United States Department of Agriculture
Forest Service

North Clack Integrated Resource Project

Environmental Assessment

Fisheries Resources Report and Biological Evaluation

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for:
Clackamas River Ranger District
Mt. Hood National Forest
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1.0 - Effects Determination/Executive Summary of Effects

The proposed action, also known as Alternative 1, would result in minor impacts to Proposed, Endangered, Threatened, and Sensitive (PETS) species that reside in the project area, particularly coastal cutthroat trout and Cope's giant salamander, as well as their habitat. PDCs would greatly minimize potential effects, but not eliminate them altogether. In terms of sensitive species, the proposed action May impact individuals or habitat, but would not likely contribute to a trend towards Federal listing or loss of viability to the population or species.

There would be slight localized increases in fine sediment with the proposed action. The project as a whole would result in a net reduction of sediment as restoration elements and road work is accomplished. In localized areas associated with temporary road construction, road rehabilitation, road maintenance, and log hauling, there is the possibility of increased levels of fine sediment. Some localized sedimentation of pool habitat could impact aquatic macroinvertebrate feeding and survival. This, in turn, could lead to slight reductions in salmonid rearing habitat and food supply. There would be no impact to salmonid survival or reproductive success resulting from fine sediment increases because the amount of sediment would be very low and localized. A separate Water Quality Specialist Report discusses the impacts and benefits to water quality. It also found that no change to stream temperatures were likely to occur.

The proposed action would have immediate benefit on levels of large wood in short sections of three streams because wood would be added. In the remaining sections, the no-harvest streamside protection buffers would minimize any reduction to the current (no-action) large wood recruitment potential. However, thinning conducted within the dry upland portion of riparian reserves of the remaining sections of streams may reduce the wood recruitment potential until remaining trees begin to fall naturally and replace those that were harvested. A slight reduction in large wood could reduce the amount of pool habitat locally and the other benefits associated with in-stream large wood (gravel collection, floodplain connection, etc.). These impacts would occur primarily in headwater streams where the harvest is proposed. Due to the fluvial geomorphology of the area (i.e., small headwater streams), substantial reductions in large wood transport from headwaters to downstream fish-bearing reaches are not expected. Additionally, existing roads sometimes halt wood from moving downstream because of culverts.

Other than Coastal cutthroat, threatened salmon, steelhead, bull trout, Pacific lamprey, eulachon, or other sensitive aquatic species do not occur in the project area. The project complies with ESA and there would be no direct or indirect effect to steelhead trout, Chinook or coho salmon or their designated critical habitat; therefore consultation with regulatory agencies is not required. The anticipated impacts summarized below may have some localized impact to habitats, but not to streams located greater than 1,000 feet downstream where these species reside.

The project would not measurably degrade aquatic habitats and therefore would not move species present, or suspected to be in the project area, such as cutthroat trout, and Cope's giant salamander, from a Regional Forest's Special Status Species List to an ESA listed status.

The effects would be very similar with Alternatives 1 and 2 for Aquatic species and their habitat, because there is no difference in road construction and thinning in Riparian Reserves between the alternatives. A summary of effects is found in the following tables.

Table 1. Summary of effects on listed species, designated critical habitat, Essential Fish Habitat.

Species (All are Threatened)	Date of Listing	Date of Critical Habitat	Suitable Habitat Present	Species Present	Effect on Individuals	Effect on Critical Habitat	Effect on Essential Fish Habitat
Lower Columbia River Steelhead (*Oncorhynchus mykiss*)	1/06	9/05	Yes	Yes	No Effect	No Effect	N/A
Lower Columbia River Chinook Salmon (*Oncorhynchus tshawytscha)*	6/05	9/05	Yes	Yes	No Effect	No Effect	No Effect
Middle Columbia River Steelhead (*Oncorhynchus mykiss*)	1/06	9/05	Yes	Yes	No Effect	No Effect	N/A
Upper Willamette River Chinook Salmon (*Oncorhynchus tshawytscha)*	6/05	9/05	Yes	Yes	No Effect	No Effect	No Effect
Columbia River Bull Trout (*Salvelinus confluentus*)	6/98	11/10	Yes	Yes	No Effect	No Effect	N/A
Lower Columbia River Coho Salmon *(Oncorhynchus kisutch)*	6/05	2/16	Yes	Yes	No Effect	No Effect	No Effect
Southern DPS Eulachon (*Thaleichthys pacificus*)	3/10	10/11	Yes	No	No Effect	No Effect	N/A

Table 2. Summary of effects for Region 6 sensitive species and Northwest Forest Plan Survey and Manage species.

Species	Suitable Habitat Present	Species Present	Determination of Effects
Pacific Lamprey *(Entosphenus tridentatus)*	Yes	Yes	May impact individuals [1]
Coastal Cutthroat Trout *(Oncorhynchus clarkii clarkii)*	Yes	Yes	May impact individuals
Inland Columbia Basin Redband Trout *(Oncorhynchus mykiss gairdneri)*	Yes	Yes	May impact individuals
Scott's Apatanian Caddisfly *(Allomyia scotti)*	Yes	Yes	May impact individuals
Cope's Giant Salamander (*Dicamptodon copei)*	Yes	Yes	May impact individuals
Columbia Duskysnail *(Colligyrus sp. nov. Columbia)*	Yes	Yes	Population Viability Maintained
Basalt Juga *(Juga sp. nov. Basalt)*	Yes	Yes	Population Viability Maintained

[1] May impact individuals or habitat, but will not likely contribute to a trend towards Federal listing or loss of viability to the population or species

2.0 - INTRODUCTION

Forest management activities that may alter the aquatic habitat or affect individuals or populations of PETS fish and aquatic species require a Biological Evaluation to be completed (FSM 267l.44 and FSM 2670.32) as part of the National Environmental Policy Act process and Endangered Species Act to determine their potential effects on sensitive, threatened or endangered species. The Biological Evaluation process (FSM 2672.43) is intended to conduct and document analyses necessary to ensure proposed management actions would not likely jeopardize the continued existence or cause adverse modification of habitat for: Species listed or proposed to be listed as endangered (E) or threatened (T) by the USDI-Fish and Wildlife Service or USDC-NOAA Fisheries, and their listed or proposed listed critical habitat.

The Biological Evaluation process (FSM 2672.41) is also intended to conduct and document analyses to ensure that Forest Service actions do not contribute to loss of viability of any native or desired non-native plant or contribute to animal species or trends toward Federal listing of any species for:

- Species listed as Regional Forester's Sensitive species by USDA-Forest Service Region 6.
- Species listed as Survey and Manage species by the Northwest Forest Plan.
- Management Indicator Species (MIS)
- Aquatic Conservation Strategy of the Northwest Forest Plan
- Essential Fish Habitat
- Clean Water Act
- Municipal Watersheds and Floodplains

3.0 - RELEVENT LAWS, REGULATIONS, AND POLICY

3.1 - REGULATORY FRAMEWORK

The North Clack Integrated Resource Project is consistent with all applicable fish/aquatic related federal laws, plans, and guidelines as outlined below. The following is a summary of those that apply to the project.

3.1.1 - Land and Resource Management Plan

Numerous existing plans provide guidance for projects and come in the form of Standards and Guidelines and recommended Best Management Practices (BMP). The first of these is the Land and Resource Management Plan (Forest Plan). There is overlap between aquatics and water quality in terms of applicable standards and guidelines; therefore, those listed below are directly related to fisheries, management indicator species, or other aquatic special status species. See the Water Quality Specialist Report for other pertinent standards and guidelines.

The project lies within the Mt. Hood National Forest (Forest). Forest standards related to fisheries and aquatic biota are found on pages 45 through 131 in the Mt. Hood National Forest Land and Resource Management Plan (1990)(Forest Plan). The Plan has direction for stream and riparian management.

Forest Plan Standards and Guidelines (pages Four-64 & Four-69)
Fisheries: FW-137, 138, 139, 145, 147
Threatened, Endangered and Sensitive Plants and Animals: FW-174, 175, 176
B7 General Riparian Area: B7-028, 030, 031, 032, 033, 037, 038, 059

3.1.2 - Northwest Forest Plan Standards and Guidelines

In the Northwest Forest Plan (NWFP), Key and Non-Key watersheds, an Aquatic Conservation Strategy, and Standards and Guidelines were specified for the protection of old growth associated species (USDA and USDI 1994). For the portions of Riparian Reserves located in Key watersheds, the NWFP contains standards and guidelines that are found on pages B11, C7, and C31. Mitigation measures were also included for species that were rare, or thought to be rare due to a lack of information about them. It was unknown whether the major elements of the NWFP would protect these species. These species, collectively known as Survey and Manage species, were included in standards and guidelines under Survey and Manage, Protection Buffers, and Protect Sites from Grazing.

The Aquatic Conservation Strategy (ACS), located on B11, contains the most detail and was developed to restore the health of watersheds and aquatic ecosystems. At B-10, the Northwest Forest Plan indicates that, to meet the intent of the ACS, management activities should either maintain the existing condition or lead to improved conditions in the long term.

Portions of the effects analysis in this document focus on key parameters or indicators that make up elements of the nine Aquatic Conservation Strategy objectives, and form the rationale of the project's ability to maintain the existing condition or lead to improved conditions in the long term, for these indicators. Indicators include such things as Water quality, Water quantity, Riparian Health, Floodplain Connectivity, Peak/base Flows, Drainage Network Increase, etc. The suite of indicators for each objective were evaluated in Section 8.1 - CONSISTENCY DETERMINATION.

Those objective are:

1 - Watershed and Landscape-Scale Features
2 - Connectivity Within and Between Watersheds
3 - Physical Integrity
4 - Water Quality
5 - Sediment Regimes
6 - In-Stream Flows
7 - Floodplain Inundation
8 - Species Composition and Structural Diversity of Plant Communities

9 - Well-Distributed Populations of Native Species

3.1.3 - Endangered Species Act

The Forest Service is directed to design activities that contribute to the recovery of listed species in accordance with recovery plans developed as directed by the ESA (50 CFR part 402) and its own agency directives (Forest Service Manual 2670). The U.S. Fish and Wildlife Service and NOAA Fisheries current list designates six fish species: upper Willamette River Spring Chinook salmon (*Oncorhynchus tshawytscha),* lower Columbia River Chinook *(O. tshawytscha),* lower Columbia River coho salmon *(O. kisutch)*, middle Columbia River steelhead *(O. mykiss),* lower Columbia River steelhead *(O. mykiss),* Columbia River Bull Trout *(Salvelinus confluentus)* and Southern DPS eulachon (*Thaleichthys pacificus) (updated* May 25, 2016). **Error! Reference source not found.**Steelhead, Chinook, coho, and bull trout are known to occur in the mainstem and several tributaries of Clackamas River. Bull trout were extirpated around 1970, but have since been reintroduced in the upper Clackamas River. Populations of salmon and Steelhead have declined since 1988, and remaining densities are considered low although the habitat is adequate to support higher numbers such as occurred in the past.

Coastal cutthroat trout are widely distributed in the project area. Pacific lamprey have been detected in the mainstem Clackamas River. Inland redband trout, Scott's apatanian caddisfly, eulachon, and Cope's giant salamander are not known to occur in the project area.

3.1.4 - Oregon State Water Quality Standards

Environmental Protection Agency regulations require each state to adopt an "anti-degradation policy" as one component of its water quality standards. The objective of the Oregon Anti-degradation Policy is, at a minimum, to maintain and protect existing instream water uses and the level of water quality necessary to protect those uses. Beneficial uses for the Clackamas River and its tributaries include cold water aquatic life, secondary contact recreation, and salmonid spawning. The Clackamas River provides over 300,000 people with drinking water. Water quality must be sufficiently maintained to provide for these uses. The Clackamas River has excellent water quality relative to administrative standards (Oregon Administrative Rules, Chapter 340, Division 41, Department of Environmental Quality). Water quality measured within the last five years shows the mainstem and tributaries have very low concentrations of measured constituents, such as sodium, potassium, and dissolved nitrogen. Other than the lowest five miles of the North Fork Clackamas River, water temperatures in the project area rarely exceed 13^0 C. The Clackamas Subbasin TMDL was approved by the Environmental Protection Agency on September 29, 2006. The project is designed to allow stream temperatures to improve over time by retaining stream protection buffers and not exceed the TMDL.

The Oregon Department of Environmental Quality ODEQ has formally recognized and supported that the NWFP and the Northwest Forest Plan Temperature TMDL Implementation Strategies would serve as the temperature TMDL implementation mechanism pursuant to the Clean Water Act.

Project design criteria for projects on the Clackamas River Ranger District were developed to reduce any potential for adverse impacts to stream temperature as the result of thinning within riparian reserves, and to meet guidelines in the Northwest Forest Plan Temperature TMDL Implementation Strategy (2012). For example, the stream protection buffers along perennial streams are designed to maintain stream

temperature goals by avoiding harvest in the primary shade zone and retaining shade producing vegetation. In addition, thinning in the secondary shade zone would not result in less than 40% canopy closure post-harvest.

3.1.5 - Clean Water Act

The Clean Water Act directs states to adopt water quality standards and a Total Maximum Daily Load (TMDL) plan to improve water quality to support the beneficial uses of water. The Clackamas Subbasin TMDL was approved by the Environmental Protection Agency on September 29, 2006. This TMDL among other issues addresses stream temperature in the project area. Included in the standards are provisions for identifying beneficial uses, establishing the status of beneficial uses, setting water quality criteria, and establishing BMP to control non-point sources of pollution. The desired conditions for streams in the project area are to provide cool water with low sediment loads, and have streambeds and banks that are stable.

3.1.6 - Regional Forester's Special Status Species

Because of their relative sensitivity to change, salmonids were selected as "an indicator species group" for aquatic habitats on the Forest. This group of species is especially important for their commercial and game values and because they occupy the spectrum of aquatic habitats on the Forest. These life history requirements of salmonids are restricted enough that it is reasonable to assume that if their needs are met, the rest of other fish species found on the Forest would be met (see FEIS, III-58). Lamprey and cutthroat trout species are present in the project area and redband trout, and Scott's apatanian caddisfly are not. Of these species, resident cutthroat trout are the most widespread.

4.0 - PROPOSED ACTION

The purpose and need for the proposed action are found in the Project Information Sheet[2] which is incorporated by reference.

[2] https://www.fs.usda.gov/nfs/11558/www/nepa/105362_FSPLT3_4630683.pdf

5.0 - ANALYSIS FRAMEWORK

5.1 - SPATIAL SCALE

The spatial scale for the North Clack Project is the 24,832 acre area defined as the project area (Figure 1). The project area is located in the Middle Clackamas River watershed that includes parts of sub-watersheds, namely: North Fork Clackamas River, Helion Creek-Clackamas River, and Roaring River. A very small portion of a unit in the Upper Eagle Creek sub-watershed is not included in the project area due to its small size and distance from any water sources.

The project lies mostly within the North Fork Clackamas River sub-watershed boundary with only small portions of the land area designated as Riparian Reserve within the other two sub-watersheds (Figure 1 and

Table 3). The Cumulative Effects Analysis Area is equal to the North Fork Clackamas River sub watershed and, unlike the project area, includes those areas directly affected by the proposed action, all the additional private land and lands managed by BLM within the sub watershed, and all downstream areas where indirect effects may occur. The Analysis Area includes these areas outside of the project area, because their effect may reach far enough downstream that when combined with project effects, they would likely be measurable.

The aquatic organisms and their habitats to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action [50 CFR §402.02] are the focus of this analysis. For the purposes of this analysis, the project area is defined as all areas where ground disturbance would take place for all proposed projects, as well as aquatic habitat areas downstream where potential effects could occur (Figure 1).

Figure 1. North Clack Integrated Resource Project Vicinity

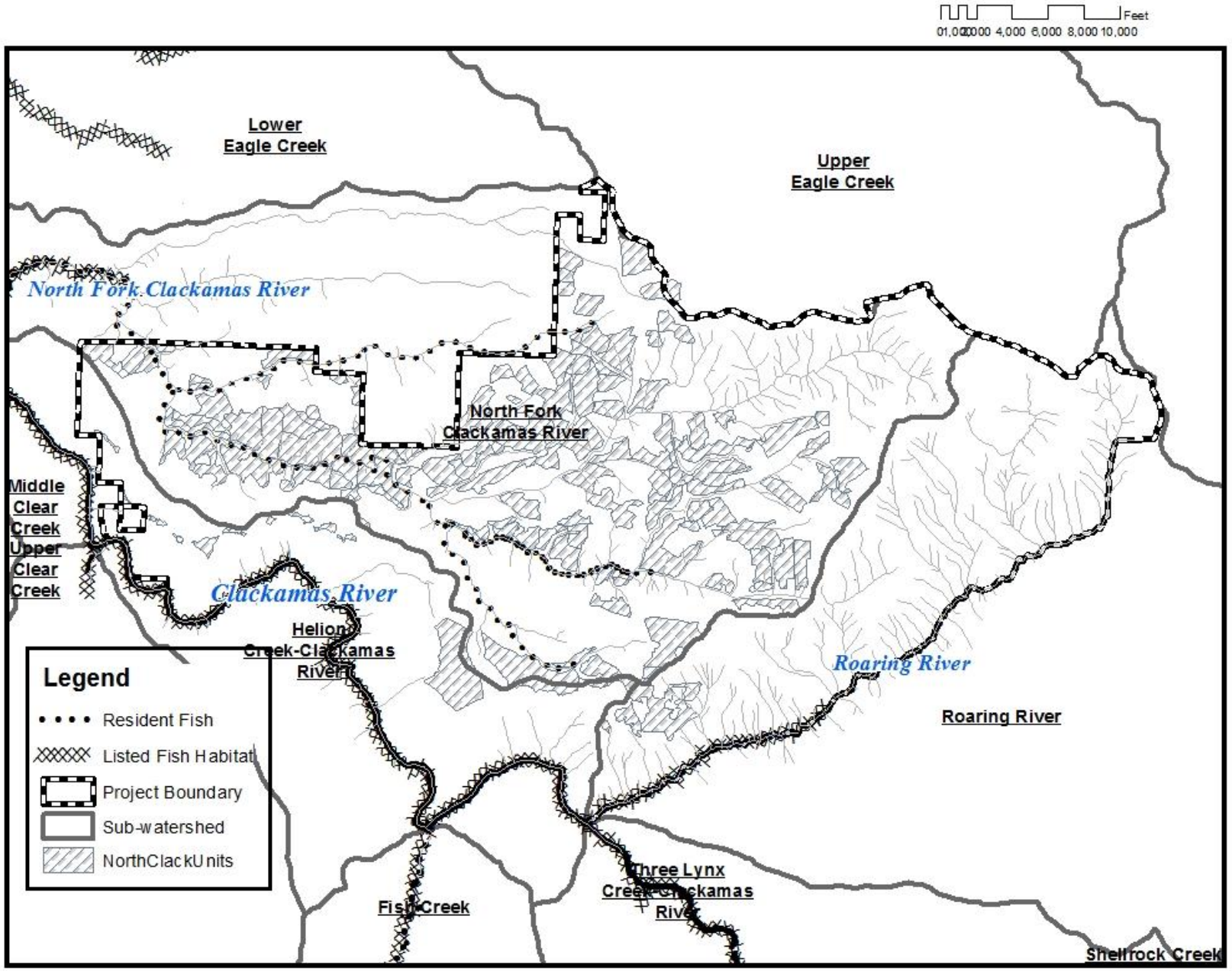


Table 3. North Clack Project Area Percent Riparian Reserve Acres within each Sub-Watershed Proposed for Treatment.

Analysis Sub-Watersheds	Percent of Unit Riparian Reserve Acres within the Sub-Watershed
North Fork Clackamas River	0.8
Roaring River	0.04
Helion Creek-Clackamas River	0

5.2 - TEMPORAL SCALE

Forest Service guidance requires definition of the timeframe in years, both short-term and long-term, when effects for aquatic species would persist. The short-term temporal effects for aquatic species may last one or two growing seasons based on the time required for disturbed vegetation to regrow. The long-term effect from the proposed action is 10-100 years. This is based on the amount of time in the future it would take for trees in Riparian Reserves to achieve a size that meets Forest Plan standards, as well as the time it would take for trees that burned 100 years ago, for example, to achieve size standards (see large wood indicator discussion below).

5.3 - MESUREMENT INDICATORS

The measurement indicators chosen for this report are: 1) water temperature, 2) sediment, 3) large wood, and 4) pool quality and quantity. Using these four indicators would serve to gauge possible effects from each of the alternatives (Table 4).

Table 4. Measurement Indicators

Resource Indicator	Measure
Water Temperature	Degrees Celsius
Sediment	Percent fines less than 6 millimeters in diameter
Large Woody Debris	Number of pieces 50 feet long and 24 and 36 inches diameter
Pool Quantity and Quality	Number of Pools and Pools greater than three feet

6.0 - EXISTING CONDITION

6.1 - General

The project is located on the Mt. Hood National Forest (Forest) in Clackamas County. The project area fits predominantly within the North Fork Clackamas River sub-watershed, with small numbers of acres within three neighboring sub-watersheds; Helion Creek-Clackamas River, Roaring River and Upper Eagle Creek. The topography ranges from steeply incised valley walls in the western part and moderate to gently sloping ridges and drainages in the eastern portion of the sub-watershed.

The aquatic habitat within the project area has been impacted over the past century by grazing, timber harvest, road building, fires, fire suppression, and recreational activities. At the turn of the twentieth century, the watershed had several homesteads, trails, wagon roads and was used for sheep and cattle grazing (USDA Forest Service, 1996). In the 1920s, road construction and timber removal began and continued through 1929 when a stand replacement fire burned through the watershed. The intensity of the fire and subsequent salvage logging resulted in mid seral conditions still evident today. Recently, off-highway vehicle use, target shooting, and dispersed camping have increased in popularity. In addition, there is garbage dumping and homeless camping in riparian areas.

All these activities have had a negative effect on the quality and quantity of habitat for aquatic species. A 50-foot waterfall, two and one half miles from the confluence of the North Fork Clackamas River and the North Fork Reservoir limits the passage of anadromous Endangered Species Act-listed fish into the project area. Native rainbow and cutthroat trout inhabit 26 miles of the mainstem North Fork Clackamas River and the lower portions of several tributaries. There are 144 miles of non-fish-bearing streams.

6.1.1 - Fish and Aquatic Species Presence/Absence

The project area has Endangered Species Act-listed species, including Chinook, and coho salmon, and steelhead, as well as Pacific lamprey and bull trout. These species are found only at the margins of the project area, in the Clackamas River and the lowest four miles of the North Fork Clackamas and Roaring Rivers. The remaining streams in the project area do not have the above named species (or their Critical Habitat) due to their small size and high gradient and barriers that block their access. There are, however, native resident cutthroat and rainbow trout, as well as introduced non-native brook trout throughout the project area streams. These species are discussed because of their sensitivity to the measurement indicators (Table 4). Additionally, Cope's giant salamander have only been found in the Eagle Creek Drainage. However, similar habitat is available in the project area and to avoid possible impacts, they are assumed to be present throughout the project area.

6.1.2 - Designated Critical Habitat and Essential Fish Habitat

The Middle Clackamas watershed surrounding the project area currently provides habitat for the following Evolutionary Significant Units (ESUs): Lower Columbia River steelhead, Upper Willamette River Chinook salmon, and Lower Columbia River coho salmon. These species and their designated critical habitat are listed as Threatened and are protected under the Endangered Species Act (ESA). Critical Habitat was designated for steelhead trout, and Chinook and coho salmon in the Clackamas River, the lower two miles of the North Fork Clackamas River, and the Lower four miles of the Roaring River (NOAA, 2016). There are 7.5 miles of Designated Critical Habitat (CH) for Chinook, coho, and steelhead at the margins of the project area. At the margin of the project area, there are 19 miles of designated Critical Habitat for steelhead, coho, and Chinook (Figure 1).

6.1.3 - Management Indicator Species

Because of their relative sensitivity to the measurement indicators in Table 4, salmonids were selected as "an indicator species group" for aquatic habitats on the Forest. This group of species is especially important for their commercial and game values and because they occupy the spectrum of aquatic habitats on the Forest. These requirements are restricted enough that it is reasonable to assume that if the life history needs of salmonids are met, the needs of other fish, salamanders, and caddisfly species found on the Forest would be met (see FEIS, III-58). Management Indicator Species (MIS) for the Forest include ESA listed fish species (Chinook salmon, coho salmon, and steelhead trout), and coastal cutthroat trout. While all of the MIS fish species have some presence, only resident cutthroat and rainbow trout are widespread in the project area.

Several analyses (NMFS (National Marine Fisheries Service), 2018) (NOAA Fisheries, 2016) (ODFW (Oregon Department of Fish and Wildlife) and NMFS (National Marine Fisheries Service), 2011) of the status of these species and their habitat were performed. The state of Oregon, in concert with the regulatory agencies, manages fish populations while the Forest manages the habitat. For a population to be viable, attributes such as species abundance, productivity, spatial structure, and genetic diversity are needed for the species to maintain its capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment. All of these attributes are affected by habitat and other environmental conditions that influence species behavior and survival.

The Forest-wide analysis also assessed the quantity and quality of habitat available on the Forest, and how much habitat was occupied, for each of the salmonid species. The analysis was performed by calculating the linear distance of stream miles of the intersect between widely available National Hydrography Dataset (NHD) and GIS fish distribution layers of the geo database on file at the Forest headquarters office. Fish distribution was compared to Forest legacy data for resident trout distribution. Results of this analysis are the differences between current and historic distribution and are summarized in 5. Further detail on PETS species is found below.

Table 5. Salmonid management indicator species occupied habitat within the project area within the Mt. Hood National Forest.

MIS	Total Occupied Habitat in the Project Area (mi)
Chinook salmon	12
Coho salmon	12
Steelhead trout	12
Resident trout	26
Non-fish-bearing streams	144

6.1.4 - Special Status Species

There are three fish, a caddisfly, and an amphibian species on the Region 6 Regional Forester's 2015 Special Status Species list that are known, or suspected to occur on the Forest (Table 6). Only Special Status species are addressed in a biological evaluation (Forest Service Manual 2670). Their presence, or absence on the Forest, as well habitat requirements are described below.

Table 6. Region 6 Special Status species.

Scientific Names	Common Name	Forest Presence	Project Area Presence
Entosphenus tridentatus	Pacific lamprey	Yes	Yes
Oncorhynchus clarkii clarkia	coastal cutthroat trout	Yes	Yes
Oncorhynchus mykiss gairdneri	inland Columbia River redband trout	Yes	No
Allomyia scotti	Scott's apatanian caddisfly	Yes	No
Dicamptodon copei	Cope's giant salamander	Yes	Assumed present

6.1.4.1 - Pacific Lamprey

The Pacific lamprey historical distribution is not well known in some parts of Oregon, but were likely widely distributed. Documentation of current distribution is complicated by the difficulty in identifying Pacific lamprey larval forms (ammocoetes and macrothalmia) among other lamprey species. They typically spawn in similar habitat to Pacific salmon and trout. Portland General Electric, as part of their new hydropower license, upgraded their fish passage facilities for Pacific lamprey, and lamprey have been detected in the mainstem Clackamas, but not near the project area.

6.1.4.2 - Coastal Cutthroat Trout

The native range of the coastal cutthroat trout extends south from the southern coastline of the Kenai Peninsula in Alaska to the Eel River in Northern California. Coastal cutthroat trout are resident in tributary streams and rivers of the Pacific basin and are rarely found more than 100 miles (160 km) from the ocean. Generally speaking, coastal cutthroat prefer cool gravel bottomed headwaters, creeks and small rivers, ponds, and lakes (Page, 2011). They are found throughout the Clackamas River basin. They prefer deep pool habitat and cover, such as that formed by woody debris. The primary risks associated with the proposed action are loss of shade and water temperature increase, and sedimentation of streams where cutthroat live.

6.1.4.3 - Inland Columbia River Redband Trout

The inland Columbia River redband trout distribution is loosely defined to include the Columbia River basin east of the Cascades to barrier falls on the Kootenay, Pend Oreille, Spokane, and Snake rivers; the upper Fraser River above Hell's Gate; and Athabasca headwaters to the Mackenzie River basin, where headwater transfers evidently occurred from the Fraser River system (Behnke 1992). On the Mt. Hood National Forest, distribution occurs within the drainages feeding into the Deschutes River. This sub- species is absent in the Hood River and rivers draining into the Willamette and Columbia rivers. The species is also absent in the Willamette Valley lowlands and foothills in Oregon. This is habitat occupied by the coastal variety of rainbow trout; the sub-species known as, *Oncorhynchus mykiss irideus.*

Because the trout is present only in drainages east of the Cascade crest, it is not believed to be present in the Clackamas River Basin or the project area.

6.1.4.4 - Scott's Apatanian Caddisfly

Habitat for the Scott's apatanian caddisfly larvae is sub-alpine forested mountain areas that are high elevation; cold (3 to 6 °C), pure, well-oxygenated water in springs, and small streams. The streams or springs were 35 – 200 cm wide with depths of 5-45 cm. "Wiry" moss was also present. All sample locations where Scott's apatanian caddisfly were collected had substrate either dominated by gravel or cobble and generally a mix of the two substrates; and little sand. Scott's apatanian Caddisfly is sometimes found on moss fronds in small, cold, alpine streams (Wiggins 1973). The caddisfly has been collected on the Mt. Hood National Forest at elevations between 3,500 and 5,722 feet.

Despite limited survey data, 28 Scott's apatanian caddisfly were observed in 2013 in Sand Canyon Creek, Cedar Creek, Little Zigzag River, a tributary to the Muddy Fork of the Sandy River, and a case was found in a tributary to McGee Creek on the Zigzag Ranger District (USDA Forest Service, Zigzag Ranger District, 2013). No Scott's apatanian were collected where they were previously recorded in Still Creek, West Fork Salmon River, or South Fork Iron Creek. However, the exact locations within the creek where they were previously recorded were not sampled. The instream vegetation was either dominated by wiry moss or detritus with large trees (21"-32" diameter) in the riparian area.

The species may occur in other localities within the Mt. Hood National Forest and even in the sub-watersheds containing the project area; however, extensive surveys have not been conducted.

6.1.4.5 - Cope's Giant Salamander

The Cope's giant salamander ranges across two distinct ecoregions in western Washington and Oregon, occurring predominantly in the Coast Ranges and Cascade Range. In the Cascade Range it occurs from the Nisqually River at Mount Rainier National Park, Washington,

southward to the upper White River watershed in Wasco County, Oregon. The species is absent in the Willamette Valley lowlands and foothills in Oregon.

Cope's giant salamanders are found in small, rocky, and usually steep-gradient streams in conifer or mixed forests (Thoms & Corkran, 2006) (Jones, 2005). They can be found under stones, slabs of bark, or other cover in streams, and are often found in pool habitat units with still water rather than faster-flowing riffles. In high-moisture conditions, they can be found crawling among rocks and vegetation along stream banks at night (Nussbaum & Storm, 1983). Down wood is associated with observations of this species.

The species is often found in its larval or paedomorphic adult forms (sexually mature adult with juvenile characteristics); both forms have gills and are restricted to aquatic environments. However Cope's giant salamanders are known to transform into terrestrial adults, and have been found in riparian areas close to surface waters.

In the Mt. Hood National Forest, records document presence on the Forest. Within Clackamas County, the salamander has been found in the North Fork Eagle Creek, and Cedar Creek-Sandy River sub-watersheds (USDA 2018); just north of the North Clack project area boundary. Since it has been observed in close proximity to the project area, it is presumed present.

6.1.5 - Survey and Manage Species

6.1.5.1 - Columbia Duskysnail

This species of aquatic mollusk has been found across the MHNF during surveys conducted over the past several years (MHNF, unpublished data). Habitat requirements for this species are fairly specific: cold, well oxygenated springs, seeps, and small streams, preferring areas without aquatic macrophytes (Duncan, 2008). Until recently, individuals had not been found in larger streams and rivers, or glacial streams. However, in 2013, the Columbia duskysnail was found within the East Fork Hood River, which is noteworthy because it is the first described in a glacially influenced stream on the eastside of the MHNF (MHNF, unpublished data). The Columbia duskysnail is present within the project area.

6.1.5.2 - Basalt Juga

The habitat requirements for the basalt juga appear similar to that of the Columbia duskysnail (Duncan, 2008). These small snails have been found in several locations on the east side of the MHNF (MHNF, unpublished data). A study conducted by the Smithsonian and to be published in 2018 has concluded that basalt juga are conspecific with the purple-lipped juga, and that their species name is *Juga bairdiana* (Ellen Strong, personal communication, August 31, 2017). This species has been documented in streams in several counties within the Mt Hood National Forest. The basalt juga is not present within the project area.

6.2 - Landscape Conditions

The Watershed Condition Framework (WCF) is a nationally consistent reconnaissance-level methodology for classifying watershed condition, using a comprehensive set of 12 indicators that are surrogate variables representing the underlying ecological, hydrological, and geomorphic functions and processes that affect watershed condition. A thorough description of the WCF is found in the Water Quality Specialist Report.

If the indicators and their surrogate variables reflect watershed impairment, the Forest Service can take direct action, or cause others to take action, to maintaining or improving watershed condition. Whether or not there is impairment in a watershed is indicated by a "good", "fair", or "poor" rating. A "Good" rating indicates ecosystem healthy functioning; "Fair" rating indicates the relevant indicators are functioning at risk; a "Poor" rating reflects indicators are functioning at an un-acceptable level of risk. This rating provides for a direct linkage between the classification system and management or improvement activities the Forest Service conducts on the ground.

According to WCF, the overall rating for the North Clack project area is "Functioning at Risk". The Roaring River and North Fork Clackamas sub-watersheds were rated as "Fair" and the Upper Eagle Creek sub-watershed was rated as "Good" for the following indicators: 1) aquatic habitat, 2) aquatic biota, and 3) roads and trails. This is based on low wood counts, high road densities, and some fish passage problems. The project area rating, were it repeated, would probably indicate improvement since 9 miles of road have been decommissioned since it was last done.

Existing conditions for temperature and other water quality parameters were discussed in the Water Quality Specialist Report, and road construction and maintenance existing conditions in the Transportation Report.

Described below is the existing condition and distribution of aquatic fauna and their habitat in the four sub-watersheds that encompass the project area. These descriptions would serve as a reference from which to gauge possible effects from the proposed action.

6.2.1 - Watershed Analysis, and Level II Survey

6.2.1.1 - USFS Watershed Analyses

The North Fork Clackamas River Watershed Analysis (USDA Forest Service, 1996) analyzed the area from the mouth of the North Fork Clackamas River to the easternmost headwaters and included information about a watershed recovering from extensive stand replacement fires and past timber practices. Aquatic related recommendations were to avoid new roads, and to concentrate on adding LWD through short and long-term recruitment. This is accomplished by placing LWD instream and utilizing silvicultural practices to create late-seral conditions and thinning of hardwoods to release conifers.

6.2.1.2 - Region 6 Stream Inventory Level II Surveys

A Level II survey is an extensive stream channel, riparian vegetation, aquatic habitat condition and biotic inventory on a watershed-wide scale. In the project area multiple Level II surveys have been completed that provide snapshots into the physical habitat conditions over the last 3 decades. Between 2 and 20 miles of survey have occurred, often in multiple years, on each of the following rivers or creeks: Bedford, Dry, Whisky, North Fork Clackamas, Boyer, and Winslow Creeks.

6.2.2 - Environmental Baseline in the Project Area

6.2.2.1 - Stream Temperature

Stream temperature plays a critical role in determining metabolic rates, physiological function, and life-history of aquatic organisms as well as ecological processes such as nutrient cycling and productivity (Allen & Castillo, 2007). Aquatic species are restricted to temperature ranges that limit their distribution and available habitat. For salmonid species, there is a well-established connection between temperature and growth rate. Warmer temperatures increase feeding activity and rates of digestion, but also increase respiratory rates and energetic costs (Allen and Castillo, 2007). The preferred water temperature of most salmonids falls within the range 10-21°C; however, multiple exposures to sub-lethal temperatures can lead to mortality (McCullough, 1999). Also, salmonid growth was just barely positive for Chinook in the 21-26°C regime (McCullough, 1999).

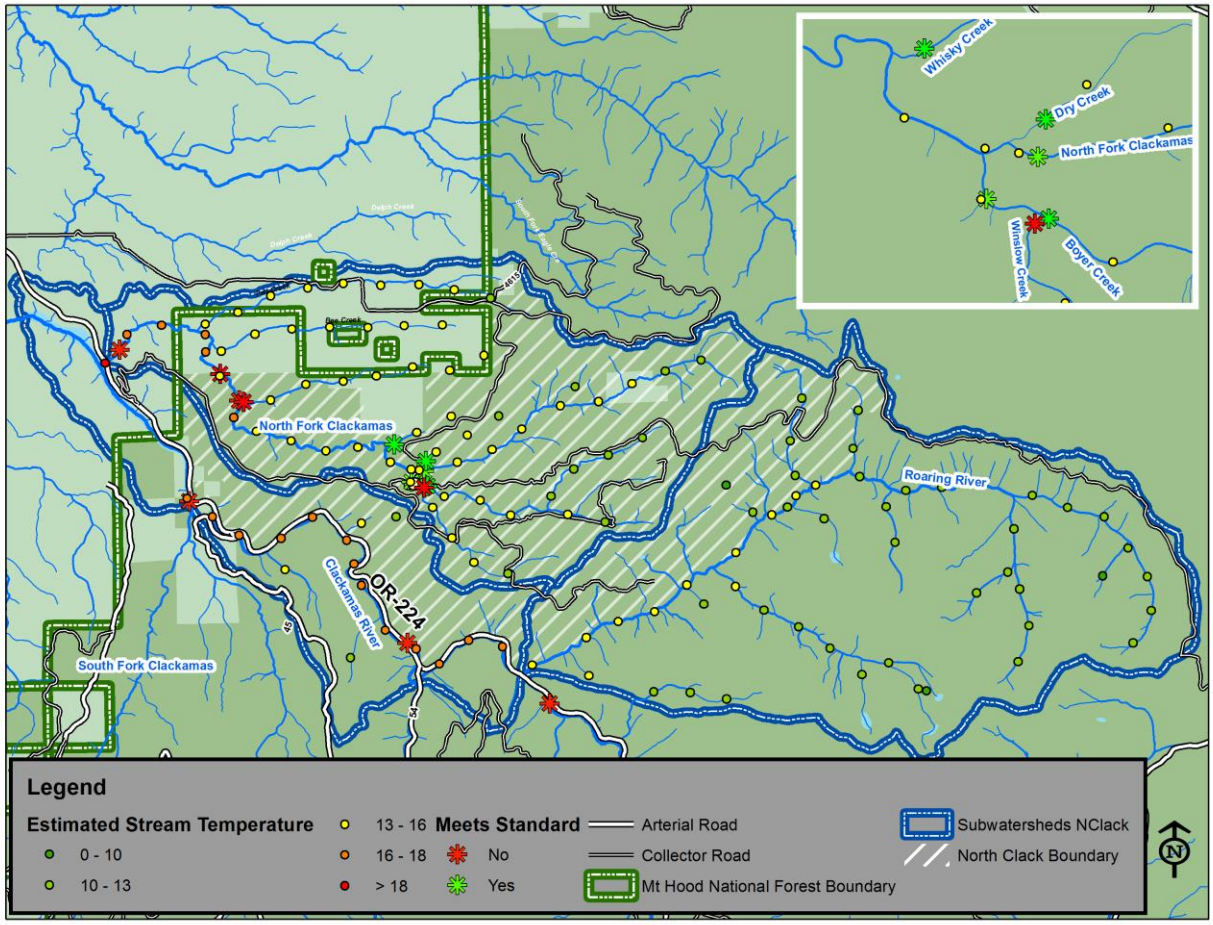
In the last 50 years, removal of streambank vegetation has resulted largely from timber harvest in riparian areas and stream temperatures may have been affected. Since then, clearcut harvesting in riparian areas has been limited and buffer widths in new harvested areas have increased; improved shade is the result of improved growth in riparian areas (WQ specialist Report). Improved shade protects stream temperatures similar to natural conditions. Other recent and ongoing actions have been designed to protect shade. Road decommissioning and fish habitat restoration projects provide improvements to riparian conditions and gradually increase shade as vegetation grows.

Since 2002, water temperatures measured in select streams met the Ultimate Upper Incipient Lethal Temperature criteria as well as the spawning and growing criteria for salmonids. Growth and development can be limited long before temperature approach lethal conditions. For Chinook salmon, ideal growing conditions are found to be 10.0 to 15.6°C, and the bounds for positive growth are 4.5°C and 19.1°C (McCullough, 1999). For Rainbow trout, the ideal conditions are similar; 5-20 Celsius (The Wild Trout Trust Ltd., 2018). The Oregon Administrative Rule (OAR) 340-041-0028 for stream temperature for cold water rearing habitat, for salmonids, is 16^0 Celsius.

Existing continuous water temperature data is limited in the project area. In 2017 out of six streams, only the North Fork Clackamas River and two tributaries, Bedford and Winslow Creeks, had temperature exceedances above the upper limit for cold-water rearing (16^0 Celsius); the

other three creeks (i.e. Dry, Whisky, and Boyer creeks) were within the standard range. One other temperature exceedance was measured in the North Fork Clackamas in 1994 (USDA Forest Service, 1991-2011). Aside from the Clackamas River at the southwest boundary and the lowest 4 miles of the Roaring River, the project area does not contain salmon and steelhead, or their Critical Habitat. Downstream of the project area (roughly 2,000 feet), the North Fork Clackamas River and the Roaring River has Critical Habitat and has exceeded the temperature standard for many years (WQ Specialist Report).

Figure 2. Water Temperature Measurement Locations and Modeled temperatures.



Based on the temperature recordings in the project area, and the results found in the Water Quality Specialist Report (2018), the streams are Properly Functioning for water temperature.

6.2.2.2 - Sediment

Most available data for sedimentation (USDA 1991-2011) for the North Fork Clackamas River Sub-watershed indicate that the habitat in the project area meets state standards, but there are exceptions. The natural sources of sediment into streams include landslides and sediment from wildfire, while roads are the primary man-made source.

The North Fork Clackamas River does not flow turbid very often. The general consensus of Clackamas Ranger District personnel for the last 10 years shows that there are less than 10 days a year where one cannot see the streambed in the project area during the high flow periods. In fact, it is very easy to locate sediment sources because of the relatively clear conditions. Sediment source monitoring the past three years shows that road rutting along Forest Road 4610, and one in particular location near river mile 7, accounts for most of the suspended sediment during high flow events. The water typically darkens to a tea coloration during the fall rains due to leaching from deciduous leaves but rarely gets brown from suspended sediment (USDA, 1996). Current conditions have not likely changed since the report was written.

With respect to fine sediment, research from the Rocky Mountain Research Station indicates an initial reduction of 64% in fine sediment delivery and a post large storm event reduction of 80% in fine sediment delivery associated with road decommissioning. Nine miles of roads have been decommissioned in project area sub-watersheds. Sediment delivery is reduced, but not totally arrested. Sediment finer than 10 mm can fill interstices of sediment and trap fry in redds by blocking pathways for emergence (Bjorn, 1969) (Phillips RW, 1975) (Harshbarger, 1982) (Bennett, 2003). When sediment is even finer – less than about 1 mm in diameter – it can impede intragravel flow of water, thus depriving incubating eggs of oxygen-rich water and preventing removal of toxic metabolic wastes (McNeil & Ahnell, 1964); (Greig, Sear, & Carling, 2005)). The threshold used in this assessment for fine sediment is based on the threshold of concern.

The threshold of concern set by the National Marine Fisheries Service and described in the Analytical Process for Preparation of Biological Assessments (USDA, USDI Fish and Wildlife Service, USDOC National Marine Fisheries Service, & USDI Bureau of Land Management, 2004), is the percent occurrence of a 6 mm particle size on the surface of gravels. The categories are

- Properly functioning <12% surface fines (particle size <6 mm)
- Functioning at Risk 12-20% surface fines (<6mm)
- Not Properly Functioning: >20% surface fines (<6mm)

There exists a relationship between embryo survival and percent of substrate particles less than 6.35 mm for Chinook, kokanee, rainbow, cutthroat and steelhead trout (Bjornn & Reiser, 1991). Above 20% surface fines, the survival of salmonid embryos declines. In-channel fine sediment was evaluated based on the Wolman pebble count method in six stream reaches in the project area over the last six years. The stream reaches where the percent substrate composed of fine sediment (material less than 6 millimeters) are identified in

Table 7. None of the six streams exceeded the standard of 20% fines, but three are considered functioning at risk (Bedford, Boyer, and Winslow creeks).

Table 7. Fine sediment data

Stream Reach	% Less than 6mm
Bedford Creek	12
Boyer Creek	16
North Fork Clackamas	10
Winslow Creek	16
Whisky Creek	11
Dry Creek	9

Unstable stream banks have the potential to directly deliver sediment to the stream system. Stream surveys conducted in the project area indicate limited areas of unstable stream banks. These unstable banks usually occur where streams parallel roads and at dispersed recreation sites.

Based on survey results for the percent substrate composed of fine sediment, three streams generally met the standard for Properly Functioning for the sediment indicator.

6.2.2.3 - Large Woody Debris

Large woody Debris (LWD) is important in streams because it creates pools, enhances deposition of spawning gravels, boosts trophic processes, and adds structural complexity. Because of past fires and logging in riparian stands, there was, and still is, less potential for "large" woody debris recruitment into associated streams. Much of the area was privately owned and was dramatically affected by multiple wildfires. No logging occurred prior to 1920, but later, logging was extensive in areas that were unburned. The result is vast stands of small trees along the rivers and streams that are smaller in diameter than the Forest standard. Despite restoration efforts over the past several decades, LWD recruitment into streams remains less than the desired level and instream wood tends to be too small to meet standards. Stream incision and reduced fish habitat quality is still evident today.

A white paper on the subject (Acker, Reeves, Hogervorst, Blundon, & Yau, 2018) found that the clearest need for restoration of riparian vegetation in the planning area was to increase the area occupied by forests dominated by large or giant trees (>30 inches diameter). Most streams are dominated by conifers or mixes of conifer and hardwoods of sapling and pole size (<10 inches diameter) and of small and medium size trees (10-20 inches diameter). These are more abundant under current conditions than under reference conditions. Thus there may be opportunities to apply vegetation treatments to promote development of stands dominated by larger trees for both the near future and for the longer term (Acker, Reeves, Hogervorst, Blundon, & Yau, 2018).

The Forest Plan standard for large wood in streams is 106 pieces per mile (FW-095). The Analytical Process Standard, the standard used by federal agencies for protection of listed salmon and steelhead is 80 pieces per mile (USDA, USDI Fish and Wildlife Service, USDOC

National Marine Fisheries Service, & USDI Bureau of Land Management, 2004). To qualify on the westside of the Mt. Hood National Forest, all pieces of large wood should be at least 50 feet long with 80 percent at least 24 inches in mean diameter (medium), and at least 20 percent of large wood pieces should be over 36 inches in mean diameter (large). Of the six streams surveyed in the project area, none met the Forest Plan or Analytical Process standard for in-stream large wood frequency (Table 8).

Table 8. Large woody debris frequency in project area streams.

Project Area Streams	Large Wood Debris frequency (pieces/mile)
Bedford Creek	10
Boyer Creek	9
Dry Creek	65
North Fork Clackamas River	4
Whisky Creek	6
Winslow Creek	32

Because of past fires and logging, project area streams do not meet the standard for large woody debris and are Not Properly Functioning.

6.2.2.4 - Pool Frequency and Quality and Large Pools

Large wood in streams is key to forming pool habitat in western Oregon. Pool habitat is a critical component of healthy stream habitat for salmonid populations. The Forest Plan requires that pool habitat be maintained or increased (FW-088) and that streams contain one or more primary pools per 5 to 7 channel widths in low gradient streams (less than 3 percent slope) and one per 3 channel widths in steeper channels (FW-090/091). A primary pool is defined as a pool at least 3 feet deep, which occupies at least half of the low water flow channel. Pool frequency is often related to the occurrence of large wood or other channel obstructions (Montgomery, Collins, Buffington, & Abbe, 2003). Pool depth is related to the shear stress and the sediment input. Fine sediment above natural background levels can fill pools and increase bed mobility, resulting in shallower scour depths (Buffington, Lisle, Woodsmith, & Hilton., 2002).

No surveyed streams in the project area meet the Analytical Process standard (2004) for pool frequency, but four met the Forest Plan standard (

Table 9). Part of the explanation for this is that the AP standard is tailored more for salmon bearing streams and rivers, while the Forest Plan standard is more suited to headwater streams above 3% gradient. One reason is that pools are not common in the smaller, steeper stream reaches common in the project area. Also, it is likely that surveyed stream reaches across the project area have fewer pools than were present historically because of past land management activities. Reasons for the decline include a reduction of pool forming large wood available for recruitment from riparian areas and sedimentation in remaining pools.

Table 9. Pools per Mile

Stream Name	Pools per mile	Pools >3 feet /mile	Channel Width (feet)	FP Standard (>1/ three channel widths)	Analytical Process Standard: Pools/mi.
North Fork Clackamas River	30	7	22	0.6	39
Bedford Creek	16	1	14	0.7	48
Boyer Creek	45	2	10	2	39
Dry Creek	49	1	5	5	39
Whisky Creek	45	0	7	3	60
Winslow Creek	43	0	10	2	48

Pool quality is a subjective measure of their "attractiveness" and suitability for fish and other aquatic fauna. Pools of higher quality are deeper and contain some form of cover for fish. Surveys conducted as part of regular monitoring indicate pools greater than three feet deep were not common, but had minimal filling due to fine sediment. Large wood cover is lacking in pools; and pool depth in the river tends to decrease dramatically due to the "rain-fall hydrograph". The reason being that "rain-fall hydrograph"-type rivers, such as the North Fork Clackamas, tend to have a more volatile flow regime and the duration of pools with three foot depths is shorter, than in a stream where much of the annual precipitation is held as snowpack. Given two rivers of equal size and volume, the river that has a rain-fall driven hydrograph would have less deep water holding habitat than the other with a snow-melt hydrograph.

Based on the number of pools per mile and the fact that the surveyed streams had few pools greater than three feet deep, the project area is considered Functioning at Risk for Pool Frequency and Quality and Large Pools.

7.0 - Effects with No Action

With no action, sediment delivery to streams in may increase associated with the deteriorating road network. The current road network would see minimal levels of maintenance associated with reduced funding levels and may pose a risk of failure and may contribute sediment to streams. With no action, road decommissioning, stormproofing and restoration of unauthorized OHV routes would not occur and those sources of erosion and sedimentation would continue, resulting in continued impacts to aquatic species.

Riparian stands would continue to grow at modest rates and natural processes of suppression would result in the smaller trees dying and eventually falling. Some may fall toward the stream while others would not.

7.1 – Effects with the Proposed Action

7.1.1 - Direct and Indirect Effects

Direct effects are those that occur during project implementation. To directly impact aquatic species/habitat, the activity needs to be in close proximity to the water body where they reside, often within the water body itself. From an aquatic perspective, direct effects most often result in disturbance to aquatic organisms – forcing movement or a flight response. Depending on the activity, it is possible that individuals can be injured or killed; this case is almost always a result of people or equipment working directly in water. Direct habitat effects are possible, but depend on the activity. The primary components of the proposed action that have a risk of direct effects on aquatic organisms or habitats are tree falling while the effects of other actions would be more indirect.

7.1.1.1 - Tree Falling and Yarding

Roughly 100 second-growth trees within the buffer zones in North Fork Clackamas, Bedford and Winslow Creek would be felled pushed, or pulled over, or brought in with helicopters and placed into streams for habitat enhancement. Streams selected for wood placement include those where fish are present, wood is lacking, and access is feasible. A tree placed instream for fish habitat enhancement may disturb/harm fish, and aquatic organisms; or result in injury or death. More likely, the result would be displacement until conditions at the site are stabilized. The former possibilities are remote and the risk is low. Because of the low risk, this activity is considered not likely to adversely affect PETS species.

7.1.1.2 - Stream Temperature

Nearly three quarters of the units have thinning in Riparian Reserves, and approximately a third of those units are adjacent to perennial streams or springs.

A project activity affects stream temperatures if there is a loss of streamside vegetation that is shading the stream. Stream temperatures are anticipated to remain at current levels because streamside vegetation would be protected and unchanged. According the Forest Hydrologist, primary shade zones (areas of riparian vegetation directly adjacent to streams) along perennial streams would continue to fill in with understory vegetation as young plantations grow. Since these areas are already densely vegetated, it is not anticipated that any aspect of this project would affect stream temperatures within the project area (Parker T. , 2018).

As described in the proposed action, a wider than standard harvest protection buffer width was prescribed as an extra measure of protection against loss of shade and water temperature increase in four units. These units are adjacent to streams that are located between 1,000 and 2,000 feet of LFH. After considering the proximity of Units 2, 4, 6, and 50, their average tree height, slope, and aspect of the side of stream that would be thinned, the prescription for buffer width was increased to a width equal to the existing tree height (Table 10)Figure 3) and (Figure 4).

Table 10. Prescribed Stream Protection Buffer Widths based on Existing Tree Height for perennial Streams in Specific Units.

Unit	Protection Buffer Width (feet)
2	118
4	125
6	111
50	89

Figure 3. Listed Fish Habitat and Proximity to Harvest Activities in Riparian Reserve (Unit 2, 4 and 6)

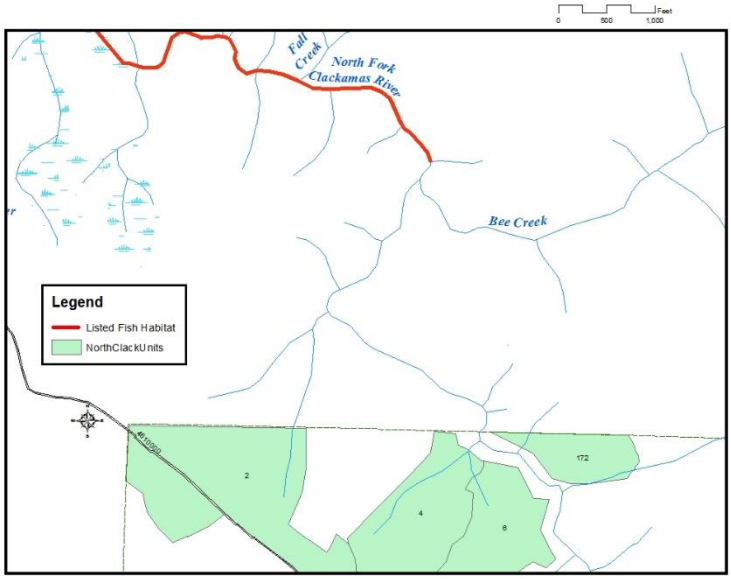
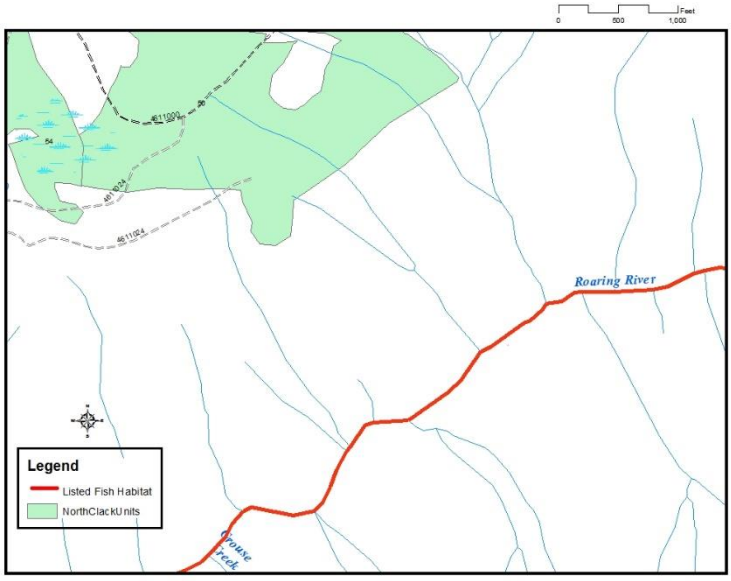


Figure 4. Listed Fish Habitat and Proximity to Harvest Activities in Riparian Reserve (Unit 50)



Protection buffers designed to protect stream shade within the primary shade zone in all North Clack Project units were based on the *TMDL* Strategy, available literature, the Water Quality Specialist Report (Parker T. , 2018), and further refined by site-specific information. Due to the width of the stream protection buffer on all fish-bearing streams and the maintenance of existing canopy cover on all streams, there would be a negligible and non-detectable change in stream temperature if the proposed action is implemented. The probability that timber falling would increase stream temperature at the sub-watershed scale is not likely and there would be no effect on water temperatures for PETS species.

7.1.1.3 - Sediment

The primary project elements that could affect sediment in streams are road work, and timber and rock haul. Road work includes: road maintenance, temporary road and landing construction (or reconstruction) and road storm proofing, closure, and rehabilitation.

Twenty miles of temporary roads would be constructed or reconstructed where they were used before. Road closure would occur on 26 miles of road and rehabilitation would occur on 7 miles of road. Additionally, there are 7 miles of OHV trail that would be rehabilitated. There are no effects of paved roads on sediment, but there are 60 miles of aggregate and native surface roads that would receive work and that would be used to haul timber and rock.

All existing landings would be used where feasible (PDC C3). New landings would not be constructed within 200’ of any stream, and existing landings must be at least 100’ from any stream. Erosion control devices would be installed on all landings as necessary to avoid sediment transport to road ditches or streams. No landings would be hydrologically connected to a stream, thus there is no causal mechanism to increase fine sediment to PETS species habitat.

There would be ground disturbance near streams during the road construction which would result in some short-term sedimentation.

The other elements (or sub-element) are road maintenance and timber and rock haul. Eleven miles of aggregate or native surface road are within 800 feet of fish-bearing streams, and would receive maintenance. The maintained roads would eventually be used for timber and rock haul.

Maintenance includes surface blading, spot rock surfacing, cleaning of ditches and cross drain inlets, and maintenance of water bars. In order to understand the mechanism of sediment introduction to streams, the project Water Quality Specialist used the GRAIP-lite model to estimate existing and potential added amounts of sediment produced by the project during implementation and post-project conditions. The percent from background levels of sediment production, including the sediment produced by the existing road network and other sources, was 1% (increase) in the North Fork Clackamas River, and -2% (decrease) in the Roaring River sub-watersheds during project implementation. There was no change in either the Helion Creek or Upper Eagle creek sub-watersheds. After project completion and vegetative recovery

from such things as road and OHV trail closures, there would be -7% (reduction) in sediment yield.

Both road maintenance and haul may affect stream sediment and indirectly affect PETS species. Indirect effects on fish from road maintenance and haul may include behavioral changes in their habitat use, their choice of prey, and predator avoidance. Those effects could result in changes to growth rate and overall fitness.

PDCs requiring installation of erosion control measures and condition based restrictions on log hauling would further minimize increases in streams that were predicted by the project Water Quality Specialist for the following reasons:

- Contract administration personnel would restrict log hauling to minimize water quality degradation. Haul would be stopped immediately if there is rutting of the road surface or a noticeable increase in the suspended sediment of water draining to the road ditches or at stream crossings (PDC G1).
- Haul would not occur on road segments that have a higher risk of soil erosion and sediment delivery to stream systems in the area when wet conditions exist (PDC G1). Log haul would be restricted to asphalt surface roads, or gravel surface when wet conditions exist.
- All haul routes would receive road upgrades as needed, such as the addition of surface aggregate, blading, and road ditch clean-out of larger sized material before use.
- Many system roads (except those that are out-sloped) contain drainage relief culverts that drain onto the forest floor and are not hydrologically connected to any stream channel. The section of each road that could drain into streams between the last drainage relief culvert and the stream crossing is relatively short (estimated 350 feet), thus minimizing the potential for erosion and sediment introduction.
- Any minor amount of fine sediment making its way into stream channels from haul roads would not likely be transported directly to streams. The sediment would move in a discontinuous manner and much would be deposited in small channels as it moves downstream.
- If sediment were to reach a stream because of haul activities, the volume of sediment would be unnoticeable compared to background levels during a precipitation event

In summary, there is a high probability that some road surface fines would reach streams and increase stream sediment especially during road maintenance and haul within the short sections of hydrologically connected roads. Because of the distance from their habitat, there would be No Effect to Threatened species or their habitat. Sediment from this project May Impact sensitive aquatic species in the project area. This slight effect would come in the form of short-term displacement of resident fish and other aquatic fauna. During project implementation, there may be short-term increases in sedimentation in localized areas that are not measurable against background levels. The sediment increases would be negligible outside of the 800 foot reach where the input occurs and have no measurable impact on fish spawning and rearing habitat or spawning success and survival. The increase will not likely contribute to a trend towards Federal listing or loss of viability to the population or species. In the long term,

however, road maintenance, closure, and rehabilitation, especially blading, outsloping, and spot rocking would reduce erosion and potential sediment introduction as compared to unmaintained roads. Road maintenance prior to haul would improve runoff from the surface into ditch relief culverts and away from streams.

7.1.1.4 - Large Woody Debris

Large woody debris (LWD) is important in streams because it creates pools, juvenile and adult hiding cover, enhances deposition of spawning gravels, boosts trophic processes, and adds structural complexity. Outside of stream protection buffers, but within a site-potential tree height, timber felling has the potential to affect recruitment of large wood to streams, instream Large Woody Debris, and corresponding aquatic habitat. In those units with riparian thinning, there could be a slight reduction in the amount of large wood available for recruitment for several decades (average 40 years). There also might be a reduction in current instream quantities of large wood as flood flows transport some of it out of the area. The actual reduction in large wood, if it occurs at all, is difficult to predict. Natural events such as wind storms could result in large amounts of down large wood even in thinned units.

Stream protection buffers have been prescribed on all streams, ponds, and wetlands to protect the habitat forming quality from the existing riparian vegetation. For each unit with thinning in Riparian Reserves, a minimum stream protection buffer was defined at varying distances based on site-specific conditions including channel migration zone, hillslope stability, and stream type. A minimum 70 foot protection buffer from the channel edge of perennial streams and 50 feet on intermittent streams was applied. There would be a minimal decrease of large woody debris for four reasons:

- The rate of LWD recruitment during high flow events is low because streams are mostly too small to transport LWD into larger streams and debris flows are infrequent,
- The size of tree available for recruitment into streams from adjacent stands is sub-standard (at the time the riparian areas would be thinned),
- There would be a slight long-term positive effect from thinning in the Riparian Reserves because larger sized habitat forming trees would be allowed to grow and be available for recruitment, and
- Perennial stream protection buffers of 70 feet or greater and intermittent buffers of 50 ft. would protect recruitment of a range of different size LWD to stream channels (Benda, Litschert, Reeves, & al., 2016), some of which would be functionally equivalent to larger older trees.

The slight reduction in large wood in upstream reaches near thinning units is not expected to translate to a reduction in large wood in larger streams that are downstream of the project area or in Listed-fish Habitat. Reductions in larger downstream reaches are not expected to be measureable for the following reasons:

- Most of the streams with treatments within one site-potential tree height are intercepted by roads with culverts that would cause capture large woody debris before reaching larger streams. This capture makes debris flows the only other large wood transport

mechanism from treatment reaches to reach many large streams. Debris flows in this area are infrequent.

- Within one site-potential tree height of a perennial stream, less than 190 acres out of the 3,757 Riparian Reserve acres on all land in the North Clack project area would have thinning activity (5 percent).

The project objectives include maintaining the current supply of LWD to streams, and increasing the size of those trees that are available for recruitment over time. Trees that fall into larger streams and floodplains are one of the largest potential large wood recruitment sources to streams. It is not likely that tree removal from this project would have an effect on tree fall into streams. Additionally, the transport of large wood in headwater streams by fluvial processes is limited due to high roughness and low stream power. Studies have shown that wood shorter than bankfull width is much more likely to be transported by streamflow (Lienkaemper, 1987); a situation that is not likely to occur in streams near North Clack project streams. Further detail is found below:

- In the project area, the natural rate of LWD recruitment to streams is low and unpredictable; on the order of decades. However, debris flows account for a high percentage of trees that occur in streams. New massive landslides in the project area that would produce LWD recruitment, like the one adjacent to unit 88, are infrequent (Mikulovsky, 2018). Average annual flow in project area streams are mostly too small to transport large diameter trees downstream.
- Most of the current supply of LWD available for recruitment to streams would be maintained under the project. Johnston (2011) found 90 percent of LWD in western Oregon and Washington streams originates at ground distances between 33 and 66 feet from streams. Benda et al. (2016) found that thinning reduces the volume of wood reaching the stream at distances less than 16 meters. All perennial streams have a no-harvest stream protection buffer that is at least 70 feet wide that maintains the primary wood source for streams. Thinning within these units would have no effect to LWD recruitment potential to downstream fish habitat. Thinning outside of a 70 foot buffer on perennial streams may have a very small short-term localized effect (i.e. less than 10%) on the LWD supply available for recruitment to streams, but greater than 90 percent of the LWD supply would remain available for recruitment on all perennial streams (Johnston, 2011).
- Likewise, standing live tree diameters in the portion of units available for recruitment to streams are too small and averages near 15 inches diameter. Stands continue to diminish in growth and lack large snags and downed wood suitable for riparian and wildlife needs. In addition, the stands have low tree diversity (Douglas-fir dominated), are single-canopied, and even-aged stands. Thinning can have both immediate effects on forest diversity and long-term effects restoring native plant communities as understory species are released and provide a seed source for future recruitment (Bahaus, 2009) and enhancing minor tree species, such as Western Red Cedar. Outside of 70-feet, structural diversity would be improved directly by initiating a new age class and by creating small openings. Thinning would release green retention trees. These retention trees would

later become the large diameter snag and downed wood needed to meet habitat needs of fish and other sensitive species.

- The Forest Vegetation Simulator model predicts a growth period is 10 to 100 years to achieve functional-sized wood. Over this time, the benefit from the project would be an increase in the number of functionally sized LWD available within Riparian Reserves for potential recruitment into streams.

Beside the small effect of thinning in Riparian Reserves, six stream reaches are planned to receive the addition of large wood to improve the instream large wood. Large wood would be placed in the lower few miles of the North Fork Clackamas River, Bedford Creek and Winslow Creek. Like many streams, these reaches lack a desirable amount of instream woody debris because the stream reaches were clearcut and burned in the past. There has been no recruitment of large trees into these streams reaches since that vegetation management activity occurred. In these stream reaches, trees would be felled, pushed or pulled over, or brought in with a helicopter to create better quality fish habitat than currently exists. The desired future condition in these reaches (and throughout the project area) is to have mature riparian vegetation with large trees that periodically fall into streams to provide large woody debris and in-stream diversity needed to provide for good water quality and aquatic habitats. In the interim before large trees grow and are available for recruitment, logs with rootwads would be added to ameliorate the current condition. The exact stream reaches for large wood addition would be selected from areas where fish are present, wood is lacking, and access is feasible. Unit 43 would be thinned to serve as a source of "fish logs" and would be thinned to achieve land management objectives.

To summarize, given the combination of small size of area treated within one site-potential tree height of perennial streams (<190 acres), presence of no-harvest stream protection buffers designed to maintain short and long term LWD recruitment to streams, and the lack of mechanism for wood transport from smaller to larger streams in the project area, the effect from riparian thinning on recruitment to streams is expected to be minimal. There would be a slight management-related negative change; or, the proposed action May impact individuals or habitat, but will not likely contribute to a trend towards Federal listing or loss of viability to the population or species. Instream and riparian processes of habitat development and wood recruitment would continue in the project area, and improve in the six reaches proposed for additional inputs. Riparian habitat conditions would continue to improve as trees grow and continue to provide large woody debris to streams. There would be no effect to Threatened species or their habitat.

7.1.1.5 - Pool Frequency and Quality and Large Pools

The elements of the proposed action discussed above affecting sediment and large wood also affect pools. Tree felling, road maintenance, and timber and rock haul could affect pool frequency and quality. Three quarters of the contract units (out of 161 total) have tree falling inside of riparian reserves, but all are protected by stream protection buffers. Three contract units are within 2,000 feet of Listed-Fish Habitat.

Log and rock hauling would occur on approximately 82 miles of roads; 14 miles of the aggregate and 5 miles of native surface roads are in within one site-potential tree height of streams. Road work includes road and landing construction, as well as road closure, stormproofing, and rehabilitation, and maintenance. Other than road maintenance, the construction and closure sub-elements would have no effect because the locations are outside of Riparian Reserves or too far away from streams to affect large wood recruitment or sedimentation of pool habitat.

In the units with felling in Riparian Reserves, 109 have intermittent streams only. From over 30 years of local field survey observations by district fish biologists, it is clear that these seasonal channels do not have the capacity to transport large wood to downstream fish habitat. Tree falling in these units would have no effect on pool habitat.

In the remaining units with perennial streams, the proposed silviculture treatments within a site-potential tree height could result in fewer pieces of large wood falling into streams and some decrease in pool habitat. Some, but not all, of these streams are fish bearing. As existing pool forming wood decays there could be gap in time where fewer trees are falling into channels to replace this wood. Any loss of pools would result in a loss of slow water rearing habitat that could cause fish to crowd into fewer pools. This in turn could result in increased competition for space and possibly food thus decreasing the overall population size during the time period pool habitat is reduced. The impact pool reduction could have on pool quantity and quality (e.g. macroinvertebrates on large wood in pools) would be minimal for three reasons:

- Pools make up a low percentage of the total habitat in the streams adjacent to harvest areas due to steep gradients and relatively confined area of the streams, thus a slight decrease in pool habitat would not change existing conditions to a great degree;
- Pools are currently formed by sub-standard sized trees that are the functional equivalent of trees with sizes that meet the standard, even though they would rot sooner; and,
- Most species of aquatic insects live in faster water, oxygen-rich habitats and thus pools are not their preferred habitat. The majority of macroinvertebrates are found in the riffles of streams because they require abundant dissolved oxygen and neutral pH.
- One of the large wood contributing (and pool forming) mechanisms is transport from upstream to downstream during high flow events. A decrease in large wood downstream of where silviculture treatment occur is unlikely because roads cutoff transport of large wood because undersized culverts block recruitment from upstream.

Road maintenance and timber and rock haul, may increase fine sediment that flows to a stream which can reduce pool volume and thus pool quality. As explained in the Sediment Section, this could happen through excavation of ditchlines during maintenance and dust, rutting and damage to the road surface during haul.

Most of the impacts of sedimentation in pools would be short-term in nature, located nearest the entry point of the source, and mostly unquantifiable against background levels. Pools are not likely to be affected by sediment when appropriate erosion control measures are applied such as spot rocking, silt fences, straw bales, matting, mulch, slash or water bars. For example,

Burroughs and King (1989) reported that measures such as erosion control blankets alone could reduce sediment production by 80 to 90 percent. During the wet season, haul routes would be inspected weekly, or more frequently if weather conditions warrant. Inspections would focus on road surface condition, drainage maintenance, and sources of soil erosion and sediment delivery to streams. If sediment traps are used, they would be inspected weekly during the wet conditions and entrained soil would be removed when the traps have filled to ¾ capacity. Removed materials would be deposited in a stable site which is not hydrologically connected to a stream. In the long term, road maintenance, especially blading, outsloping, and spot rocking would reduce erosion and potential sediment introduction as compared to unmaintained roads. Road maintenance prior to timber and rock haul would improve runoff from the surface into ditch relief culverts and away from streams. Rehabilitating OHV trails and closing roads would reduce future sediment into streams. Both the quantity and quality of pool habitat in the project area is expected to be maintained or increased in the future from the long-term improvements in road condition from the maintenance and erosion risk reduction.

In summary, the proposed action is not likely to change the current number and quality of pools in streams. This is due to the retention of adequate sized buffers and the absence of road construction or rehabilitation in nearby streams. There would be a slight reduction in frequency in large wood recruitment to streams, and a short-term increase of sediment in localized areas. However, the increased tree width and height in thinned stands is expected to contribute larger sized trees and more abundant and better quality pools in the future. Also, trees would felled, pushed, or pulled over, or brought in with helicopters in select streams where wood is lacking to create more and better quality pools that would have long term benefits. Overall, the proposed action would have no measurable effect on pool frequency or quality; and would have No Effect on PETS species.

7.2 - Alternative Two

Alternative Two was generated in response to comments from the public. It includes the addition of 116 acres of regeneration harvest over the proposed action. The location of the additional regeneration harvest is within units previously planned for thinning harvest. These units do not contain riparian reserves and no additional roads would be needed than what is proposed in Alternative One. The effects to Aquatic Species and their habitats would be similar to the proposed action.

7.3 - Cumulative Effects

Cumulative effects include the effects of past, present and reasonably foreseeable actions that overlap in time and space with the proposed action. The North Fork Reservoir intercepts, dilutes, and negates any combined effect that may result from adding effects from the Roaring River and Helion Creek sub-watersheds. The focus of this analysis is on the North Fork Clackamas River sub-watershed where most of the impacts occur.

The timeframe includes effects from the previous several decades when many of the impacts occurred in the Cumulative Effects Area. The timeframe considered for cumulative effects is approximately 100 years in the past since impacts from logging and fires then are still felt today. And the time frame will extend until approximately 2030 in the future when the effects of the proposed actions are not likely to be felt any longer.

The Water Quality Specialist Report analyzed stream temperature and found that there would be no change to temperature with the action alternatives, therefore there can be no cumulative effects for that measure. Stream temperature is not discussed further in this section. The Water Quality Specialist Report also analyzed stream sedimentation. While the analysis found some cumulative effect to sedimentation from other actions, sedimentation was found to be minimal and cumulative effects were not found to be substantial. Sediment is not discussed further in this section.

7.3.1 - Past Effects

Past actions and fires have been discussed in the Existing Condition sections. Past effects that overlap in space and time with effects of the project are timber harvest, including haul; aquatic habitat projects; OHV trail and road work; culvert replacement, and fires on Federal, State, and private timber lands.

There has been reduced large wood recruitment, instream large wood and marginal pool habitats from past logging and fires. Removing large wood from stream channels was a common past practice associated with timber harvest. There is less large wood in many streams within the project area than desired. Although most previous timber harvest occurred decades ago, riparian stands were treated more aggressively in many areas than current practices and thus the amount of standing wood remaining was minimal. Similarly, instream large wood, and pool number and quality is less than would have occurred historically. These areas are still recovering (trees are still growing) and have yet to grow to a size where they would contribute to functional large trees for recruitment. Logging on private lands has also resulted in reduced in stream large wood.

7.3.2 - Present Actions

The proposed action includes streamside protection buffers and the addition of wood into stream. In addition to the proposed actions, there are other ongoing actions that are considered. These include OHV use, and trail maintenance that would have minimal impact to large wood recruitment.

7.3.3 - Future Actions

While there may be future logging or other management within the watershed, there are no current proposals with sufficient site specificity to conduct an analysis. With the Forest's OHV plan, decisions were made to create trails and convert roads to trails. Most of this work has been completed, but one authorized new trail has yet to be constructed, and on road has yet to

be converted to a motorized trail. A recent Forest-wide assessment authorized the replacement of culverts. It is not likely that these actions would negatively impact instream large woody debris or pools.

The replacement of culverts would occur as funding allows. Culvert replacement projects would benefit large woody debris transport and pool formation in the vicinity of the road. Old culverts would be replaced with properly sized structures to reduce the risk of catastrophic failure of the entire road prism from being plugged. Collectively, the replacement of six culverts would improve aquatic habitat quality by improving accessibility to aquatic organisms, improving large woody debris transport through the properly sized culverts, creating higher quality pools with instream cover, and creating better forage for fish with insects that colonize the redistributed wood.

7.3.4 - Cumulative Effects Summary

Since the direct effects of the action alternatives showed a net reduction in sediment, no change to stream temperature, and sufficient progress toward improving instream large wood and pools, it is very unlikely that other actions when combined with past actions would result in substantive cumulative effects to fish and other aquatic organisms.

8.0 - Compliance with Forest Plan and NWFP

Table 11. Compliance with Mt. Hood National Forest Plan and Northwest Forest Plan Standards and Guidelines.

Forest Plan Standards and Guidelines	Action Alternatives
FW-109-114, and 127-129, 132-136 Temperature, Sediment, Large Woody Debris and Pools: Water quality and habitat quality shall be maintained to protect existing on and off-Forest beneficial water uses.	Yes
FW-137, Fish habitat capability shall be maintained at existing levels or greater	improves
FW-139, Degraded fish habitat shall be improved	Yes
FW-175, Habitat for TES species shall be protected and/or improved	Yes
General Riparian Area: B7-028, Regulated Timber harvest should occur within B7 inclusions within category B and C Management Areas. Regulated timber harvest shall be prohibited within B7 inclusions within category A Management Areas.	Yes
B7-037 Landings should not be located in stream channels, including dry ephemeral draws. Perpendicular road crossings may be permitted and rehabilitation shall be required.	Yes
B7-038 Stream crossings shall be rehabilitated	Yes
B7-059 Unneeded or abandoned roads should be rehabilitated	Yes
C31 Northwest Forest Plan Stds and Guidelines: Riparian Reserve Widths	Yes

8.1 - CONSISTENCY DETERMINATION

The Northwest Forest Plan (NWFP) (USDA and USDI 1994) Aquatic Conservation Strategy (ACS) was developed "…to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands." Within this strategy are nine ACS objectives that give direction regarding aquatic processes that are key to watershed health.

8.1.1 - Aquatic Conservation Strategy

The ACS objectives are detailed on page B-11 of the Northwest Forest Plan. At B-10, the Northwest Forest Plan indicates that, to meet the intent of the ACS, management activities should either maintain the existing condition or lead to improved conditions in the long term.

Portions of the effects analysis for the proposed action in this document focus on key parameters or indicators that make up elements of the nine Aquatic Conservation Strategy objectives. They form the rationale of the project's ability to maintain the existing condition or lead to improved conditions in the long term. The proposed action was evaluated at various temporal and spatial scales. The following table identifies the relevant indicators for each objective. The suite of indicators for each objective was evaluated to determine if the action achieves the specific ACS objective.

Table 12. Aquatic Conservation Strategy Objectives and Related Indicators

Indicators	#1	#2	#3	#4	#5	#6	#7	#8	#9
Temperature	N/A	X	N/A	X	N/A	N/A	N/A	X	X
Sediment	N/A	N/A	N/A	X	X	X	N/A	X	X
Chemical Contamination	N/A	N/A	N/A	X	N/A	N/A	N/A	X	X
Physical Barriers	X	X	N/A	N/A	N/A	N/A	N/A	X	X
Substrate	N/A	N/A	X	N/A	X	X	N/A	N/A	X
Large Woody Debris	N/A	N/A	X	N/A	N/A	N/A	N/A	X	X
Pool Frequency	N/A	N/A	X	N/A	N/A	N/A	N/A	N/A	X
Pool Quality	N/A	N/A	X	N/A	N/A	N/A	N/A	N/A	X
Off-Channel Habitat	X	X	X	N/A	N/A	N/A	N/A	N/A	X
Refugia	X	X	N/A	N/A	N/A	N/A	N/A	X	X
Width/Depth Ratio	N/A	N/A	X	N/A	N/A	N/A	N/A	X	X
Streambank Condition	N/A	N/A	X	N/A	N/A	X	N/A	X	X
Floodplain Connectivity	X	X	X	N/A	N/A	N/A	X	X	X
Peak/base Flows	N/A	N/A	N/A	N/A	X	X	X	N/A	N/A
Drainage Network Increase	N/A	N/A	N/A	N/A	X	X	X	N/A	N/A

8.1.1.1 - ACS Objective 1 - Watershed and Landscape-Scale Features

Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

The vegetation in the project area including riparian reserves has been changed over the years by logging and repeated fires, to the current vast stands of second-growth with low levels of diversity. Past clearcutting and road construction have also reduced pool and margin habitat in streams, reduced aquatic cover habitat, and removed or delayed future recruitment of large down wood, large snags, and live trees. Large wood loss also resulted in loss of habitat connectivity for species like mollusks and salamanders that use logs that span streams that access uplands areas.

The project would accelerate the restoration of riparian late-successional conditions. Riparian prescriptions would restore stands by creating diversity and complexity in largely homogenous stands. Stream protection buffers provide in-stream woody debris recruitment. The proposed action would add whole trees into streams to provide some immediate benefit. The proposed action provides a balance between the maintenance of existing habitat for aquatic and terrestrial riparian species, populations, and communities, and landscape scale restoration. Maintenance results primarily through no-harvest stream protection buffers. Restoration results from thinning multiple stands which accelerate the move toward late-successional conditions and improve the distribution, diversity and complexity typical of landscape features that developed under natural conditions. Over time, as late-successional conditions are restored in riparian reserves, missing elements such as large woody debris complexity both at the stream and landscape scales would be restored.

For these reasons, the objective of maintaining and restoring watershed and landscape-scale features would be met for this project because it would lead to improved conditions in the long term.

8.1.1.2 - ACS Objective 2 - Connectivity Within and Between Watersheds

Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

Connectivity in the project area has been affected by the construction of roads, as well as wildfires and clearcutting in riparian areas. Connectivity has been disrupted by roads that cross streams with culverts impassable to aquatic organisms. Roads and clearcuts in riparian areas have also broken some connections for dispersal of terrestrial riparian dependent species such as salamanders. In recent years, road decommissioning and the replacement of certain culverts has removed some of these barriers.

In the project area, a network of riparian reserves covers rivers, streams, springs, ponds and wetlands and the land adjacent to them. Due to climatic and geologic factors, the project area has a relatively dense network of streams, springs and wet areas all providing for spatial connectivity for aquatic and riparian dependent species. Maintenance of natural flow paths on the landscape and within the project area assure temporal connectivity.

Temporary roads that cross streams were carefully located on relatively gentle stable slopes to be consistent with riparian reserve standards and guidelines. They would be outsloped, used during dry conditions, and rehabilitated upon completion. Because the temporary stream crossings would be removed and rehabilitated, there would not be a long-term change to connectivity.

Stream temperature, current wood recruitment and undisturbed terrestrial dispersal corridors would be maintained in the short term by protection buffers adjacent to streams and the falling of trees into streams. Riparian treatment prescriptions would restore stands in the long term by accelerating the creation of missing diversity and complexity elements including large diameter trees, skips, and down wood. As these and other Riparian Reserve stands are enhanced across the project area, aquatic connectivity and late-successional connectivity would be restored more rapidly. On system roads, the project would decommission roads, including the removal of culverts that restrict the movement of aquatic organisms. It would maintain and repair roads to reduce sedimentation. As these enhancements are made, spatial and temporal connectivity at the site scale would be restored to more natural flow paths.

For these reasons, the objective of maintaining and restoring connectivity within and between watersheds would be met for this project because it would lead to improved conditions in the long term.

8.1.1.3 - ACS Objective 3 - Physical Integrity

Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

The physical integrity of aquatic systems has been affected by the construction of roads, and clearcutting in riparian areas.

Stream protection buffers and road use restrictions during wet conditions and other PDCs would minimize erosion and changes to stream shorelines, banks and bottom configurations and maintain the integrity of stream channels. Temporary road construction that would cross streams were carefully located on gentle stable slopes to be consistent with riparian reserve standards and guidelines. They would be outsloped, used during dry conditions, and rehabilitated upon completion. Because the temporary stream crossings would be removed and rehabilitated, there would not be a long-term change to the physical integrity of streams. Roads that are constructed or reconstructed would be temporary and would be rehabilitated after use. System road repairs and maintenance have PDCs to protect the physical integrity of the aquatic system. Changes in peak streamflows associated with vegetation manipulation and

roads were assessed and it was determined that peak flows would not likely cause stream channel destabilization or impacts to the physical integrity of the aquatic system.

For these reasons, the objective of maintaining and restoring physical integrity of aquatic systems would be met for this project because it would lead to improved conditions in the long term.

8.1.1.4 - ACS Objective 4 - Water Quality

Maintain and restore water quality necessary to support healthy riparian, aquatic and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

Temperature and sediment in the project area have been affected by the past construction of roads, and clearcutting in riparian areas. Temperature and sediment situations are gradually improving as roads are improved or decommissioned and as riparian vegetation grows and provides shade.

The quality of water would be maintained by following PDCs that include restrictions on wet season logging and haul, equipment slope restrictions and erosion control methods. On system roads, the project would reduce sedimentation by decommissioning and closing roads by rehabilitating unauthorized OHV routes, and maintaining all haul routes. As these enhancements are made, water quality would improve. Stream protection buffers would maintain stream temperatures and filter out some potential sediment where timber harvest is taking place.

PDCs for logging and road construction and maintenance would insure that project activities minimize sediment delivery. There may be some short-term localized increases in sediment delivery associated with temporary roads and other actions; however the level of sediment is very low compared to the natural background sediment level in the project area. The short-term sediment impacts associated with the temporary roads would also be spread out in time and space. The analysis found a net reduction of sediment with implementation of road repair, unauthorized OHV restoration and road decommissioning and stormproofing. The analysis of aquatic species found that the biological, physical and chemical aspects of water quality were within the range needed to support survival, growth, reproduction and migration.

For these reasons, the objective of maintaining and restoring water quality would be met for this project because it would lead to improved conditions in the long term.

8.1.1.5 - ACS Objective 5 - Sediment Regimes

Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

Even though this project area has a history of natural erosion processes through landslides, debris flows, and fire; human activities, such as road construction, and OHV use have changed the frequency and timing of erosion processes. Road decommissioning efforts have reduced some sedimentation.

Peak stream flows were examined by assessing the effect of vegetation manipulation and roads on peak stream flows individually and in combination and it was determined that implementation of the project would not impact the timing, volume, rate or character of sediment input, storage or transport. The project area has recovered hydrologically as trees in young stands grow. Implementation of project activities including thinning mid-aged stands, regeneration harvest, repairing roads, rehabilitating reused temporary roads and decommissioning system roads are not anticipated to have any impact on base stream flows. On system roads, the project would decommission and close roads, rehabilitate unauthorized OHV routes, and maintain all haul routes. As these enhancements are made, a more natural sediment regime would result at those locations.

The project would implement PDCs that include restrictions on wet season logging and haul, equipment slope restrictions and erosion control methods. Stream protection buffers would trap material away from streams. Temporary roads that cross streams were carefully located on gentle stable slopes to be consistent with riparian reserve standards and guidelines. They would be outsloped, used during dry conditions, and rehabilitated upon completion. Because the temporary stream crossings would be removed and rehabilitated, there would not be a long-term change to sediment regimes. Road repairs, maintenance, and decommissioning would result in a road system that minimizes sedimentation.

For these reasons, the objective of maintaining and restoring sediment regimes would be met for this project because it would lead to improved conditions in the long term.

8.1.1.6 - ACS Objective 6 - In-Stream Flows

Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration and spatial distribution of peak, high, and low flows must be protected.

The project area is prone to rain on snow events. The trend in recent decades has been toward full recovery as young stands grow. Compared to regeneration harvest, thinning has much less effect on hydrologic flow patterns and the potential for increased peak streamflow.

Peak stream flows were examined by assessing the effect of vegetation manipulation and roads on peak stream flows individually and in combination and it was determined that implementation of the project would not impact the timing, magnitude, duration or spatial distribution of in-stream flows. Hydrologic recovery would continue to be well above the levels of concern identified in the Forest Plan. On system roads, the project would decommission and close roads, replace and repair culverts, and maintain all haul routes. As these enhancements are made, improvements to sediment, nutrient and wood routing would occur at those

locations. Implementation of project activities including thinning mid-aged stands, regeneration harvest, repairing roads, rehabilitating reused temporary roads and decommissioning system roads are not likely to have any negative impact on base stream flows. Protection buffers would provide shade and riparian vegetation sufficient to prevent reduced flows during low flow periods.

For these reasons, the objective of maintaining and restoring in-stream flows would be met for this project because it would lead to improved conditions in the long term.

8.1.1.7 - ACS Objective 7 - Floodplain Inundation

Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

The timing, variability and duration of floodplain inundation and water table elevation in some meadows and wetlands have been altered by past clearcutting and the removal of large wood in streams over the past 50 years. Riparian reserves overlay and surround streams, wetlands, and wet meadows.

The proposed action includes installation of in-channel structures, or Beaver Dam Analogues (BDAs), to simulate beaver dams and to encourage beavers to build dams in incised channels and across potential floodplain surfaces. The dams are expected to entrain substrate, aggrade the bottom, and reconnect the stream to the floodplain.

In addition to BDAs, protection buffers adjacent to streams, seeps, springs, ponds, meadows and wetlands would provide a source of medium-sized woody debris recruitment. Adding whole trees into streams would provide an immediate benefit to streams. And over time, wood recruited to streams naturally from protection buffers would add complexity and slow flow as meanders and pools are created. By physically protecting these areas and by also protecting the timing, magnitude, duration and spatial distribution of peak, high, and low flows as described in Objective #6, the timing and duration of floodplain inundation and water table elevation in meadows and wetlands would be maintained. The project area would continue hydrologic recovery beyond the minimum levels identified in the Forest Plan as young stands grow, resulting in long-term restoration of floodplain habitats and water tables.

For these reasons, the objective of maintaining and restoring flood plain inundation and water tables would be met for this project because it would lead to improved conditions in the long term.

8.1.1.8 - ACS Objective 8 - Species Composition and Structural Diversity of Plant Communities

Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering appropriate rates of surface erosion, bank erosion, and channel migration and

to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

Past regeneration harvest has changed both the species composition and structural diversity in riparian reserves. Stands are dominated by dense, mid-serial Douglas-fir stands. Many decades ago, stands that were once old growth, were converted to second growth, with riparian areas dominated by alder.

Thinning in uniform mid-aged Douglas-fir stands in dry upland portions of riparian reserves would diversify and restore native tree composition including retention of minor tree species. This project would promote the recruitment of structurally diverse plant communities by protecting areas of unique diversity such as wetlands, and by variable density thinning with skips, gaps, heavy thins and forage creation, in regeneration units to enhance structural diversity. Gaps, heavy thins, pruning, and forage areas would allow light to penetrate beneath the canopy and provide space for natural recruitment of diverse plant communities. Protection buffers along streams would provide for short-term wood recruitment needs. Trees would be felled, pushed or pulled over, or flown into streams to provide an immediate benefit. Thinned riparian reserves would promote the growth of trees and over the long term, provide sufficient large woody debris for uplands, riparian areas, and stream communities.

For these reasons, the objective of maintaining and restoring species composition and structural diversity of plant communities would be met for this project because it would lead to improved conditions in the long term.

8.1.1.9 - ACS Objective 9 - Well-Distributed Populations of Native Species

Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.

Past regeneration harvest, fires, and road construction has changed both the species composition and structure in riparian reserves. Aquatic species were affected by removal of shade, increases in sedimentation from road construction and the blockage of movement by culverts. Some key aquatic species have become rare, and some unwanted plant species have flourished along roads and are outcompeting desired species. There is an ongoing trend of improving watershed conditions as trees and vegetation regrow, as roads are decommissioned and as uniform riparian vegetation is made more diverse.

Thinning prescriptions would retain minor native tree species and would restore uniform stands to a more diverse mix of native species and accelerate attainment of late-successional characteristics. Design criteria address measures to minimize the spread of invasive plants and to use native species for erosion control. Protection buffers along streams would provide for short-term wood recruitment needs and provide shade to minimize impacts to invertebrate and vertebrate aquatic and riparian-dependent species. Thinned riparian reserves would promote the growth of native trees and over the long term, provide sufficient large woody debris which benefits a wide range of native plant and animal species. A more diverse arrangement of large

wood and native plants in riparian reserves and along streams would host native invertebrate, and riparian dependent species for the improved health of the aquatic and riparian system.

For these reasons, the objective of maintaining and restoring well-distributed populations of native species would be met for this project because it would lead to improved conditions in the long term.

8.1.2 - ACS Summary

While some short-term impacts to aquatic resources have been disclosed, the impact would be minimal and in most cases undetectable at the sub watershed scale. The project would lead to improved water quality and enhanced riparian and watershed conditions in the long term because of the following:

- Stream protection buffers would provide sufficient stream shade, a source of woody debris recruitment to streams and would minimize the potential for sediment transport to streams.
- Variable density thinning with skips, would enhance structural diversity in riparian reserves.
- Thinning in riparian reserves would accelerate the development of late-successional conditions.
- Adding whole trees to streams would lead to improved stream conditions as pools develop.
- The decommissioning, closing, and stormproofing of system roads and restoration of unauthorized OHV trails would lead to improved water quality.
- System road repairs and maintenance would allow for safe use while ameliorating water quality issues.
- Tumala Meadow enhancement would reconnect the stream to the floodplain and help restore a high quality meadow habitat.

For these reasons, the objective of maintaining existing conditions or implementing actions that restore watershed and landscape-scale features in the long term would be met for this project. This project is consistent with the Aquatic Conservation Strategy Objectives.

9.0 Summary of Effects

Table 13. Summary of Effects to Resource Elements from the North Clack Integrated Resource Project

Resource Indicator	Action Alternatives
Temperature:	None of the streams exceeded the DEQ coldwater rearing and spawning standards for temperature, and project maintains existing conditions.
Sediment	None of the streams exceeded the 20% fines (< 6mm dia.) federal standard. Post project, remains less than standard, and improves existing condition by improving road condition.
Large Woody Debris	The condition would remain less than ideal, but improves existing condition by adding greater than 100 pieces per mile in six stream reaches.
Pool Quantity and Quality	Pool habitats would remain less than ideal, but improves existing condition by adding greater than 100 pieces per mile in six stream reaches.

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