and its coastal wintering habitat. Critical habitat for the federally listed Northern Spotted Owl (*Strix occidentalis caurina*) has been identified, with the majority of the suitable habitat found within the Mt Hood Wilderness and the upper end of the Old Maid Flat area (USDA 1996). Twenty sensitive plant species are either documented or suspected to occur in the Upper Sandy watershed (Regional Forester's Sensitive Species List) including fir clubmoss (*Huperzia occidentale*) and loose-flowered bluegrass (*Poa Laxiflora*). Both species have been documented in the Lost Creek watershed (USDA 1996).

The Upper Sandy 5th field watershed contains approximately 7,663 acres of special habitats, including an abundance of unique alpine/subalpine and mudflow communities. In some cases, species of concern utilize these various special habitats. Mt Hood's subalpine and alpine zone is the largest special habitat in the Upper Sandy watershed and because subalpine/alpine plants account for only one percent of the Mt Hood National Forest, the Upper Sandy watershed's contribution (approximately 20 percent) provides an important component to forest wide biodiversity. Wetlands represent another key area and several species of sensitive plants can be found (USDA 1996).

The Old Maid Flat area, which is located in the Upper Sandy 6th field watershed, is designated as a Geologic Special Interest Area in the Mt Hood Forest Plan. The 300-year-old mudflow, which forms a broad, flat valley bottom, is a textbook example of primary successional stages associated with volcanic activity. The lodgepole dominated, park-like open canopy forest is home to an abundance of bryophytes, lichens, mosses and over 100 species of mushrooms (USDA 1994).

Watershed Conditions

The following watershed conditions are taken largely from the 1996 Upper Sandy Watershed Analysis and stream surveys completed by the Forest Service and Oregon Department of Fish and Wildlife (USDA 1996 and USDA Stream Inventory Level II Surveys 1992, 1996, 1996).

Changes in Peak/Base Flow

The Upper Sandy Watershed Analysis (1996), pg. 4-143, assessed changes in peak flows within the 5th field watershed using methodology from the Washington Department of Natural Resources (DNR) Standard Methodology for Completing Watershed Analysis. This method assumes that the greatest likelihood for causing significant, long-term cumulative effects on forest hydrologic processes is through the influence of created openings from timber harvest and roads on snow accumulation and melt. Peak flows were calculated for the 2, 5, 10, 25, 50 and 100-year recurrence interval peak stream flow events. The threshold of concern is if peak flows change greater than 10 percent for any recurrence interval storm. The Upper Sandy watershed and associated subwatersheds are below the 10 percent threshold associated with adverse impacts, except for Clear Fork subwatershed. The Clear Fork subwatershed has a 13 percent increase in peak flow for a 2 year recurrence interval, which has the potential to increase

suspended sediments and turbidity levels due to in-channel processes such as streambank and inner gorge failures. The Northwest Forest Plan—the first 20 years (1994–2013): watershed condition status and trends reports that the hydrology indicator (that addresses the influences of road and vegetation changes on peak flows) is in the Functioning Properly condition (watersheds exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition)

Increases in peak stream flows associated with stream drainage network enhancement were also evaluated. Current research suggests that roads function hydrologically to modify stream flow generation in forested watersheds by altering the spatial distribution of surface and subsurface flow paths. Observation suggest roadside ditches and gullies function as effective surface flow paths which substantially increase drainage density during storm events. Current calculations estimate stream drainage network enhancement at 16 percent for the entire watershed. The threshold of concern is if peak flows change greater than 10 percent, placing the Upper Sandy watershed within the threshold of concern.

Peak stream flows in the Upper Sandy 5th field watershed appear to be on an increasing trend. This is attributed to the created openings associated with development and timber harvest in the watershed. This indicates that the peak flow magnitude for the 2+ year recurrence interval has been altered for the last 50 years with the potential to cause long-term alterations and channel disruption on nearly an annual basis.

The Upper Sandy Watershed Analysis (1996), pg. 4-155, assessed changes in base flows within the 5th field watershed using the Season Kendall Trends Analysis on the 30-day duration base flow for the Sandy River at Marmot. The Upper Sandy has a decreasing base flow trend that exists in low-flow yields for the period 1950-1994, which appears to be associated with hardwood encroachment into riparian areas and water withdraws associated with development and private residences in the lower portion of the Upper Sandy 6th field watershed.

Drainage Network

Road cuts and ditches may intercept surface flow and shallow groundwater flows, which can substantially increase drainage density during storm events. The Upper Sandy Watershed Analysis (1996), pg. 4-151 states *"…increases of greater than 10 percent of stream drainage network expansion are the threshold of concern."* The Upper Sandy watershed is below this threshold of concern for all subbasins, except Clear Fork subbasin, which far exceeds the threshold at 25 percent stream drainage network expansion (T. Parker 2018, personal communication). Stream drainage network expansion is of concern in the Upper Sandy where more than 74 percent of the roads are located within 300 feet of streams.

Figure 5. BPA right-of-way and powerlines in the Upper Sandy watershed.

Road Density & Location

While road densities within the Upper Sandy watershed are moderate, many roads in the watershed run parallel to

major streams and have the potential to effectively contribute to reduced water quality and habitat degradation (USFS 1996). Examples include Lolo Pass Road (FS Road 18), FS Roads 1825 and 1828, and BPA access roads. Figure 6 displays active and decommissioned roads within the watershed and their proximity to streams.

While road densities within the subwatershed are 1.4 miles/square mile (30 percent of which are decommissioned), 74 percent of the road network is within 300 feet of streams.

The BPA right-of-way crosses through the northwest section of the Upper Sandy watershed and has numerous undocumented access roads (Figure 5). Road densities reported above do not take into account these undocumented access roads. Although the right-of-way is less than 1 percent of the watershed, poorly maintained access roads increase the road density and reduce water quality.

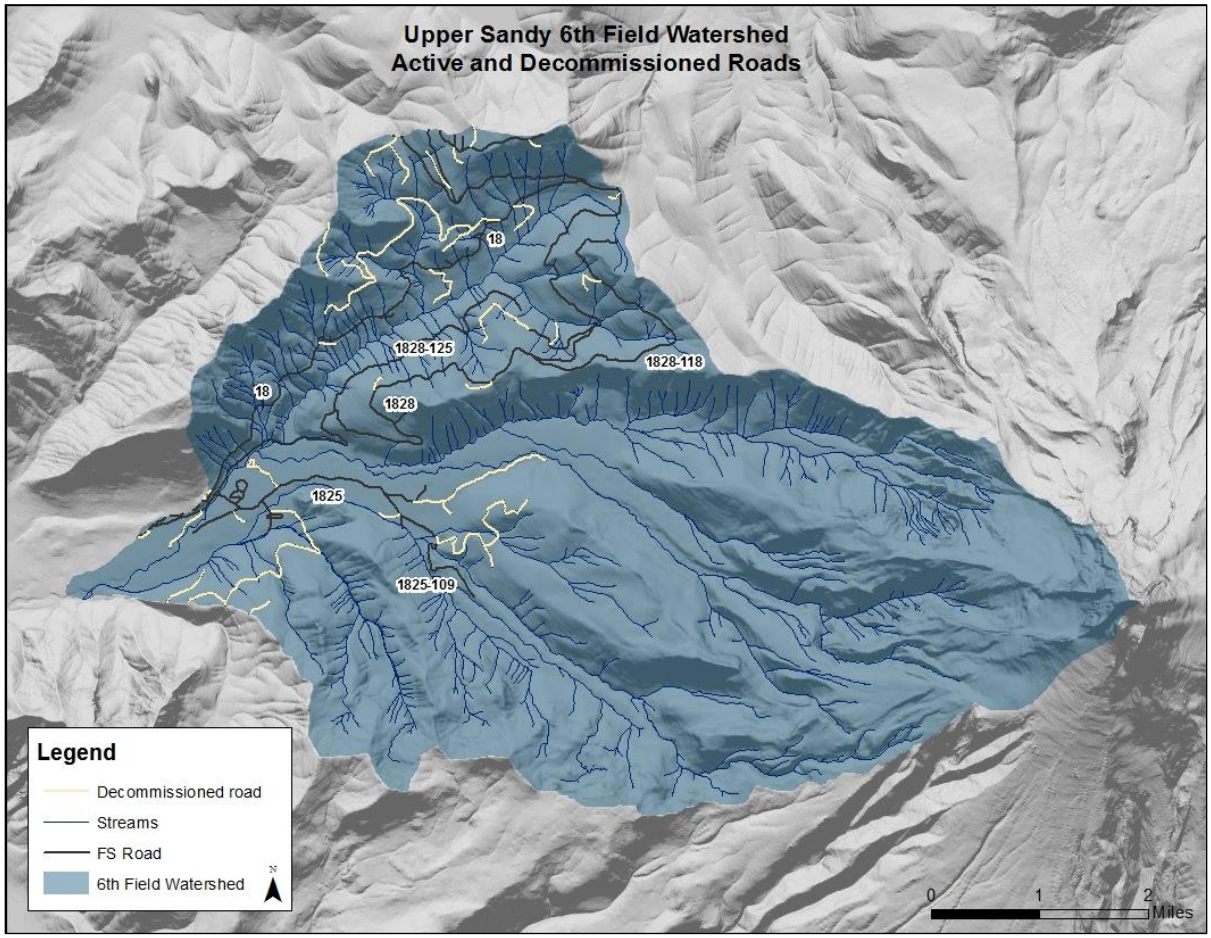

Figure 6. Active and decommissioned roads in the Upper Sandy 6th field watershed.

Disturbance History

The late 18th century eruption of Mt. Hood resulted in a volcanic laharic event, which flowed through the center of the watershed, leaving behind thick deposits of mud and poor soil. This area has yet to recover from the eruption and remains in a primary successional stage.
Fire has played a small role in the watershed over the last 100 years, although from1873 to 1920, three quarters of the watershed experience stand replacing fires. Since 1920, only 13 percent of the

watershed has been impacted by fires; all fires were patches smaller than 11 acres. Most fires are a product of abandoned recreational campfires and are generally extinguished before they grow large in size.

Flooding is a natural reoccurring disturbance in the watershed. Over the past 75 years there have been four large scale flooding (1964, 1996, 2006, 2011), which were caused by natural conditions, such as rain on snow events.

Human disturbances have played a role in the watershed over the last 100 or more years. Examples include road building, recreational facility construction, stream clean out and channelization, and fire suppression. Timber harvest has not had a major influence on the entire watershed; eight percent of the watershed has been harvested. The majority of harvest activities have occurred in the Clear Fork subwatershed, as shown in Figure 7. Along with timber harvest, BPA powerlines and related access roads have also impacted the upland and riparian areas of Clear Fork by increasing sediment transport and runoff.

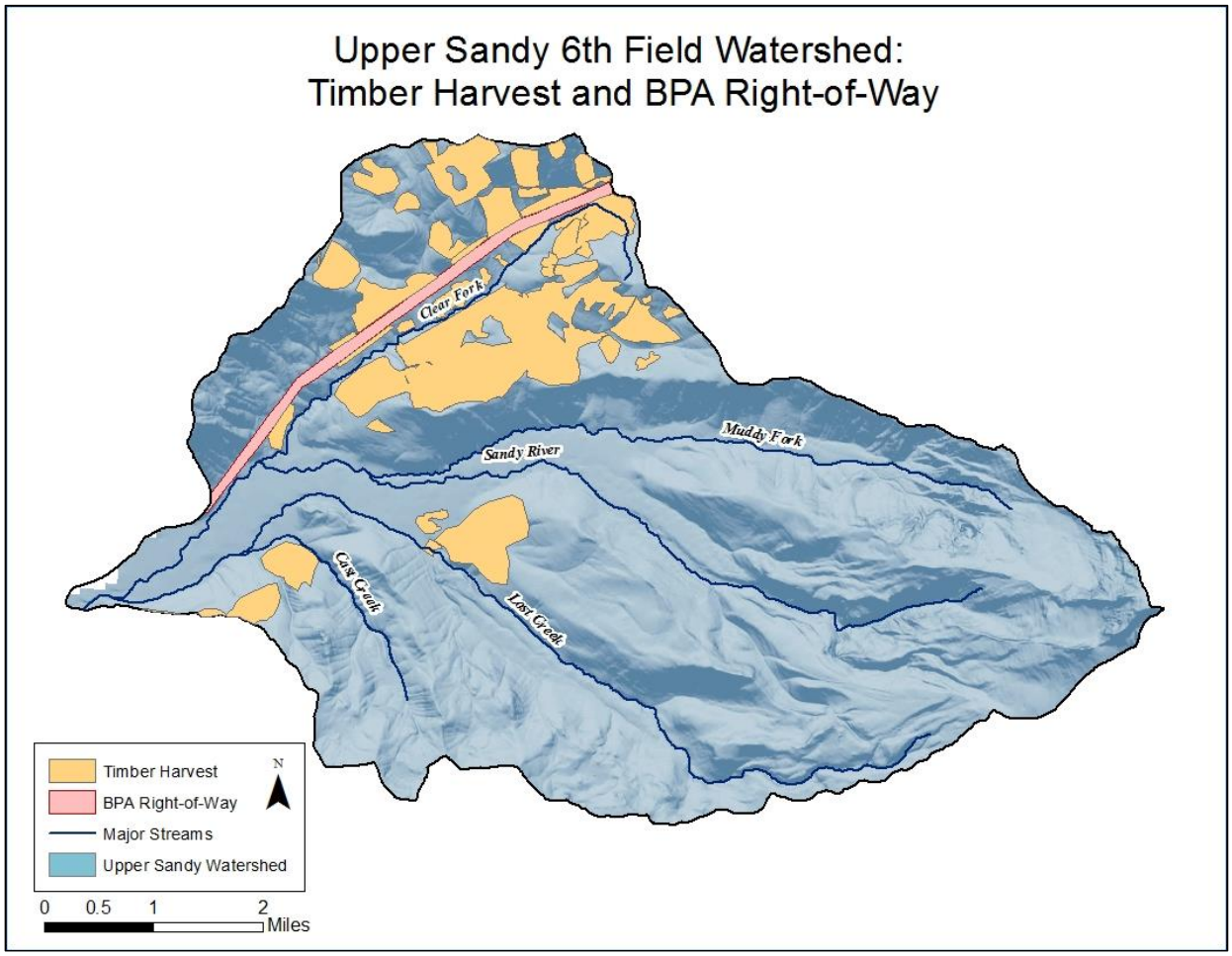

Figure 7. Map of BPA right-of-way and previous timber harvest units in the Upper Sandy 6th field watershed.

Invasive Weeds

The Upper Sandy watershed has been analyzed and is included in the Final Environmental Impact Statement for Site-Specific Invasive Plant Treatments for the Mt. Hood National Forest and Columbia River Gorge National Scenic Area in Oregon, Including Forest Plan Amendment Number 16. Surveys completed in 2004 documented invasive weeds such as orange hawkweed (*Hieracium aurantiacum*), spotted knapweed (*Centaurea stoebe*), and ragwort (*Jacobaea vulgaris*) (USDA 2008). Scotch broom (*Cytisus scoparius*) is also prevalent throughout the BPA right-of-way that crosses through the Clear Fork subwatershed.

Riparian Reserves

Canopy closure in the Upper Sandy watershed is greater than 70 percent for the majority of subwatersheds (USFS 1996). Lost Creek, Muddy Fork, and Cast Creek subwatersheds meet the natural condition with greater than 80 percent of the area in the riparian reserve with greater than 70 percent canopy closure. Clear Fork subwatershed has less than 50 percent of the riparian area with over 70 percent canopy closure. The powerline right of way is within 321 acres of the riparian reserve in the Clear Fork subwatershed and has reduced the riparian reserve canopy closure, along with timber harvest and roads.

The Upper Sandy watershed is dominated by small conifers with a small patches of old growth trees. Stream shade provided by existing riparian stands is adequate in all subwatersheds, with the exception of the poorly shaded Clear Fork. Subwatersheds with adequate stream shade are dominated by hardwood trees with some stands of mixed conifers. The Clear Fork lacks adequate stream shade from RM 1.8 to 4.8, a product of inadequate buffers and blowdown from timber harvests. Located within a portion of the riparian reserves are numerous infrastructures such as Lolo Pass Road, FS Roads 1825 and 1828, Forest Service campgrounds McNeil, Riley Horse Camp, and Lost Creek, and the BPA right of way. Future large wood recruitment has been impacted by human actions, historic volcanic mudflows, and past fire history.

Figure 8. Lost Creek Trib2 hardwood dominant riparian area.

Stream Bank Condition

Stream reaches with sensitivity to disturbance, sediment supply and stream bank erosion potential have been identified in the Upper Sandy River, Muddy Fork, Clear Fork and Lost Creek. Many of these stream reaches flow through mud flow deposits consisting of

poorly sorted material in a sandy matrix which leads to a highly erosive environment. These banks are prone to dry ravel once the bank angle becomes over-steepened and are prone to erosion from the stream channel at the toe slope causing bank failure. For the most part these are natural processes that occur in glacial valleys or in areas with glacial and volcanic mudflow deposits.

The Upper Sandy River has a significant amount of unstable substrate where private residences have been built along the river, at downstream end of the 6th field watershed. Human caused stream bank instability above the residential area is related to recreational uses including hiking, horseback riding, and campsite development. The Upper Sandy, Clear Fork, and Lost Creek are popular areas for medium to large groups to camp. Lost Creek Campground and Riley Horse Camp, both located on the banks of Lost Creek, have several areas of unstable stream banks related to foot traffic, horse traffic, and camping. Lost Creek Campground has a nature trail directly in the riparian area with some portions directly within the stream bed that reduces bank stability in the area.

Floodplain Connectivity

Streams within the Upper Sandy 6th field watershed have a history of large wood removal, channel cleanout, and limited construction which has caused down-cutting and impairment of floodplain connectivity. Though there has not been any quantification of length of side channels that have been cut off or reduced or their linkages to wetlands and floodplains, it is believed these processes have been reduced at the 5th field scale.

The Upper Sandy River and tributaries have a history of large wood removal and channel cleanout from past logging and flood "repair" operations, causing down-cutting and localized entrenchment with decreased flood plain connectivity. Connectivity has also been affected by campground management, private residence management and maintenance of associated infrastructures.

In-Channel Conditions

The Upper Sandy 6th field watershed is approximately 22,225 acres in size. It is compiled of four main subwatersheds: Upper Sandy River, Lost Creek, Clear Fork, and Muddy Fork. Lost Creek enters the Upper Sandy at river mile (RM) 45.3 and continues for 9.2 miles. Clear Fork enters the Upper Sandy River at RM 47.3, and continues for 4.6 miles. The Muddy Fork enters the Upper Sandy at RM 48.4, and continues for 3.7 miles. The Upper Sandy, Lost Creek, Clear Fork, and Muddy Fork are designated as anchor habitats within the Upper Sandy 5th field watershed. Other streams and reaches within the watershed do provide important habitat, though not to a higher degree or concentration of other similar reaches and channel types within the basin.

In-channel condition data is available from the Stream Management, Analysis, Reporting, and Tracking (SMART) database for streams within the boundaries of the Mt. Hood National Forest. Aquatic habitat types, pool abundance, and large wood data is available for the Upper Sandy River and tributaries. The Upper Sandy River and Muddy Fork have very limited pool habitat, mostly consist of riffle habitats, and contain little to no side channels. Clear Fork and Lost Creek are about 70 percent riffle, with 25 percent of less pool habitat and 15 percent or less side channel habitat. Stream structure in the Upper Sandy watershed is documented to have moderate to severe problems, indicating limited pools and limited debris.

Temperature

Modeled stream temperature data from the U.S. Forest Service NorWeST stream temperature project was used to assess historic, current and future stream temperatures in the Upper Sandy 6th field watershed. The NorWeST database provides highly accurate (R2=90%; RMSE<1.0 ˚C), high-resolution (1 kilometer) stream temperature scenarios for mean stream temperature at unique stream sites (Isaak et. Al, 2016). Stream temperature was modeled using the following set of spatial covariate predictors: air temperature, stream discharge, elevation, latitude, canopy cover, cumulative drainage area, stream slope, mean annual precipitation, and baseflow index.

The composite scenario used for assessment on the Upper Sandy 6th field watershed represented the 10 year average August mean stream temperatures from 2002-2011. Oregon Department of Environmental Quality (ODEQ) temperature criteria for fish use in the Upper Sandy basin was used as the threshold of concern (ODEQ, 2003). ODEQ identified the seven-day- average maximum temperature of a stream identified as having salmon and steelhead spawning use at various times of the year. In the Upper Sandy watershed, stream temperature is a concern only during the August 15-June 15 spawning season. The maximum temperature standard is 13˚C during these months. As shown in Figure 8, temperatures above 13^0C are limited to the lower reaches of Lost Creek and Cast Creek, placing them above the maximum temperature standard.

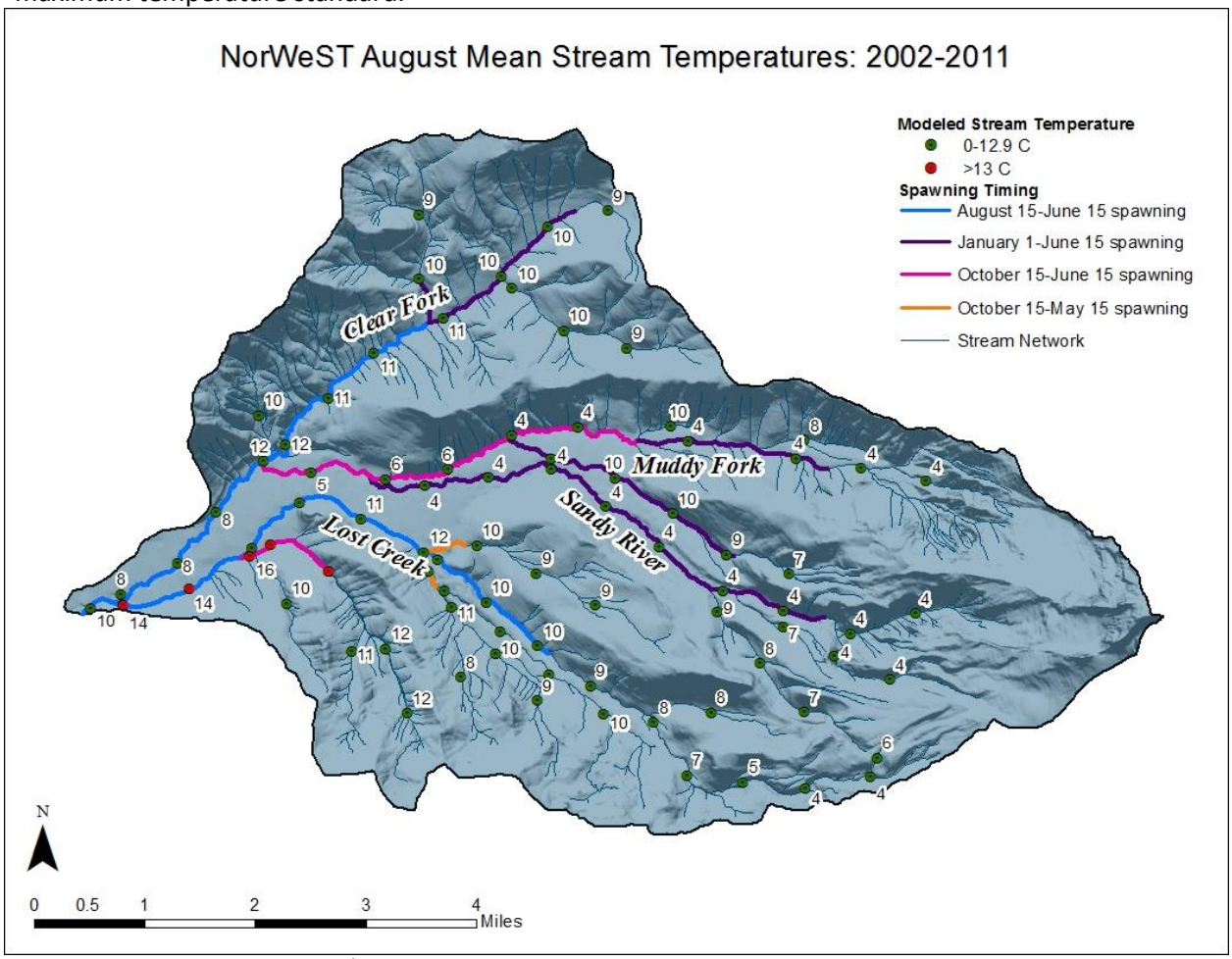

Figure 9. The Upper Sandy 6th field watershed NoRWeST stream temperature scenario for August 2002-2011, with ODEQ spawning use temperature standards.

Sediment and Substrate

The Oregon Department of Fish and Wildlife conducted sediment surveys on the Upper Sandy watershed in 2016, including Lost Creek, Muddy Fork, a tributary to the Muddy Fork, and a tributary to the Clear Fork. The Forest Service conducted a sediment survey on Clear Creek in 2003. Sand and gravel were found to be the most common sediment size in the reaches surveyed, as shown in Table 4.

Stream	Silt/organics	Sand	Gravel	Cobble	Boulder	Bedrock
Lost Creek	0	17	23	28	15	17
Muddy Fork	0	29	23	14	35	0
Clear Fork	0	23	66	9	1	0
Clear Fork tributary	9	12	16	22	26	14
Muddy Fork tributary	2	32	28	20	17	0

Table 4. Average percent substrate in streams in the Upper Sandy 6th field watershed.

The Forest Service surveyed the Upper Sandy River in 1996 and identified numerous spawning areas for resident and anadromous fish that were silted over (Serres 1996). It is most likely that fish moving up the Sandy River are heading to tributaries to spawn. Sediment was identified as a moderate issue for the Sandy River, Clear Creek and Lost Creek (USDA 1996). Human use, glacier runoff, flood damage, and unstable channels are the main cause for sedimentation. In the Muddy Fork, sediment was identified as a severe issue. It was found that most patches of gravels that could be utilized for spawning were associated with large wood structures (ODFW 2016). Clear Fork has significant sediment issues after large amounts of sediment were delivered from the 1996 flood event (SRBP 2005). Lolo Pass Road, Forest Service Road 1828, and the BPA access roads contribute additional sediment to the Clear Fork and its tributaries.

Physical Barriers

Stream passage barriers in the Upper Sandy River and tributaries are primarily of natural origin, with the exception of two culvert barriers on the 1828 and 1825-111 roads. The physical barriers are due to culverts are on Clear Fork Tributary B and a smaller Clear Fork unnamed tributary.

Lost Creek has a series of chutes and falls at RM 8.2 that present a physical barrier for anadromous fish passage. The Upper Sandy River has a waterfall barrier at RM 52. Trib2 and Trib3 to Lost Creek on FS Road 1825-111 are partial to full fish barriers depending on flow conditions.

Large Wood

Large woody debris (LWD) provides pool structure, sediment storage, substrate, channel roughness, and velocity refuge for biota. The Upper Sandy River and tributaries have a history of large wood removal and channel straightening and thus is well below the 80 pieces per mile (large sized) PIG standard, as depicted in Figure 9 (USDA 1996).

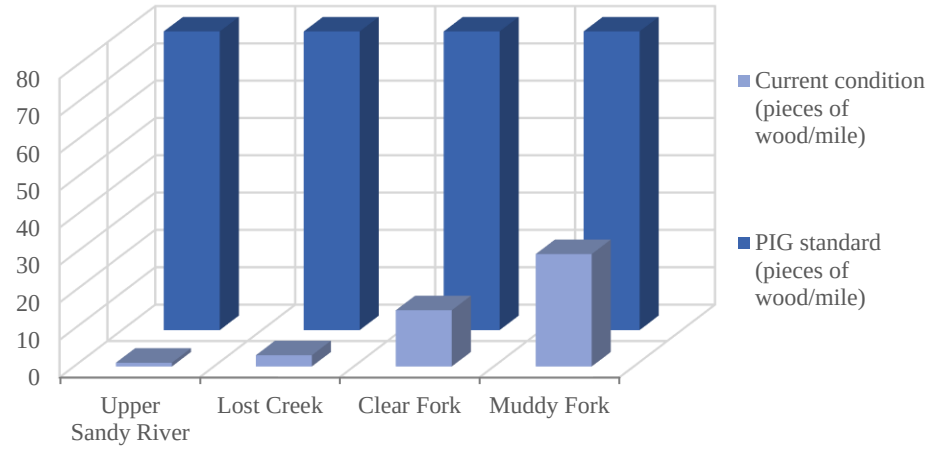

Figure 10. Current condition of Upper Sandy watershed streams compared to the PIG standard.

To assess trend in the in-channel large woody debris (LWD), the LWD recruitment potential of riparian reserves was assessed using the methodology from the DNR Standard Methodology for Watershed Analysis (USDA 1996). LWD recruitment potential was rated as high, moderate, or low based on stand age and dominant tree type.

Lost Creek, Muddy Fork, and the Upper Sandy are in areas that may not support stands that will grow trees over 21 inches and therefore may not have much high woody debris recruitment. These conditions are most likely natural conditions as a result of the streams coursing through silver fir stands and mudflows. In the Upper Sandy watershed, LWD levels are low and it appears that levels may stay that way due to limited opportunity for LWD recruitment. Additional LWD is needed in the Upper Sandy watershed streams to increase channel complexity and jumpstart habitat improvement until the forest stands can recruit wood to streams naturally.

Pool Frequency

Pools are formed by substrate, large wood accumulations or by root masses from stream banks that scour depressions into the channel bottom. Pool frequency is usually inversely related to stream gradient, in healthy systems. Past anthropogenic actions have simplified stream channels and floodplains and decreased future large wood recruitment. These include road building, logging, stream cleanout, firewood cutting, residence construction, developed and dispersed camping, and hazard tree removal. Past volcanic mudflows and fire in the watershed in the last two centuries further exacerbated the situation by leaving most riparian stands in mid-seral condition or stunted in growth.

Frequency of pools for most reaches of the Upper Sandy and its tributaries are well below the range or natural variation and LRMP standards (USDA 1996). The number of pools per mile compared with the Columbia River Basin Project Implementation Guide (PIG) standards is depicted in Figure 10.

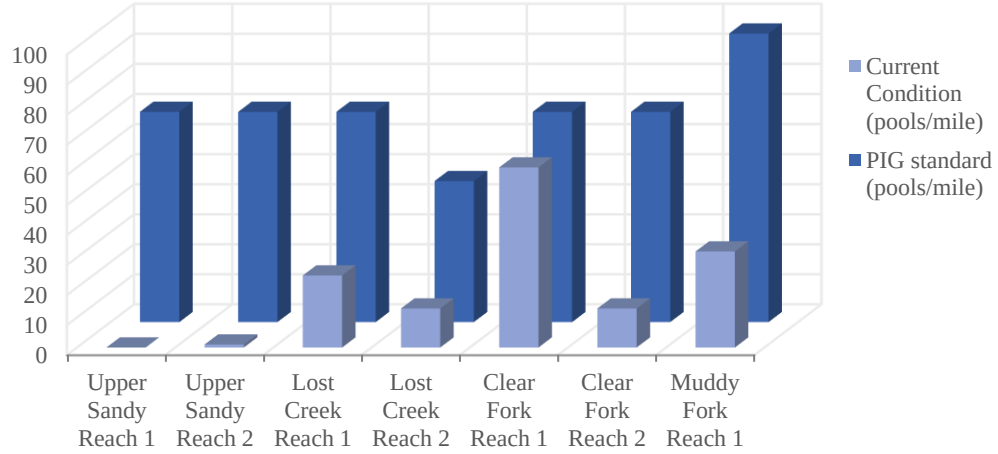

Figure 11. Existing pools per mile for the Upper Sandy River, Lost Creek, Clear Fork, and Muddy Fork compared to the PIG standard based on stream size.

Pool Quality

To assess pool quality, pool volumes within sections of the Upper Sandy watershed were compared to two similar streams in the Bull Run River watershed that reflect undisturbed conditions (USDA 1996). The relationship between pool levels and pool volume was examined to determine if the number of pools was well correlated with the pool quality as expressed by pool volume. Pool levels above the mid-range of the range of natural variation were found in Clear Fork and Lost Creek. The Upper Sandy River and the Muddy Fork have pool numbers at the high end of the range of natural variation and pool volume at the low end of the range of natural variation, indicating small, lower quality pools.

Off-Channel Habitat

High quality side channel habitat with large wood functioning as a roughness element and cover appears to be lacking within the watershed. Clear Fork has few side channels that are accessible year round, while others that have been filled or cut off from main river flows. Muddy Fork has zero off-channel habitat (ODFW 2016). Lost Creek has very limited off-channel habitat due to incision, except for a short reach near RM 1.7 (USDA 1992). Most side channel fish habitat has been simplified or disconnected by removing down large wood. The conversion of riparian stands from a multi-layer overstory dominated by conifers to simple, single thread channels dominated by hardwood overstories has reduced large wood recruitment to roughen the floodplain and create side channels. Off channel habitat opportunities have also been greatly decreased by channel straitening after the 1964 floods. In several streams, straitened channels have resulted in downcutting and further abandonment of connectivity to the floodplain side channels. Furthermore, with the removal of large wood from natural and anthropogenic causes, existing off channel habitat has been simplified and cover provided by these structures reduced.

Side channel and off channel habitat is critical to several life history stages of anadromous fish. High quality side channel habitat with large wood debris jams and single pieces providing roughness elements, cover and refugia during spawning, feeding and rearing of adult and juvenile fish is the desired condition. Available habitat has been greatly decreased in the Upper Sandy watershed, particularly in Lost Creek and Clear Fork. Causes include road building in and along riparian areas, past logging, recreational use, past fire history, and firewood cutting.

Width/Depth Ratio

Stream channels and floodplains in the Upper Sandy watershed have been simplified and modified due to channel cleanout that has occurred after major floods. Stream bank erosion due to human use and the geology of the watershed has simplified and down-cut channels. Table 5 is a summary of width to depth (W/D) ratios taken from Mt. Hood National Forest and Oregon Department of Fish and Wildlife stream surveys.

Table 5. Upper Sandy 6th field watershed width/depth ratios.

Stream Name and Reach Number	W/D Ratio
Clear Fork Reach 1	25
Clear Fork Reach 2	39
Clear Fork Reach 3	16
Clear Fork Reach 4	36
Clear Fork Reach 5	21
Lost Creek Reach 1	28.3
Lost Creek Reach 2	18.4
Lost Creek Reach 4	6.3
Upper Sandy River Reach 1	31.8
Upper Sandy River Reach 2	21.5
Upper Sandy River Reach 3	16.5
Upper Sandy River Reach 4	22.7
Muddy Fork	16.1

Limiting Factor Analysis for Anadromous Fish

Sandy River Basin Partners developed a basin-wide analysis of 23 reaches in the Upper Sandy watershed using the Ecosystem Diagnosis and Treatment Model (EDT) (SRBP 2005). The following description of EDT is an excerpt from the Mobrand Biometrics website (http://www.mobrand.com/edt.htm):
"The Ecosystem Diagnosis and Treatment (EDT) is a species habitat-relationship model developed for anadromous and resident salmonids. It has been developed over a number of years primarily by state, tribal, local and private interests in the Pacific Northwest. This type of mode links habitat characteristics to biological features of fish and wildlife species. In practice, EDT is a process for assembling and organizing watershed information as a basis for development and implementation of recovery and management plans. It is based on the premise that restoration of specific species will primarily involve restoration of their ecosystems. EDT provides a detailed depiction of the environment and an assessment of that environment with regard to performance of fish and wildlife populations. Environment includes physical habitat features as well as biological interactions such as predation and competition. Reach specific data for 46 parameters are loaded into the model for both existing (Patent) condition and historic (Template) conditions, based on range of natural variation. Model outputs allow for

interpretation of variance between existing and historic conditions and cumulative adverse impacts to target juvenile salmonids. Cumulative impacts are tallied as fish move downstream through other reaches to the Columbia River, Pacific Ocean and then as they return as adults."

The Sandy River basin EDT model analysis was populated with stream survey data from Forest Service Level II stream surveys, ODFW physical habitat surveys, and BLM aquatic surveys. Initial analysis was completed by Mobrand Biometrics first in 2002 and updated in 2004 for the entire Sandy River basin. Table 6 displays model results for the Upper Sandy watershed with the three most limiting factors on production based on a comparison of existing aquatic conditions (Patent) and historic (Template) or those conditions that were believed to be within the Range of Natural Variability (RNV). Historic conditions are for habitat types that persisted prior to European settlement (approximately 1850's). The reader is encouraged to explore the entire Sandy River basin EDT analysis document to gain a basin-level understanding of fisheries issues.

Table 6. Streams and reaches within the Upper Sandy watershed with the two most limiting factors outlined in EDT for coho and Chinook salmon and winter steelhead production.

1. Limiting Factor			**2. Limiting Factor**		
Chinook	Coho	Steelhead	Chinook	Coho	Steelhead
Habitat Diversity, Sediment Load	Habitat Diversity	Sediment Load	Channel Stability, Flow, Temperature	Channel Stability, Flow, Sediment Load	Flow, Habitat Diversity

Restoration Goals, Objectives, and Opportunities

Goal Identification

The goal of the Upper Sandy River WRAP is to provide and operational scale tool for restoring the watershed by strategically focusing investments in essential watershed improvement projects and conservation practices at the 6th field watershed scale that tiers to the larger Sandy River basin restoration strategy, which all of the Sandy River basin partners are heavily invested in. With the completion of the Sandy River Basin Aquatic Habitat Restoration strategy, participating entities now coordinate future investments in aquatic habitat restoration in a manner that leverages limited resources where they provide the greatest benefits to the long-term recovery and healthy functioning of salmon and steelhead habitat in the basin (SRBWG 2007). The Upper Sandy WRAP builds on and refines the broader restoration plan. Disproportionately important salmon and steelhead anchor habitats will be restored to maximize the potential of the habitat for anadromous fish production. The projects are primarily targeted toward increasing habitat complexity and channel stability. Restoration work will continue until the essential projects are completed. Project planning and implementation will be integrated with forest, district and Sandy River basin partner priorities.

Desired Condition

The desired condition for the Upper Sandy watershed is a resilient and properly functioning watershed which exhibits appropriate water quality and quantity, diverse and complex terrestrial, riparian and aquatic conditions, and self-sustaining wild populations of anadromous and resident fish species.

The U.S. Forest Service will manage U.S. Forest Service lands to protect, restore, and maintain water quality so that Federal and State water quality goals and water quality standards are met or exceeded in accordance with applicable laws and regulations. Two national programs provide the foundation for water quality protection and restoration on U.S. Forest Service lands: 1) the National Best Management Practices for Water Quality Management, which focuses on protecting water quality while implementing numerous, diverse activities across the landscape (see below); and 2) the Watershed Condition Framework, which focuses on implementing integrated, whole watershed restoration programs in priority watersheds on U.S. Forest Service lands (http://www.fs.fed.us/publications/watershed/Watershed Condition Framework.pdf).

Objectives

Alignment with National, Regional, and Forest Priorities

The Upper Sandy 6th Field WRAP tiers to the 1996 Upper Sandy 5th Field Watershed Analysis (WA) (USDA 1996) – per direction under the Aquatic Conservation Strategy (ACS) of the 1994 Northwest Forest Plan (USDA and USDI 1994). The 2007 Sandy River Basin Aquatic Restoration Plan (SRBWG 2006, 2007) was completed to guide implementation of restoration in the priority Sandy River basin per direction under the 2005 R6 Aquatic Restoration Strategy (ARS) (USDA 2005). The 2005 strategy was later replaced with the 2008 R6 Aquatic Restoration Conservation Strategy (ARCS), a foundational regional strategy for incorporation into forest plans (USDA 2008).

The 2017 Upper Sandy 6th field WRAP is an update to the 2007 Sandy River Basin Aquatic Habitat Restoration Strategy under the guidance of the national 2010 Watershed Condition Framework (WCF) (USDA 2010).

Alignment with State or local goals

The Sandy River Basin Aquatic Restoration Strategy is a cohesive, comprehensive, and collaborative approach that builds upon the breadth and diversity of existing partnerships. All of the participating entities in the basin readily supported the development of such a strategy for the Sandy River basin. The aquatic habitat restoration strategy for the Sandy River basin provides a geographic focus and hierarchical framework for directing future investments toward high priority restoration needs (SRBWG 2007).

The strategy:

- Identifies priority watersheds in the basin (at the 5th, 6th, and 7th field scales) that provide the cornerstones for addressing freshwater habitat restoration needs of Sandy
- River basin salmon and steelhead populations.
- Establishes the hierarchy, or sequence, in which actions should be pursued in order to achieve maximum resource benefits.
- Describes the factors limiting salmon and steelhead abundance, productivity, spatial distribution, and diversity. Many of these same factors also limit water quality.
- Defines specific restoration actions (and types of restoration actions where they are not known site-specifically) in priority watersheds necessary to address limiting factors.

The Upper Sandy 6th field WRAP is an update to the 2007 Sandy River Basin Aquatic Habitat Restoration Strategy (SRBWG 2007) under the guidance of the national 2010 Watershed Condition Framework (USDA 2010). This 2017 WRAP adjusts updates and/or adds essential projects as needed to improve the sub-watershed condition class, which addresses an outcome-based performance measure of progress

toward restoring the productivity and resilience of the watershed. The Upper Sandy 6th field WRAP can be viewed as the operational scaled (HUC12) plan which tiers to the broader Sandy River basin restoration strategy.

Opportunities

Partnership Involvement

As described in the background section of this document, a strong and productive partnership exists within the Sandy River basin. This coalition of partners has collectively completed several significant accomplishments, furthering conservation and recovery efforts for salmon and steelhead populations in the basin, through a robust restoration strategy that coordinates future investments in aquatic habitat restoration in a manner that leverages limited resources where they provide the greatest benefits to the long-term healthy functioning habitat in the basin (SRBWG 2007). For more information visit: www.sandyriverpartners.org

All of the partners are committed to and heavily invested in the Sandy River basin aquatic habitat strategy. The Upper Sandy 6th field WRAP sharpens focus at a 6th field watershed scale and provides the operational footprint for completing restoration actions that are part of the broader basin-wide planning effort. The Sandy River basin partners meet bi-monthly to coordinate/strategize funding opportunities, plan projects, discuss implementation logistics, and maintain strong working relationships.

Agreements & Funding Partners

The Sandy River basin partners have a robust portfolio of agreements and funding already in place and out-year strategies prepared to continue funding streams and partnerships. Some of these instruments include: Challenge Cost Share Agreements, Whole Watershed Restoration Initiative (WWRI), Oregon Watershed Enhancement Board (OWEB), PayCo, and USFS BLI's including NFWF, NFVW and CMLG, and 14 entities with internal funding opportunities (see below).

Restoration Planning and Implementation Partners

The following entities will continue to work together in both planning and implementation phases of WRAP execution.

Clackamas County	www.co.clackamas.or.us
Columbia Land Trust	www.columbialandtrust.org
METRO	www.oregonmetro.gov
Mt. Hood National Forest	www.fs.fed.us/r6/mthood
Multnomah County	www.co.multnomah.or.us
National Marine Fisheries Service	www.nmfs.noaa.gov
Nature Conservancy	www.nature.org
Northwest Steelheaders	www.sandysteelheaders.org
Oregon Department of Fish and Wildlife	www.dfw.state.or.us
Portland Water Bureau	www.portlandonline.com/water
Sandy River Basin Watershed Council	www.sandyriver.org
The Freshwater Trust	www.thefreshwatertrust.org/
USDI Bureau of Land Management	www.blm.gov/nhp
Western Rivers Conservancy	www.westernrivers.org

Outcomes/Output

Performance Measurement Accomplishment

- Restore natural watershed processes, including riparian function, in-channel habitat, reduce road related impacts, and eradication of invasive plants to recover/improve production of ESA listed salmon and steelhead.
- Improve water quality in the Upper Sandy 6th field watershed by improving riparian forest health through additional shading to surface waters and through a reduction in sediment delivery from road related impacts.
- Provide educational engagement opportunities for local private landowners and the general public to learn about watershed restoration.
- Maintain and strengthen partnership between the Mt. Hood National Forest, the coalition of Sandy River basin partners, local communities, and private landowners.
- Provide jobs to local contractors, material suppliers, and the sport fishing and recreation industry.

Socioeconomic Consideration

- Work to be performed in the Upper Sandy 6th field watershed will contribute to the local communities' and broader Portland metropolitan socioeconomic success by:
- Providing jobs to local contractors by implementation of road and in channel work utilizing heavy equipment, such as front loaders, excavators, dump trucks, bull dozers, helicopters, yarders and log hauling trucks.
- Employing contractors to supply materials not readily available on the forest, such as rock, logs, culverts, tools, and other supplies.
- Hiring engineering firms with expertise in river restoration to design in stream structures appropriate for hydraulic conditions.
- Contracting work involving tree thinning/hauling/invasive species removal and riparian planting work.
- Continued interaction with established and dispersed campground users and day-use recreationist on forest land to help facilitate greater conservation awareness.
- Restoration of the Upper Sandy 6th field watershed will contribute to numerous efforts to conserve and restore severely depressed populations of salmon and steelhead. These species provide a fishery that not only employs local guides, but also fuels the local tackle retailers/manufactures, boat manufacturing companies, and numerous other small businesses that depend on angling revenue.
- During high flow events, the Sandy River and tributaries are prone to cause property damage to private residences downstream. Restoring side channels, providing channel roughness, and restoring floodplain connectivity will minimize the effects of legacy management which sought to create a hydraulically smooth environment.
- This project contributes to the recovery of several species of ESA listed fish, which are part of the heritage of the Pacific Northwest.

Specific Project Activities (Essential Projects)

Past Restoration Efforts

Historically the Upper Sandy watershed, primarily Lost Creek and Clear Fork, provided high quality spawning and rearing habitat for coho, spring Chinook, winter steelhead, and cutthroat trout. The Upper Sandy watershed has been identified as an anchor habitat for coho and winter steelhead that provides key spawning and rearing habitat due to the habitat and spring fed characteristics (SRBWG 2007). The Upper Sandy Watershed Analysis (USFS 1996) covered the Upper Sandy 6th field watershed. The watershed analysis identified restoration opportunities at the watershed scale that support broad ecosystem management objectives described in the Northwest Forest Plan. Other documents such as the Sandy River Basin Characterization Report and the Sandy River Basin Aquatic Habitat Restoration Strategy also identified habitat conditions, restoration opportunities, and evaluated limiting factors for fisheries production. Juvenile steelhead and coho densities have declined in recent years and are believed to be lower than those found in similar, less disturbed streams. Aquatic habitat conditions are believed to limit egg and fry survival, winter habitat for juvenile steelhead trout, and summer habitat for coho salmon, resulting in population declines for those species. The main cause of these declines is likely habitat degradation and loss of aquatic ecosystem function from roads, stream cleanouts, channel straightening, historic fires, and historic timber harvest along the stream corridor (SRBP 2005, SRBWG 2007, USFS 1995).

Throughout the 1980's and 1990's, large wood and boulders were added to Lost Creek and Clear Fork to increase aquatic habitat complexity. These structures were often a single log cabled to large boulders or key trees. Since that time, flood events have caused many of these structures to become mobilized and they now provide little habitat benefits. Many of these large pieces of wood are now parallel to the flow of the stream. However, some structures have accumulated woody debris and formed large pools and accumulated spawning sized gravel.

Loss of aquatic function from roads due to mass road failures and high amounts of road-related sediment are well documented. Decommissioning roads in the Sandy River basin has been one of the top priorities. From 2009 to 2011, 100 percent of the planned road decommissioning restoration was completed with the exception of decommission with delay roads. However, numerous stream crossings within the basin have undersized culverts that need maintenance or should be completely replaced with appropriate size culverts.

Prioritizing watershed on the National Forest

Upper Sandy watershed, located on the Mt. Hood National Forest, is a 6th field watershed in the Sandy River basin and is a top priority watershed for habitat improvements within the hierarchy of priorities of the SRBWG (2007). Upper Sandy watershed restoration would likely provide the biggest return on investment in the Sandy River basin, third to the Salmon River and Still Creek watersheds, where restoration was completed in 2019. This watershed was identified by the SRBWG as an anchor habitat for coho salmon and winter steelhead trout (SRBWG 2007). Historically, the Upper Sandy watershed, including Lost Creek and Clear Fork, provided high quality spawning and rearing habitat for spring Chinook salmon, coho salmon, winter steelhead trout, and cutthroat trout (SRBP 2005). Next to the Salmon River and Still Creek, the Upper Sandy watershed provides the highest densities of spawning and rearing habitat for salmonids in the Sandy River basin. The largest limiting factor to salmonid production in the Upper Sandy watershed is the lack of isolated side channels and off channel habitats (1st restoration priority; SRBWG 2007). Because Upper Sandy has already been identified as a priority

restoration watershed (SRBWG 2007), the USDA Mt. Hood National Forest will implement the Watershed Condition Framework (WCF) restoration actions in this watershed. The Forest Service WCF is designed to proactively implement integrated restoration on priority watersheds and to enhance communication and coordination with partners (USDA 2011).

Prioritizing essential projects

The goal of the Upper Sandy WRAP is to accelerate the recovery of naturally functioning conditions within stream channels and riparian areas to improve long and short term survival and restore production of juvenile and adult coho salmon, spring Chinook salmon, winter steelhead, and cutthroat trout. The series of projects proposed as "Essential Projects" (Table 9) are intended to accomplish these goals by restoring riparian health and vigor by restoring flood plain resiliency with coarse woody debris and large wood floodplain structures designed to protect recovering pioneer riparian vegetation during peak flow events. Stream channels and aquatic habitat will be rehabilitated by installing and modifying existing large wood structures in specific locations along Lost Creek and Clear Fork that would give the most benefit to increasing aquatic habitat diversity and resiliency. In addition, these projects are designed to accelerate the recovery and diversity of riparian stands by maximizing the growth of conifers by thinning and under-planting riparian stands. A rapid response approach will be used to remove invasive plants that are now attempting to get established. Addressing under-sized culverts will reduce road-related sediment from entering the streams by reducing road fill failures. Partners within the Sandy River basin fully support and have prioritized these proposed essential projects for the recovery of the entire basin.

Essential Project Activities

Essential projects will directly address key attributes that are limiting factors described in this document. These projects will restore riparian health and vigor by restoring riparian resiliency with coarse woody debris and large wood floodplain structures designed to protect recovering pioneer riparian vegetation during peak flow events. Aquatic habitat will be rehabilitated by installing large wood structures in specific locations along Lost Creek, Clear Fork, and additional reaches within the Upper Sandy watershed that would give the most benefit by increasing aquatic habitat diversity and resiliency. Restoration projects in this plan include instream habitat restoration, fish passage, riparian enhancements, culvert replacement, ditch line rehabilitation, and water quality improvements (Table 7). Riparian enhancements include the thinning of red alders and crowded conifer stands, invasive plant removal, and decommissioning dispersed campsites that impede riparian function. Fish passage will be returned to a to tributaries of Lost Creek and Clear Fork that have excessive jump heights and are limiting juvenile salmonid migration. Undersized culverts will be replaced to enhance fish passage and limit road-related sediments from entering the streams. Additionally, ditch lines will be rehabilitated to provide proper drainage while limiting unnatural sediment transport to the streams.

Table 7. Specific project activities (Essential Projects). All project activities occur on the USDA, Mt. Hood National Forest in the Upper Sandy 6th field watershed.

Essential Project Number*	Project Name	Project Description	Output or improvement	Cost
Instream Restoration				
1	Cast Creek	Increase river complexity and floodplain connection (RM 0.0 – 1.0)	1.0 miles	$92,000
2	Clear Fork 1a, 1b, 1c, and 1d	Increase river complexity and floodplain connection (RM 0.0 – 4.4)	4.4 miles	$441,000
3	Lost 1a and 1b	Increase river complexity and floodplain connection (RM 0.0 – 4.5)	4.5 miles	$586,000
4	Lost Trib2	Increase river complexity and floodplain connection (RM 0.0 – 0.25)	0.25 miles	$25,000
Recreation Impacts (Riparian and Water Quality Restoration)				
5	Dispersed Campsite Rehabilitation	Rehabilitate riparian conditions at dispersed campsites reducing sediment input	20 acres	$20,000
6	Developed Recreation Site Rehabilitation	Lost Creek Campground, Riley Horse Camp, McNeil Campground, Ramona Falls and Top Spur Trailhead.	10 acres	$45,000

Table 7 continued.

Essential Project Number*	Project Name	Project Description	Output or improvement	Cost
Roads				
7	Decommission Road 1828-125	2.5 miles decommission with delay	2.5 miles	$42,500
8	Decommission Road 1828-180	1.3 miles decommission with delay	1.3 miles	$22,100
9	Decommission Road 1825-380	0.1 miles decommission	0.1 miles	$1,700
10	Decommission Road 1828-118	1.6 miles decommission after Top Spur Trailhead	1.6 miles	$27,200
11	Decommission Road 1828-024	0.1 miles decommission	0.1 miles	$1,700
12	Decommission two unauthorized user defined roads along 1825 and 1828 roads	0.20 miles decommission	0.2 miles	$3,400
13	Road 1825-111	Replace culverts	2 AOP crossings	$500,000
14	Road 1825-109	New cross-drain culvert and rehabilitate ditch line	1 culvert; 0.15 miles of ditch line	$20,000
15	Road 1828	Replace culverts	26 culverts; 2 AOP	$825,000
16	Road 18	Replace culverts	12 culverts	$1,200,000
17	BPA Road System	Stormproof and gates	2 gates; 4.8 miles	$78,000
Other Riparian and Water Quality Restoration				
18	Invasive plants	BPA corridor, 18, 1825, and 1828 roads	312 acres	$45,000

Total cost of essential projects= **$3,975,600**

Essential Projects #1 through #4 Instream Restoration Activities

Project Name: Upper Sandy Instream Restoration

1. Cast Creek; 2. Clear Fork 1a, 1b, 1c, and 1d; 3. Lost Creek 1a and 1b; and 4. Lost Trib2

Attribute Addressed: 1.2 Water Quality Problems – Summer Temperature, 3.1 Aquatic Habitat – Habitat Fragmentation, 3.2 Aquatic Habitat – Large Woody Debris, and 3.3 Aquatic Habitat – Channel Shape and Function.

Project Description: The Upper Sandy River has sporadic stream dikes and stream channel straightening were constructed throughout the streams to protect roads or recreation areas in the past which has reduced floodplain connectivity and entrenched stream segments. Low levels of downed woody debris are a result of poor riparian conditions and stream "clean-outs" (LWD removal) after various flood events such as the 1964 flood. The depositional areas below the alluvial fan pinch points are naturally dynamic however with poor riparian conditions and lack of downed woody debris have increased lateral stream channel migration and avulsion rates. Stream bank stability and terrace erosion rates are also high due to the accelerated channel instability and have generated high bank-full and low flow width to

depth ratios and reduced pool quantity and quality. The accelerated channel migration rates and future floods pose a high risk to downstream areas in the channel migration zone. The lack of floodplain roughness has allowed the stream to lose sinuosity that has led to the increased gradient of the reach. The increase in slope and loss of sinuosity has also significantly altered pool and riffle spacing.

Previous habitat enhancement efforts have improved conditions to some degree, however approximately half of the habitat structures have been damaged from previous peak flow events. The damaged structures have been dislodged from their original orientation or location and either were rotated parallel to the flow or deposited on the floodplain. Although these structures are not meeting their original objectives, most are still providing some habitat value or are providing roughness to the floodplain and helping to protect pioneer riparian vegetation.

The objectives of the four essential projects are to accelerate the recovery of aquatic habitat by restoring floodplain resiliency and integrity, restoring side channels, alcoves, ground water channels, pool frequency, pool volume, and hiding cover. These objectives would be accomplished through construction of numerous LWD structures, dike removal, and construction or enhancement of off channel habitats. Nearly 2,980 logs and 1,115 whole trees will be used to construct structures to achieve the objectives. Completion of this project will rehabilitate over 10 miles of stream habitat.

Land Ownership: National Forest System Lands

Partners Involvement: The Forest Service has partnered with The Freshwater Trust, Bureau of Land Management, and the SRBWC who have been instrumental in securing funds through OWEB, Ecotrust's WWRI, National Forest Foundation, Nation Fish and Wildlife Federation, and Portland Water Bureau HCP grants. The Forest Service has partnered with TEAMS Enterprises for completing the designs of all instream and riparian rehabilitation projects. Partners from ODFW, U.S. Fish and Wildlife, NOAA, U.S. Bureau of Land Management, METRO, The Nature Conservancy, The Freshwater Trust, SRBWC, Portland Water Bureau and FS staff from other National Forests have actively reviewed the designs for all instream and riparian habitat restoration projects. Portland Water Bureau and ODFW have been key organizations providing the funding needed to monitor pre- and post-projects.

Timeline: NEPA analysis was completed in 2018. Project implementation will occur 2018 – 2022 and monitoring will be continue for five years.

Estimated costs and Associated BLI: $1,144,000; NFWF and NFVW

Essential Project #5 Dispersed Recreation Site Rehabilitation

Project Name: Dispersed Campsite Rehabilitation

Attribute Addressed: 7.2 Soils – Soil Erosion and 5.1 Riparian Vegetation – Vegetation Condition

Project Description: The Upper Sandy 6th field watershed is a popular area for recreation that includes: kayaking, hiking, fishing, and camping. Over the years, numerous user-created campsites and trails have been established in the riparian corridor associated with these activities. These areas have been heavily impacted with severely reduced ground cover, shrubs, and young trees resulting in increased bank erosion and sediment delivery to streams. The objectives of the Dispersed Campsite Rehabilitation Project will be to fully decommission some of the campsite, remove trails, vehicle turnouts, and reduce

the size of other campsites. User-developed campsites will be fully decommissioned using hand tools and a mini-excavator. Hand tools will be used to de-compact the soils and plant a mix of native hardwoods, conifers, and shrubs. A mini-excavator will be used to place downed wood throughout sites to discourage future use. Trails will be removed by planting a mix of native plants throughout the impacted area and scattering large downed wood to discourage future use. The de-vegetated footprint and impact of six user developed campsites will be reduced in size by restoring 2.5 acres with native trees and shrubs and placing downed large wood around the perimeter of these sites. Overall, 20 acres of riparian habitat will be stored in the Upper Sandy Watershed by this project.

Land Ownership: National Forest System Lands

Partners Involvement: Wilderness Volunteers, Timber Lake Job Corps, Mazamas, Sandy River Basin Watershed Council, National Forest Foundation.

Timeline: NEPA was completed in 2013 and 2018. Implementation will be conducted 2018 - 2022.

Estimated costs and Associated BLI: $20,000; NFRW, NFWF, and NFVW

Essential Project #6 Developed Recreation Site Rehabilitation

Project Name: Developed Recreation Site Rehabilitation

Attribute Addressed: 7.2 Soils – Soil Erosion and 5.1 Riparian Vegetation – Vegetation Condition

Project Description: Lost Creek Campground, McNeil Campground, Riley Horse Camp, and Top Spur Trailhead are important and popular areas for recreation on Mt. Hood NF.

These developed recreation sites are extremely popular leading to resource damage in the riparian reserve. Some user created trails will be fully decommissioned using hand tools and a mini-excavator. Hand tools will be used to de-compact the soils and plant a mix of native hardwoods, conifers, and shrubs. A mini-excavator will be used to place downed wood and boulders throughout sites to discourage future use. Trails will be removed by planting a mix of native plants throughout the impacted area and scattering large downed wood to discourage future use.

In Lost Creek Campground, a board walk was constructed in the 1980's to encourage fishing and educate recreationists on riparian functions. However, this board walk is constructed in the 5-year flood prone zone and constructed with treated wood. This board walk impedes riparian function and continues to release harmful chemicals into Lost Creek. The objective of this project is to move the board walk out of the 100-year flood prone area while maintaining an educational experience for people that recreate on Mt. Hood NF.

Land Ownership: National Forest System Lands

Partners Involvement: Wilderness Volunteers, Timber Lake Job Corps, Mazamas, Sandy River Basin Watershed Council

Timeline: NEPA was completed in 2013 and 2018. Implementation will be conducted 2018 - 2022.

Estimated costs and Associated BLI: $45,000; NFRW, NFWF, and NFVW

Essential Projects #7 - #12 Road Decommissioning

Project Name: Upper Sandy Road Decommissioning: 7. Road Decommission 1828-125; 8. Road 1828-180; 9. 1825-180; 10. 1828-118; 11. 1828-024; 12. Unauthorized user created roads.

Attribute Addressed: 6.1 Open Road Density, 6.2 Road Maintenance, 6.3 Road Proximity to Water, 6.4 Mass Wasting, and 7.2 Soil Erosion

Project Description: The Upper Sandy Road Decommissioning Project encompasses a variety of restorative actions within the watershed. Road decommissioning would result in removal from the road network and either active or passive decommissioning. Active decommissioning entails complete obliteration of the road surface, restoring the natural slope, and removing all culverts. 5.8 miles of road are proposed for decommissioning

Land Ownership: National Forest System Lands

Partners Involvement: Bark, Wilderness Volunteers, and The Freshwater Trust. Likely cost share funding sources include OWEB, WWRI, and CCS.

Timeline: The NEPA for this project was completed in 2010. Implementation would not occur until after vegetation management activities are concluded in the area so the various road decommissioning actions would be phased in over a several year period likely beginning in 2020 and ending in 2023. Monitoring would occur for 5 years following implementation.

Estimated costs and Associated BLI: $98,600; NFVW, retained receipts

Essential Project #13 - #16 Culvert Replacements

Project Name: Upper Sandy Culvert Replacements. 13. Road 1825-111 (2) AOP crossings; 14. Road 1825-109 new cross drain culvert and dich line enhancement; 15. Road 1828 (2) AOP's and replace 26 undersized culverts; and 16. Road 18 replace 12 undersized culverts. See Appendix A for list of priority culverts.

Attribute Addressed: 3.1 Aquatic Habitat – Habitat Fragmentation, 6.2 Roads and trails- Road Maintenance, 6.3 Roads and trails- Proximity to water, 6.4 Roads and Trails- Mass wasting

Project Description: Four culverts in the Upper Sandy River Basin have been identified as a barrier to fish passage, are undersized, and cannot pass a 100-year flood. The project objective is to install a road crossing structure that provides anadromous and resident salmonid passage and is large enough to pass a 100-year flood including debris. 38 culverts with streams are not fish bearing, but the existing pipes do not have the capacity to carry a 100-year flood. The project objective is to install stream crossing structures that is large enough to pass a 100-year flood including debris.

Land Ownership: National Forest System Lands

Partners Involvement: Partner involvement would primarily be for funding acquisition. While all the basin partners support fish passage improvement, the following are key partners in terms of funding acquisition: Federal Highways/ODOT – FLTP grants, ODFW, The Freshwater Trust, and Sandy River Watershed Council. Likely cost share funding sources include OWEB and CCS.

Timeline: NEPA analysis for this project has been completed in 2018. The MHNF is currently designing the replacement structure and intend to install the new crossings in 2020 - 2023 pending funding. Monitoring completed within one year of project implementation.

Estimated Costs and Associated BLI: $2,545,000; CMLG, retained receipts

Essential Project #17 BPA Access Road Storm-Proofing

Project Name: BPA Powerline Road Storm-proofing

Attribute Addressed: 6.2 Road Maintenance, 6.3 Road Proximity to Water, 6.4 Mass Wasting, and 7.2 Soil Erosion

Project Description: The BPA power line runs through the Upper Sandy River Watershed for approximately 6 miles. Along its entire length there are roads, primarily native surface, to allow BPA crews access for maintenance and repairs to the powerlines and towers. These roads are not meant for public travel and little to no maintenance occurs. This project would storm proof these access roads as defined above except that the roads would not be closed and culverts would not be pulled. Most work would be installing and maintaining water bars, adding pit run rock to minimize erosion in applicable sections, maintain drainage culverts, add additional drainage culverts where needed, and maintain gates and access points.

Land Ownership: National Forest System Lands

Partners Involvement: Bonneville Power Administration (BPA).

Timeline: This work is considered road maintenance which does not require NEPA. Implementation will occur in 2021. Monitoring would occur following implementation and after the first winter.

Estimated costs and Associated BLI: $78,000; NFVW, retained receipts

Essential Project #18 Invasive Plant Removal

Project Name: Invasive Plant Removal

Attribute Addressed: 5.1 Riparian Vegetation – Vegetation

Project Description: Riparian areas are critical to overall watershed health. Many of the rare and threatened species still present in the Upper Sandy watershed rely on riparian habitats at critical stages of their life histories. Due to their position in the landscape, riparian habitats are among the most threatened in the watershed. Located at the base of steep hillsides and receiving regular flooding, the riparian areas along the Sandy River, Lost Creek, and Clear Fork offer some of the most flat, fertile, picturesque, and easily exploitable lands. These areas are the first to be impacted by logging, roads, and recreation. Timber harvest, historical flooding, and recreation has significantly altered the condition of the riparian corridor. These past activities have introduced numerous invasive plants to the Upper Sandy Watershed. Invasive plants can outgrow, replace, and destroy native plants. Numerous invasive plants already exist in the Sandy River Basin; however, low levels currently exist in the Upper Sandy Watershed. Therefore, the objective of the Invasive Plant Removal Project is to rapidly respond to

invasive plants that are initially getting established. Invasive plants will be removed by hand pulling such as Garlic mustard (*Alliaria petiolata*) Policeman's helmet (*Impatiens glandulifera*) English ivy (*Hedera helix*) English holly (*Ilex aquifolium*).

Land Ownership: National Forest System Lands

Partners Involvement: Oregon Department of Agriculture (ODA), BPA, Portland Water Bureau, SRWC, Mt. Hood Community College – Project YESS, and Sandy Basin Vegetation Restoration Coalition (SBVRC[2]) partnered with the FS to map invasive plants in the basin.

Timeline: The majority of the planning and implementation will occur annually from 2018 through 2023 to eliminate newly established invasive plants. Monitoring will occur the following year after implementation. Further invasive plant removal will occur the following years but at less intense rates.

Estimated costs and Associated BLI: $45,000; NFVW and NFWF.

Non-Essential Projects

1. Fully restore 1825 and 1828 roads, including 0.2 miles of reconstruction and asphalt patching of the 1825 road and 0.92 miles of full road reconstruction of the 1828. Priority for watershed health would be to fully maintain the 1828 as an asphalt road due to the volume of traffic that road receives, potential commercial wood product harvest in the Clear Fork watershed, and numerous stream crossings along this route. The 1828 also serves as a detour route when Lolo Pass Road is blocked.
2. Road-to-trail decommission Burnt Lake Road (1825-111/1825-109). Convert 1.25 miles of the Burnt Lake Road to a trail. Currently, this road is a keyhole into the Mt. Hood Wilderness and only serves as an access route to one trailhead. This project would alleviate the need to replace two AOP culverts along this route. About 600 feet of the road is susceptible to failure where the road cut is secured with wire gabions, which will eventually fail. The slopes above the gabion structures are unstable, mature trees have become undercut, and sediment is potentially delivered to Lost Creek. The trail could start near the Lost Creek Campground. A parking area with an appropriate concrete vault toilet could be establish at the new trailhead.
3. Remove Lost Creek Nature Trail boardwalk from the 100 year floodplain. Currently, this trail is made of treated wood and extends ~400 feet across the 100 year floodplain of Lost Creek. About a 40 foot section of this boardwalk is inundated during less than a 5-year flood.
4. Much of the Clear Fork riparian stand structure is outside the range of natural variability and a simplification of stand structure over large areas due to historic timber harvest. Many of the riparian reserves are dominated by red alder in this watershed. We recommend conifer plantings. Any silviculture treatments in riparian reserves (within two site-potential trees = 420 feet on both sides of the stream) should be limited to stands less than 50 years of age and all woody material should be felled toward the streams or left as downed woody debris or girdled for snag creation (Spies et al. 2013; Frissell et al. 2014; Pollock and Beechie 2014; Benda et al. 2015).

[2] Sandy Basin Vegetation Restoration Coalition (SBVRC) include: The Nature Conservancy, the Mt. Hood National Forest, the Sandy River Basin Watershed Council, City of Portland Metro, City of Portland Water Bureau, Salem District BLM District, Oregon Parks and Recreation, East Multnomah County Soil & Water Conservation District, and Clackamas County Soil & Water Conservation District.

Costs

Table 8. Estimate costs to plan, design, implement, and monitor project in Upper Sandy 6th field watershed located on USDA, Mt. Hood National Forest from 2018 to 2023.

Essential Project Number	Project Name	Output	Funding (listed in thousands, 1=$1,000)								
			Total Cost	Project Planning and Design		Project Implementation		Project Monitoring		Total	
				FS	Partners	FS	Partners	FS	Partners	FS	Partners
1	Cast Creek	1 mi	92	2	2	10	74	2	2	14	78
2	Clear Fork	4.4 mi	441	20	2	50	362	2	5	72	369
3	Lost Creek	4.5 mi	586	20	2	50	507	2	5	72	514
4	Lost Trib2	0.2 mi	25	2	2	10	7	2	2	14	11
5	Dispersed Campsite Rehab	20 ac	20	1	1	8	8	1	1	10	10
6	Developed Rec. Rehab	10 ac	45	1	1	20	21	1	1	22	23
7	Decom. Road 1828-125	2.5 mi	42.5	1	0	41	0	0.5	0	42.5	0
8	Decom. Road 1828-180	1.3 mi	22.1	1	0	20.6	0	0.5	0	22.1	0
9	Decom. Road 1825-380	0.1 mi	1.7	1	0	0.2	0	0.5	0	1.7	0
10	Decom. Road 1828-118	1.6 mi	27.2	1	0	25.7	0	0.5	0	27.2	0
11	Decom. Road 1828-024	0.1 mi	1.7	1	0	0.2	0	0.5	0	1.7	0
12	Decom. two unauthorized roads	0.2 mi	3.4	1	0	1.9	0	0.5	0	3.4	0
13	1825-111 AOPs	2 AOP	500	100	0	390	0	10	0	500	0
14	Road 1825-109 culvert	1 culv.	20	2	0	16	0	2	0	20	0
15	Road 1828 culverts	2 AOP; 26 culv.	825	100	0	675	0	50	0	825	0
16	Road 18 culverts	12 culv.	1200	50	100	300	700	50	0	400	800
17	BPA Road stormproofing	4.8 mi	78	0	10	0	64	2	2	2	76
18	Invasive plant removal	312 ac	45	0	0	0	40	3	2	3	42

Forest Service total = $2,053,600; Partner total = $1,923,000.

Timelines and Project Scheduling

Essential projects in the Upper Sandy 6th field watershed are anticipated to be completed with adequate funding by **2022**. The USDA, Mt. Hood National Forest along their numerous partners will be able to increase aquatic habitat complexity by reconnecting the floodplain to the mainstem channel in Lost Creek and Clear Fork, and increase large wood accumulations, all of which will increase flows to historic side channels, add and enhance pool habitats, provide refuge for all stages of salmonid life history, and accumulate spawning gravels. Fish passage will be restored. Addressing problematic culverts will protect the Upper Sandy watershed by limiting unnatural sediment delivery to the stream. A rapid response to non-native invasive plants control will protect the riparian rehabilitation projects.

Table 9. Estimated project completion date for essential projects in the Upper Sandy River 6th field watershed in the Mt. Hood National Forest. Monitoring may extend beyond dates listed below to measure biological and physical responses of the project treatments.

Essential Project Number	Project Name	Estimated Completion Date of Essential Projects
1	Cast Creek	2019
2	Clear Fork 1a, 1b, 1c, and 1d	2019 - 2022
3	Lost Creek 1a and 1b	2019 - 2021
4	Lost Trib2	2019
5	Dispersed Campsite Rehabilitation	2019 - 2020
6	Developed Recreation Site Rehabilitation	2019 - 2021
7	Decommission Road 1828-125	2020 - 2023
8	Decommission Road 1828-180	2020 -2023
9	Decommission Road 1825-380	2022 - 2023
10	Decommission Road 1828-118	2020 - 2023
11	Decommission Road 1828-024	2020 - 2023
12	Decommission two unauthorized user defined roads	2020 - 2023
13	1825-111 AOPs	2020 - 2023
14	Road 1825-109 culvert	2020 - 2023
15	Road 1828 culverts	2020 - 2023
16	Road 18 culverts	2020 – 2023
17	BPA Road stormproofing	2021
18	Invasive plant removal	2019-2023

Table 10. Timelines and scheduling for essential projects. All project activities occur on the USDA, Mt. Hood National Forest in Upper Sandy 6th field sub-watershed. Design consists of completion of inventories, planning, designs, and NEPA analyses. Implementation consists of completing all treatments necessary to meet the attributes addressed. Monitoring consists of pre- and post-photos, channel surveys, smolt surveys, spawning surveys, stream temperature monitoring, or road storm patrol.

Essential Project Number	Project Name	Project Task	Funding (listed in thousands, 1=$1,000)							
			2019		2020		2021		2022	
			FS	Partners	FS	Partners	FS	Partners	FS	Partners
1	Cast Creek	Design	2	2						
		Implementation	10	74						
		Monitoring	2	2						
2	Clear Fork	Design	20	2						
		Implementation	25	100	25	162		100		
		Monitoring							2	5
3	Lost Creek	Design	20	2						
		Implementation	50	250		257				
		Monitoring					2	5		
4	Lost Trib2	Design	2	2						
		Implementation	10	7						
		Monitoring	2	2						
5	Dispersed Campsite Rehab	Design	1	1						
		Implementation	4	4	4	4				
		Monitoring			1	1				
6	Dev. Rec. Rehab	Design	1	1						
		Implementation			10	11	10	10		
		Monitoring					1	1		
7	Decom. Road 1828-125	Design					1	0		
		Implementation							42.5	
		Monitoring							0.5	
8	Decom. Road 1828-180	Design					1	0		
		Implementation							22.1	
		Monitoring							0.5	
9	Decom. Road 1825-380	Design					1	0		
		Implementation							1.7	
		Monitoring							0.5	
10	Decom. Road 1828-118	Design					1	0		
		Implementation							27.2	
		Monitoring							0.5	
11	Decom. Road 1828-024	Design					1	0		
		Implementation							1.7	
		Monitoring							0.5	
12	Decom. unauthorized roads	Design					1	0		
		Implementation							3.4	
		Monitoring							0.5	
13	1825-111 AOPs	Design			100					
		Implementation					390			
		Monitoring							10	

Table 10 continued

Essential Project Number	Project Name	Project Task	Funding (listed in thousands, 1=$1,000)							
			2019		2020		2021		2022	
			FS	Partners	FS	Partners	FS	Partners	FS	Partners
14	Road 1825-109 culvert	Design			2					
		Implementation					16			
		Monitoring							2	
15	Road 1828 culverts	Design			100					
		Implementation					675			
		Monitoring							50	
16	Road 18 culverts	Design			50	100				
		Implementation					300	700	50	
		Monitoring							100	
17	BPA Road	Design				10				
		Implementation						64		
		Monitoring							2	2
18	Invasive plant removal	Design								
		Implementation		10		10		10		10
		Monitoring			1		1	1	1	1

Restoration Project Monitoring and Evaluation

Post-project monitoring and evaluation is essential in determining the overall success of the essential projects. The Forest Service will conduct all the physical habitat monitoring using Rosgen Level 2 surveys that include: channel cross sections, pebble counts, sediment surveys, and channel geometry. The Forest Service along with its partners (Oregon Department of Fish and Wildlife, The Freshwater Trust, and SRWG) will monitor biological indicators of essential projects by conducting extensive smolt monitoring, spawning surveys, and snorkeling surveys that will identify juvenile salmonid use of constructed side channels and alcoves. Beginning in 2009, the Upper Sandy watershed has standardized the monitoring of smolt out migrants using rotary traps. This long-term data set will be used to evaluate the biological success of these projects. Standardized spawning surveys have been conducted since the late 1990's. The partners will also assist in the mapping of invasive plant species, conduct rapid response to remove invasive plants, and monitor riparian treatments. The Forest Service will conduct storm road patrols to evaluate the success of road projects. Table 11 displays project monitoring and evaluation for restoration in the Upper Sandy watershed.

Table 11. Project monitoring and evaluation. All project activities occur on the USDA, Mt. Hood National Forest in Upper Sandy 6th field watershed.

Project Name	Parameters to be Monitored*	Who Will Monitor?	Frequency
Cast, Lost, Clear Fork and Lost Trib2 creeks	Rosgen Level 2, spawning surveys, and smolt surveys	USFS and project partners	Pre- and post-project for five years
Dispersed and Developed Recreation Rehabilitation	Photo points, survival and stocking rates	USFS and project partners	Post-project for five years
Roads	Road storm patrol	USFS	Post-project for five years
Invasive Plant Removal	Rapid response, pre- and post-project mapping	USFS and project partners	Post-project for five years

*Description of parameters: Rosgen Level 2 surveys consist of channel cross sections, longitudinal profiles, pebble counts, sediment surveys, and channel geometry. These measurements determine changes in physical stream characteristics, effectiveness in maintaining stream meander pattern, dimension, and profile. Photo points will be used to detect visual changes in amount of habitat and vegetation. Large wood surveys will be conducted to determine if wood is maintained in the project reaches and recruitment of new woody debris. Stream temperature will be monitored to detect decreases over time following treatments. Spawning and smolt surveys will be conducted to measure the biological responses to watershed treatments. Storm patrols will be conducted following large precipitation events to determine effectiveness of road and culvert treatments and determine maintenance needs. Invasive plants sites will be mapped and monitored to determine effectiveness of hand pulling treatments.

References

Benda, L., S. E. Litshert, G. Reeves, and R. Pabst. 2016. Thinning and in-stream wood recruitment in riparian second growth forests in coastal Oregon and the use of buffers and tree tipping as mitigation. Journal of Forest Research 27:821-836.

Bilby, R.E., B.R. Fransen, J.K. Walter, C.J. Cederholm, and W.J. Scarlett. 2001. Preliminary Evaluation of the Use of Nitrogen Stable Isotope Ratios to Establish Escapement Levels for Pacific Salmon. Fisheries 26 (1): 6-14.

City of Portland. 2004. Development and Application of the EDT Database and Model for the Sandy River Basin. Prepared by City of Portland Bureau of Water Works with assistance from Mobrand Biometrics, Inc.

Chan, S., K. Maas-Hebner, and B. Emmingham. 1996. Thinning hardwood and conifer stands to increase light levels: Have you thinned enough? COPE Report 9(4): 2-6.

Chan, S., M. Bailey, D. Karnes, R. Metzger, and W. Kastner. 1997. Riparian silviculture in the Oregon Coast Range: A partnership between management and research, pp. 190-198 in Proceedings of the 1997 National Silviculture Workshop. General Technical Report GTR-283, USDA Forest Service, Northeastern Forest and Range Experiment Station, Radnor, PA.

Emmingham, W.H., and K. Maas. 1994. Survival and growth of conifers released in alder dominated coastal riparian zones. COPE Report 7 (2&3): 75-77.

Frissell, Christopher. 1994. A New Strategy for Watershed Restoration and Recovery of Pacific Salmon in the Northwest. Pacific Rivers Council.

Frissell, Christopher. 1998. Landscape Refugia for Conservation of Pacific Salmon in Selected River Basins of the Olympic Peninsula and Hood Canal, Washington. Flathead Lake Biological Station. Polson, Montana. Biological Station Open File Report No. 147-98.

Frissell, C.A., R.J. Baker, D.A. DellaSala, R.M. Hughes, D.A. McCullough, R. K. Nawa, J. Rhodes, M.C. Scurlock, and R.C. Wissmar. 2014. Conservation of aquatic and fishery resources in the Pacific Northwest: Implications of new science for the Aquatic Conservation Strategy of the Northwest Forest Plan. Final report to the Coast Range Association, Corvallis, Oregon.

Hibbs, D.E., P.A. Giordano. 1996. Vegetation characteristics of alder dominated riparian buffer strips in the Oregon Coast Range. Northwest Science 70:213-222.

Issak, D.J., S. Wenger, E. Peterson. 2016. NorWeST: An interagency temperature database and climate scenarios for rivers and streams of the American West. US Forest Service, Rocky Mountain Research Station. Boise, Idaho.

Maas, K. and Emminham. 1995. Third year survival and growth of conifers planted in red alder dominated riparian areas. COPE report 8(1):5-7.

Minore, D. and H.G. Weatherly. 1994. Riparian trees, shrubs, and forest regeneration in the coastal mountains of Oregon. New Forest 8:249-263

Newton, M.R. Willis, J. Walsh, E. Cole, and S. Chan. 1996. Enhancing riparian habitat for fish, wildlife, and timber in managed forest. Weed Tecnology 10:429-438.

NOAA Fisheries, 2001. *Guidelines for Salmonid Passage at Stream Crossings. Southwest Region*.

Oregon Department of Environmental Quality. 2003. Division 41: Water Quality Standards. http://www.oregon.gov/deq/Regulations/Pages/OARDiv41.aspx

Oregon Department of Environmental Quality (ODEQ). 2005. Sandy River Basin Total Maximum Daily Load (TMDL).

Oregon Department of Fish and Wildlife (ODFW). 2001. Sandy River Basin Fish Management Plan Amendment.

Oregon Department of Fish and Wildlife (ODFW). 2002. Draft Sandy Subbasin Summary. Prepared for the Northwest Power Planning Council.

Pollock, M. M., and T. J. Beechie. 2014. Does riparian forest restoration thinning enhance biodiversity? The ecological importance of large wood. Journal of the American Water Resources Association 50:543-559.

Portland General Electric (PGE). 2002a. Settlement Agreement Concerning the Removal of the Bull Run Hydroelectric Project—FERC No. 477.

Portland General Electric (PGE). 2002b. Surrender Application for the Bull Run Hydroelectric Project – FERC No. 477.

Sandy River Basin Partners (SRBP). 2005. Sandy River Basin Characterization Report. Prepared by the Sandy River Basin Partners.

Sandy River Basin Partners (SRBP). 2004. Agreement in Principle: In Preparation for Developing a Habitat Conservation Plan for the Bull Run Water Supply.

Sandy River Basin Working Group (SRBWG). 2006. Salmon and Steelhead Conservation: An assessment of anchor habitat on the Sandy River, Oregon. Oregon Trout, Portland, Oregon.

Sandy River Basin Working Group (SRBWG). 2007. Sandy River Basin Aquatic Habitat Restoration Strategy: An anchor habitat-based prioritization of restoration opportunities. Oregon Trout. Portland, Oregon.

Sandy River Basin Partners (SRBP). 2005. Sandy River Basin Characterization Report. Prepared by the Sandy River Basin Partners.

Safeeq, M., Shukla, S., Arismendi, I., Grant, G. E., Lewis, S. L., & Nolin, A. W. 2015. Influence of winter season climate variability on snow-precipitation ratio in the Western U.S. International Journal of Climatology.

Spies, T, M. Pollock, G. Reeves, and T. Beechie. 2013. Effects of riparian thinning on wood recruitment: a scientific synthesis. Forest Science Laboratory, Corvallis, Oregon.

Taylor, B. 1998. Salmon and Steelhead Runs and Related Events of the Sandy River Basin – a Historical Perspective. Prepared for Portland General Electric.

Uebel, J., K. Godbout. 1982. Lost Creek Stream Survey, 7/20-7/22/1982. U.S. Forest Service. Mt. Hood National Forest. Zigzag, Oregon.

USDA. 1990. Final Environmental Impact Statement. Land and Resource Management Plan. Mt. Hood National Forest. Pacific Northwest Region.

USDA. 1992. Lost Creek Stream Inventory Level II Survey. Mt Hood National Forest. Zigzag, Oregon.

USDA. 1994. U.S. Department of Agriculture, Pacific Northwest Region, Forest Service. Upper Sandy Wild and Scenic River Management Plan. Mt Hood National Forest.

USDA. 1995. U.S. Department of Agriculture, Pacific Northwest Region, Forest Service. Zigzag Watershed Analysis. Mt Hood National Forest.

USDA. 1996. Clear Fork of the Sandy River Inventory Level II Survey. Mt Hood National Forest. Zigzag, Oregon.

USDA. 1996. Upper Sandy River Stream Inventory Level II Survey. Mt Hood National Forest. Zigzag, Oregon.

USDA. 1996. U.S. Department of Agriculture, Pacific Northwest Region, Forest Service. Upper Sandy Watershed Analysis. Mt Hood National Forest.

USDA. 2005. Aquatic Restoration Strategy. U.S. Forest Service, Pacific Northwest Region, 333 SW First Avenue, Portland, Oregon 97204-3440.

USDA. 2008. Aquatic Restoration Conservation Strategy. U.S. Forest Service, Pacific Northwest Region, 333 SW First Avenue, Portland, Oregon 97204-3440.

USDA. 2008. Final Impact Statement. Site-Specific Invasive Plant Treatments for Mt Hood National Forest and Columbia River Gorge National Scenic Area in Oregon, including Forest Plan Amendment #16. U.S. Forest Service. Mt Hood National Forest and Columbia Gorge National Scenic Area.

USDA. 2010. Forest Service Watershed Condition Classification Technical Guide. US Forest Service, 1400 Independence Ave., SW Washington, D.C., 20250-0003.

USDA. 2011. Still Creek Watershed Restoration Action Plan. Mt Hood National Forest. Zigzag, Oregon.

USDA Forest Service. 2011. Watershed Condition Framework. FS-977, Washington, D.C

USDA. 2017, August 24. Land and Resource Management. Mt Hood National Forest webpage. https://www.fs.usda.gov/detail/mthood/landmanagement/resourcemanagement/?cid=FSBDEV3_036668

USDA and USDI. 1994. Record of Decision (ROD) for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl. USDA Forest Service and USDI Bureau of Land Management. April 13, 1994. Washington D.C., 73 p. with appendices.

U.S. Forest Service (USFS). 1979. Soil Resource Inventory. Prepared for the Mount Hood National Forest. Inventory and Report by Steve Howes, Soil Scientist.

Appendix A. Culvert data

Table 1. Road 18 priority culverts to be replaced.

Rd	WRAP Priority	INFRA ID	Latitude	Longitude	Dia. (in)	Length (ft)	Pipe Grad. (%)	Status in August	Bankfull Average (ft)	D100 (mm)	Stream grad. (%)	Priority	Comments
1800	9	18.575	45.39483	-121.8653	36	85	32.35	Isolated Pools	12.0	350	48	High	Culvert is fully plugged! Road is functioning as dam during high flow events. Excessive scour at inlet, lots of deposition. An additional 2 foot culvert is the current outlet. High potential for catastrophic road fill failure.
1800	10	18.434	45.39673	-121.8648	36	78	11.38	Isolated Pools	12.3	300	31	High	Two culverts are present and data are for primary culvert only.
1800	11	14.271	45.42747	-121.8066	12	52	5.98	Flowing	5.1	280	35	High	Possible issues with AOP, especially as 2 salamanders were observed utilizing downstream pool.
1800	14	15.115	45.42157	-121.8219	30	106	1.56	Flowing	12.0	300	28	High	Scour and deposition at inlet, possibly causing an AOP barrier.
1800	32	14.463	45.42679	-121.8109	24	63	13.59	Flowing	4.5	150	36	Medium	Receives flow from stream and ditch, deposition occurring at the inlet.
1800	33	14.660	45.42565	-121.8139	24	65	10.22	Flowing	3.6	170	35	Medium	Issues with AOP.
1800	34	14.691	45.42529	-121.8151	18	63	13.33	Flowing	3.3	45	40	Medium	Heavily groundwater fed with additional input from ditch.
1800	35	14.781	45.42417	-121.817	30	102	20	Flowing	7.8	200	28	Medium	Receives flow from primary drainage plus an additional 10 percent from second drainage.
1800	36	16.175	45.41523	-121.838	84	192	11.11	Flowing	13.3	200	18	Medium	Recommend replacement with a bridge.
1800	37	17.957	45.40096	-121.8594	36	79	2.7	Isolated Pools	5.3	140	43	Medium	Culvert appears to be relatively new and is of large size, but gravels are already accumulating at inlet.
1800	38	18.418	45.39686	-121.8645	18	43	15.88	Flowing	2.9	50	19	Medium	Do at the same time as INFRA_ID 18.434.
1800	39	14.705	45.42503	-121.8156	24	66	14.55	Flowing	6.7	175	25	Medium	Ditch contributes significant flow. Blockage at inlet. Stream is fed by large number of seeps in addition to surface flow.

Table 2. Road 1828 priority culverts to be replaced.

Rd	WRAP Priority	INFRA ID	Latitude	Longitude	Dia. (in)	Length (ft)	Pipe Grad. (%)	Status in August	Bankfull Average (ft)	D100 (mm)	Stream grad. (%)	Priority	Comments
1828	1	2.099	45.40912	-121.7998	24	39	7	Flowing	6.3	55	40	High	Consider full AOP. Undersized and some sediment settling out at inlet. Culvert located immediately north of Trib B AOP.
1828	2	2.142	45.40882	-121.7998	108	82	9.15	Flowing	13.4	225	11	High	AOP on TRIB B. Opens 3,823 feet of steelhead and trout habitat.
1828	3	7.883	45.39252	-121.8621	48	41	5.93	Dry	11.5	550	14	High	AOP. Opens 1,811 feet of steelhead and trout habitat. Headwall at inlet. Evidence of extremely high flows with significant deposition and streambank erosion at inlet and evidence that stream flows over road at very high flows.
1828	4	0.246	45.42361	-121.7970	18	24	12.38	Isolated Pools	4.9	230	24	High	High velocity water during heavy rain events. Significant gravel deposition at inlet.
1828	5	0.257	45.42352	-121.7972	18	30	11.57	Flowing	2.7	170	16	High	Culvert receives flow from stream, a secondary dry drainage, and road ditch.
1828	6	0.271	45.42342	-121.7974	18	24	14.67	Flowing	3.2	125	27	High	Receives flow from both stream and road ditch
1828	7	0.302	45.42335	-121.798	18	25	3.76	Isolated Pools	4.2	120	34	High	Stream and significant flow from road ditch.
1828	8	0.856	45.42096	-121.8069	18	27	9.89	Flowing	6.5	140	67	High	Significant water from both stream and ditch.
1828	9	4.376	45.40116	-121.8331	18	33	13.45	Dry	3.1	210	26	High	Heavily clogged. Receives high flows from both channel and road ditch.
1828	13	7.943	45.3919	-121.8635	24	51	8.27	Dry	4.6	170	11	High	Fine sediment accumulating at inlet with significant inputs from both road ditch and stream.
1828	14	8.139	45.39036	-121.8664	18	43	5.74	Dry	3.0	?	32	Medium	High velocity flow in stream. Reason for medium priority is only because it is a tributary to the mainstem Sandy River and not Clear Fork.
1828	17	0.223	45.42384	-121.7967	18	28	14.64	Isolated Pools	3.8	90	21	Medium	Significant substrate accumulating at inlet. Substantial input from ditch.
1828	18	0.324	45.42334	-121.7985	18	34	4.18	Flowing	3.7	250	27	Medium	Receives significant flow from both stream and ditch, leading to deposition and pooling at inlet. At time of survey, water was flowing in ditch but not stream.
1828	19	0.43	45.4235	-121.8006	18	34	9.32	Flowing	4.4	85	30	Medium	Receives flow from stream and ditch, with significnat inputs of groundwater around here. A 4-5 foot culvert is recommended with possibility of AOP assessment.

Table 2 continued.

Rd	WRAP Priority	INFRA ID	Latitude	Longitude	Dia. (in)	Length (ft)	Pipe Grad. (%)	Status in August	Bankfull Average (ft)	D100 (mm)	Stream grad. (%)	Priority	Comments
1828	20	2.031	45.40983	-121.8013	36	34	10.5	Flowing	5.1	280	27	Medium	Possible AOP due to persistent flow in late summer.
1828	21	1.411	45.41516	-121.8079	18	46	7.35	Dry	2.2	50	29	Medium	Receives significant flow from both stream and ditch and should be sized to accommodate both.
1828	22	2.303	45.40743	-121.8021	18	64	16.56	Flowing	6.9	20	37	Medium	Wide bankfull due to multiple streams feeding this culvert just upstream of road crossing.
1828	23	2.328	45.40718	-121.8025	18	76	17.5	Flowing	3.4	110	37	Medium	Some fines settling out at inlet.
1828	24	2.581	45.40451	-121.8045	24	63	40.16	Flowing	2.8	20	34	Medium	Receives flow from both stream and ditch.
1828	25	2.649	45.40389	-121.8056	18	41	32.54	Dry	3.1	35	40	Medium	Outlet is 50% clogged with debris.
1828	26	3.759	45.40062	-121.8238	18	50	29.34	Dry	1.5	75	45	Medium	Receives approximately half of flow from ditch, and gravels are accumulating behind inlet. Additionally, the stream splits in two above the inlet, sending roughly half of the stream flow into the culvert and the other half to the road ditch, where it heads downhill.
1828	27	4.108	45.40208	-121.8294	24	50	32.76	Dry	2.9	90	49	Medium	Culvert is undersized and receives roughly equal flow from stream channel and road ditch.
1828	28	5.278	45.39465	-121.8384	24	42	15.1	Flowing	4.7	150	19	Medium	Undersized and some gravels accumulating at inlet.
1828	29	5.834	45.39266	-121.8378	18	35	9	Dry	NA	NA	NA	Medium	Heavily blocked at inlet, accumulating fine sediment upstream, and depositing fine sediment downstream.
1828	30	6.872	45.39366	-121.8511	18	32	8.69	Dry	1.5	30	6	Medium	This is a cross drain that was surveyed because it was heavily blocked. Tributary to mainstem Sandy River.
1828	31	7.386	45.39272	-121.8524	24	35	7.6	Dry	3.5	310	21	Medium	Accumulating gravels at inlet from both stream and ditch. Tributary to mainstem Sandy River.

Table 3. Road 1828-111 priority culverts to be replaced.

Rd	WRAP Priority	INFRA ID	Latitude	Longitude	Dia. (in)	Length (ft)	Pipe Grad. (%)	Status in August	Bankfull Average (ft)	D100 (mm)	Stream grad. (%)	Priority	Comments
1825-111	A	?	45.37963	-121.82971	X	X	X	Flowing	X	X	X	High	AOP. High priority for steelhead and coho. Open 1,833 feet of habitat.
1825-111	B	?	45.38053	-121.83034	X	X	X	Flowing	X	X	X	High	AOP. Complete barrier. High priority habitat for spawning and rearing coho salmon. Would open 735 feet of habitat.