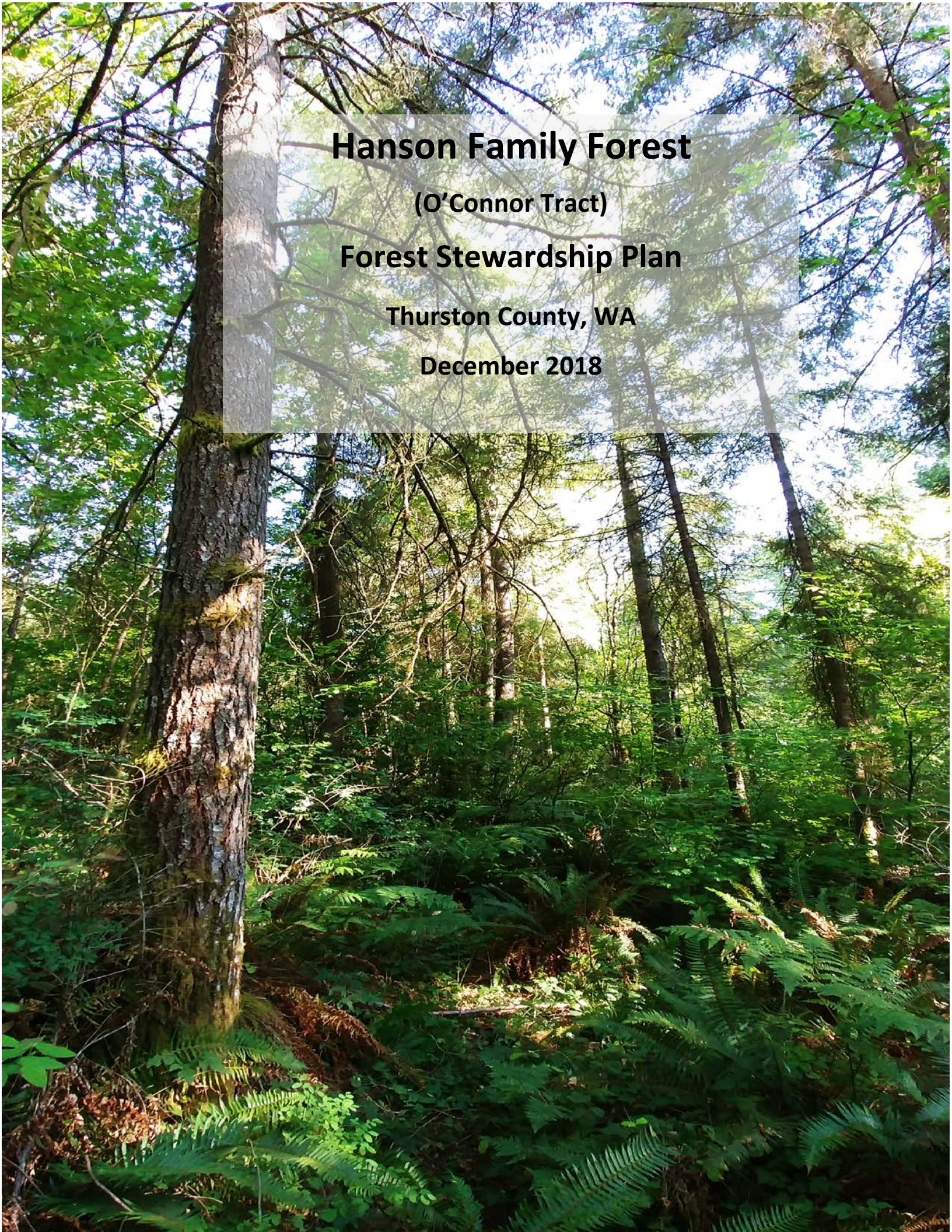


Hanson Family Forest

(O'Connor Tract)

Forest Stewardship Plan

Thurston County, WA

December 2018

There are many silvicultural methods that can be applied to this forest. The management recommendations contained in this plan can be implemented literally, but are more intended to provide guidance when preparing for and implementing forest management activities. In particular, timber harvests may vary in size and location based on current market conditions, revenue needs, logging costs, operational constraints and the recommendations of other forestry and natural resource specialists.

Hanson Family Forest
Forest Stewardship Plan

# of acres plan covers:	102.5
County and state:	Thurston, WA
Watershed	Skookumchuck
Forest certification number:	
USDA Farm & Tract #:	Farm: 1515 Tract: 4133
Date plan prepared:	December 2018
Plan Preparers	
Kirk Hanson Northwest Natural Resource Group 2701 1st Ave, Ste. 240 Seattle, WA 98121 360-316-9317 kirk@nnrg.org	Rodney & Diana Hanson 5239 56th Avenue SE Olympia, WA 98503 (360) 491-1213 rodihans@gmail.com
Signatures	
Date: 3/15/19	Date:
 Kirk Hanson Northwest Certified Forestry	Forest Owner

This plan meets the requirements of the Washington Specification Guide for the NRCS Conservation Activity Plan.

_____

Date

Natural Resource Conservation Service

Table of Contents

Background and Site Information:

Legal Description:
Section 10 Township 15 Range 2W

Nearest City or Town:
Bucoda, Washington

Parcel Numbers:
12510120100 (40)
12510340000 (40)
12510430000 (22.34)

Property Size
102.34 acres

- 82.34 forested
- 20 wetland

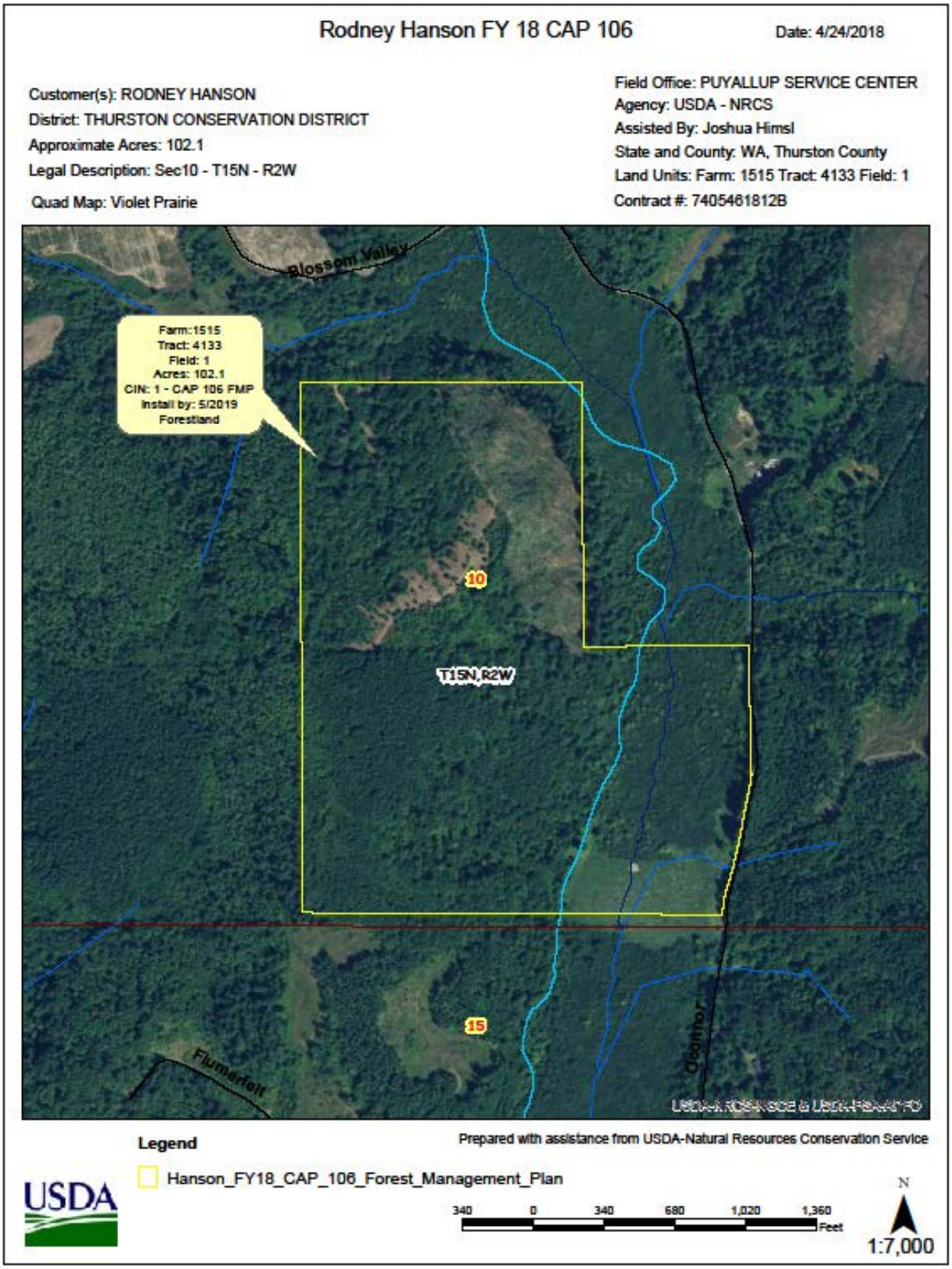
Date of Land Acquisition
2018

Tax Designation

The Thurston County Assessor currently classifies parcels 12510120100 and 12510340000 under Land Use Code 88 as “Designated Forest Land” under RCW 84.33.035(5). "Forest land" is synonymous with "designated forest land" and signifies a parcel of land that is twenty or more acres or multiple parcels of land that are contiguous and total twenty or more acres that is or are devoted primarily to growing and harvesting timber. Designated forest land means the land only and does not include a residential home site. The term includes land used for incidental uses that are compatible with the growing and harvesting of timber but no more than ten percent of the land may be used for such incidental uses. It also includes the land on which appurtenances necessary for the production, preparation, or sale of the timber products exist in conjunction with land producing these products.

Parcel 12510430000 is classified under Land Use Code 91 as “Undeveloped Land”.

NRCS Conservation Plan Map



LANDOWNERS OBJECTIVES

Short term (0-10 years)

1. Identify and mark property corners and lines.
2. Pre-commercially thin dense alder stands.
3. Control invasive species in young plantations and along forest roads.
4. Control coppicing big leaf maple in newly established Douglas-fir plantation.
5. Replant failed alder plantation with diverse conifers.
6. Reopen forest roads, repair erosion and install culverts.
7. Commercially thin 26 year old Douglas-fir plantation.

Long term (10+ years)

1. Create a working forest that provides a sustained yield of timber by commercially thinning timber thinning every 5 – 10 years. Generate, at a minimum, sufficient income to cover all forest ownership and management costs.
2. Manage forest in trust as an investment and legacy for the family such that it provides opportunities for recreation, livelihood and periodic dividends.
3. Conserve and enhance wildlife habitat by retaining and/or recruiting snags and large downed logs, maintaining a diverse mix of hardwoods and conifers of varying ages, and promoting mast producing trees and shrubs.
4. Manage forest using uneven-aged silvicultural methods to improve structural and biological diversity, increase wildlife habitat, produce older and larger trees, increased diversity of hardwoods and conifers, larger snags and downed logs, creation of canopy gaps, etc.

Top Three Priorities for Owning Land

1. Family endowment
2. Recreation and aesthetics
3. Conservation and wildlife habitat and ecosystem services

INTRODUCTORY OVERVIEW OF THE PROPERTY

Overview

This forest spans three tax parcels totaling approximately 102 acres that are located 2.5 miles due West of the town of Bucoda, WA. Access to the property is from O'Connor Road SE, a paved and county-maintained road that extends north from Highway 507. From O'Connor Road SE, a gravel forest access road travels southwest across the two adjoining parcels to the north before entering the property near its northwest corner. The property is fully stocked with varying ages and species of trees. A 26 year old Douglas fir plantation dominates the southern 40 acre parcel. The northern 40 acre parcel is comprised of multiple stands of young timber including 1- 3 year old plantations of Douglas fir, western red cedar and red alder, and 18-20 year old red alder dominated stands.

The elevation across this property ranges from a low of 240 feet above sea level to a high of 460 feet. The topography is highly variable, ranging from moderately steep slopes along the northern and eastern sides of the property that are punctuated with seasonal stream valleys, to a gently rolling highland along its western half.

Past Management History

The original old growth throughout the area was initially harvested over approximately a 90 year period between 1860 – 1950. The first sawmill in the immediate vicinity was built in Bucoda in 1857 by Aaron Webster. It was purchased in 1902 by the Mutual Lumber Company. The company produced 120,000 board-feet of lumber per day (> 30 truck loads), but the mill burned down in 1912. Mutual Lumber moved its operation to Tenino until 1919, when it then rebuilt the operation in Bucoda, as well as a

Logging camp, Mutual Lumber Company, Bucoda, ca. 1930. Photo: University of WA Libraries

hotel and housing for its workers. By 1922, the town was dubbed "the little town with the million-dollar payroll" due to Mutual's production. The last log was sawed in Bucoda in 1944.

A second generation of forest naturally regenerated across this property following the first clearcut harvesting, as replanting after harvest was not required by State law until 1946. Douglas-fir heavily colonized the upper portions of the property, but red alder, Big leaf maple, western red cedar, western hemlock and grand fir also naturally regenerated and filled in gaps and areas of the Douglas-fir understory. The second growth timber was cut in smaller units sequentially in approximately the following timeline:

90 year old Douglas-fir stumps from 2015 harvest of FMU 3.

Date	Activity	Acres	FMU
1991	2nd growth clearcut & replanted to DF	70	1, 2, 4, 5, 6, 7
2014	Cleared for xmas tree farming	9	4, 5
2015	Clearcut & replanted to DF	9	3
2015	Replanted to RC	4	4
2015	Replanted to RA	5	5
2015	Pre-commercial thin and BM control	11.5	1, 2, RMZ
2018	Replanted to DF	4	4

Current Management Practices

Since the current owner acquired the property in April 2018, they have engaged in the following activities:

1. Reopening forest access roads,
2. Caging DF and RC throughout FMU 4,
3. Removing invasive species

Region

Thimbleberry in July in understory of alder.

Thurston County has a total acreage of 487,040 acres, or 761 square miles. It is in the Western part of Washington, at the southern end of Puget Sound. The county is bounded on the east by the Nisqually River, which separates it from Pierce County. Many narrow inlets of Puget Sound form most of the irregular northern boundary, and the small regular part of this boundary joins Mason County. Grays Harbor County forms the western boundary, and Lewis County is to the south. Olympia, which is in the north-central part of the county, is the county seat and state capital. It is about 30 miles southwest of Tacoma and 60 miles southwest of Seattle.

Thurston County is on a glacial plain that extends northward from a mountainous rim. It is bordered on the west, south, and east by mountains. Along the western boundary are low-lying mountain chains. The Black Hills and their adjoining ridges and spurs are in this area. The elevation at Capitol Peak is 2,658 feet. The mountains are mainly rounded peaks and ridges of basalt. Along the western part of the southern border are low, rolling foothills and mountain spurs. The Michigan Hills, which are about 700 feet high, are in this area. Farther east, across the Chehalis River Valley and on the Lewis County border, are other mountain spurs. These spurs include Baldhill, Porcupine Ridge, and the Northcraft Mountains. The highest point in the county, 2,984 feet, is on a ridge running into the county from the Stahl and Ladd Mountains at the foothills of the Cascade Range in the most eastern tip of Thurston County.

Thurston County is drained by five different river systems. These systems are the Black, Chehalis, Deschutes, Nisqually, and Skookumchuck Rivers.

Two-thirds of Thurston County is woodland. Of this acreage, 50 percent is held by private nonindustrial owners and 26 percent by forest industries. The remaining 24 percent is county, state, or federal property. About 20 percent of the county is used for hay, pasture, hay silage, sweet corn, corn silage, peas, small grain, or blueberries.

Climate

The climate of Thurston County is greatly tempered by winds from the Pacific Ocean. Summers are fairly warm and winters are cool and wet with snow and freezing temperatures occuring

only at higher elevations. Average winter low temperatures are 33 – 35 degrees. Irrigation is needed because rainfall is extremely light in summer, when several weeks often pass without precipitation. During the rest of the year, rains are frequent, especially in late fall and winter.

In most winters one or two storms throughout the survey area bring strong and sometimes damaging winds, and in some years the accompanying heavy rains cause serious flooding. Every few years, in either winter or summer, the invasion of a large continental airmass from the east results in temperatures that are well below freezing for several consecutive days in winter or in a week or more of sweltering heat in summer. In winter, the average temperature is 39 degrees F, and the average daily minimum temperature is 33 degrees. In summer, the average temperature is 62 degrees, and the average daily maximum temperature is about 75 degrees.

The total annual precipitation is about 51 inches. Of these totals, about 21 percent usually falls in April through September. The growing season for most crops falls within this period. Thunderstorms occur on about 5 days each year. The average seasonal snowfall is about 15 inches. On an average of less than 5 days, at least 1 inch of snow is on the ground. The number of such days varies from year to year.

The average relative humidity in mid-afternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 90 percent. The sun shines 65 percent of the time in summer and 30 percent in winter. The prevailing wind is from the south-southwest. Average windspeed is highest, 8 miles per hour, in winter.

Woodland Zones

Two-thirds of Thurston County is woodland. Of this acreage, 50 percent is held by private nonindustrial owners and 26 percent by forest industries. The remaining 24 percent is county, state, or federal property.

Thurston County can be divided into four major woodland zones. These zones are defined by the naturally occurring forest overstory species, climate, and soil characteristics. Although the species in the zone name dominate the zone, other species can, and many times do, occur as isolated trees or nearly pure stands. The boundary lines separating the different zones should be thought of as gradual changes in native vegetation and soil rather than a precise division. With few exceptions each woodland zone is made up of distinct kinds of soil. A given soil occurs only in its specific zone.

This forest occurs within the *Douglas fir/red alder zone*.

Douglas fir/red alder zone

The Douglas fir/red alder zone is the most extensive zone in Thurston County. Elevation ranges from 0 to 1,700 feet in this zone. The soils are mostly deep and are poorly drained. The temperature is mild, and the frost-free period ranges from 1 25 days. The mean annual precipitation is 35 to 60 inches, however, soil moisture for tree growth is limited during the summer. Associated tree species include western red cedar, big leaf maple, western hemlock, grand fir, black cottonwood, Pacific madrone, bitter cherry, and western dogwood.

Common forest understory species are salal, cascade Oregon grape, western bracken fern, western sword fern, western hazel, vine maple, salmonberry, red huckleberry, trailing blackberry, Pacific trillium, northern twinflower, violet, and bedstraw.

The main management concerns in this zone are restricted harvesting during the rainy season on the finer textured soils; the invasion of brush and red alder into cutover areas, which can prevent the establishment of planted seedlings; and a high seedling mortality rate on poorly drained and somewhat excessively drained soils. Red alder frequently invades cutover areas and, if not controlled, can outcompete young Douglas fir seedlings. Thinning Douglas fir and red alder stands increase commercial yields at the time of intermediate and final harvest.

RESOURCE CATEGORY I – FOREST HEALTH/WILDFIRE/INVASIVE SPECIES

"Forest health" is an often used and misunderstood concept. In terms of forest management, forest health is often defined as growing trees that are vigorous, free of insects and diseases, of good form, of desirable (a.k.a. commercially valuable) species, and at a spacing in the forest that allows them as fast growth as possible without compromising timber quality. This definition frames health in terms of human (economic) values for wood products. Forest health can also be defined on an ecological basis. Dead, diseased, old, and slow-growing trees of all species naturally occurring on the site are part of a healthy forest from a biodiversity perspective.

It is important to remember and acknowledge that we are most often discussing forest health in terms of human values. The forest does not care if a large veneer quality tree dies, rots, or burns. We humans often do. When viewed through a set of ecological values, the number of reasons to justify timber harvesting decreases noticeably. They might include:

1. Infestation of an exotic, non-native insect or disease whose spread could be prevented or significantly reduced by harvesting.
2. Improving wildlife habitat or maintaining habitat for species that are rare or declining.
3. Significant mortality or blowdown.
4. Addressing years of build-up of fuels due to modern fire suppression.

Silviculture is a practice by which we respectfully remove products from the forest for human use, employing methods which we believe most closely imitate and least impact the "natural" processes occurring there. It is important to acknowledge the distinction between our human and ecological definitions of forest health, and not to use the former to justify creating forests of diminished ecological value.

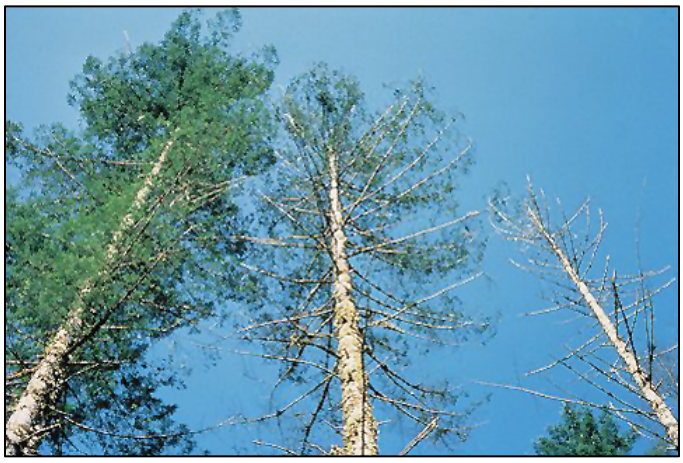
Disease

Naturally occurring diseases, root and stem funguses, and other pathogens are important agents of forest diversification. When their effect is tree mortality, they contribute snags and downed logs that provide important habitat and nutrient cycling functions, create openings in the forest that allow other tree and shrub species to become established, and overall contribute to a highly heterogeneous and uneven-aged stand composition. Relative to timber production, fungal pathogens can severely decrease the growth rates of infected trees, and lead to excessive mortality that reduces future timber harvest volume. Management of root rot must be consistent with the goals and objectives of the forest owner.

Unless fungal pathogens are demonstrably excessively impacting the growth and productivity of a forest, and if maximizing timber growth is not a top priority, they should be accepted as part of the ecological processes of the forest and allowed to function as agents of forest diversification. Containment and eradication of root rot can require large patch cuts around the last known infected tree in order to isolate the disease. This approach may create large openings or affect the character of the forest in ways that are not compatible with the goals and values of many small woodland owners. Therefore, less intrusive management strategies are recommended here. Maintaining a diversity of tree species is the primary key to limiting the severity of disease impacts in a forest. Given that most common fungal pathogens tend to be species specific, thinning known infected trees and replanting the infected site to a non-susceptible species is the least intrusive strategy.

Laminated root rot

Although obvious signs of laminated root rot were not immediately evident, it's highly likely the fungal disease is present within the Douglas-fir dominated stand on the property. Laminated root rot (*Phellinus weirii*) is a ubiquitous native soil-borne fungus that is often present wherever Douglas fir occurs. Laminated root rot can also infect western hemlock and grand fir. Indicators of the disease include:



Crown die-off in Douglas-fir as symptom of laminated root rot.
Photo credit: American Phytopathological Society.

- Groups of dead trees,
- Individual trees setting large numbers of cones,
- Trees with thin crowns and/or yellowish needles,
- Reduction in annual incremental growth, and growth of terminal lead and lateral tips,
- Boles of trees that are weeping significant amounts of pitch, and

- Groups of windthrown trees exhibiting abbreviated roots.

Root rot spreads through ectotrophic mycelium in roots and root grafts and moves outwards from infection centers at a rate of approximately 10 inches per year, slowly creating an expanding pocket of mortality. Wet soils exacerbate root rot potential in Douglas fir, as does soil compaction, disturbance and root damage caused by logging equipment. In a homogenous plantation setting, root rot will spread systematically from tree to tree in a roughly concentric ring from the infected site.

Invasive species

The most significant forest health issue facing this property is an extensive infestation of invasive species, in particular Himalayan blackberry and English holly. Himalayan blackberry is rife across the newly established plantations in FMU's 4 & 5, and is beginning to outcompete the Douglas-fir and western red cedar seedlings in FMU 4. Aside from regenerating prolifically throughout these units, it is also forming large clumps along forest edges. Blackberry dominates nearly all road margins within approximately 25' of either side of the road, including in the mid-aged stands where the road has created a sufficient gap in the canopy to support its continuing growth in the understory. Blackberry has also colonized the log landings along the western edge of FMU 3 that were created during the 2015 clearcut of that unit.

Himalayan blackberry spreading across three year old red alder plantation.

Himalayan blackberry along forest roads through young hardwood stands.

English holly was observed in various stages of regeneration, from small seedlings to 20' tall trees, throughout the understory of the mid-aged stands. Given that it is spread by birds and is extremely shade tolerant, it likely is much more common throughout the understory than initially observed.

Tansy ragwort was observed on forest roads that pass through the open plantations, and a small population of Scotch broom was observed along the forest edge near the NW corner of FMU 1.

12' tall English holly beneath mature alder in FMU 6.

Wildfire

Although wildfire is quite scarce in the western part of Washington compared to the east side of the Cascade Mountains, it is still a relevant natural disturbance regime in this area. Fires tend to be most destructive in young, dense stands and stands with an abundance of downed woody debris and/or standing dead trees. Given increasing residential development in close proximity to this land, and increasingly drier summers, fire risk is a growing concern for this property. The young Douglas fir plantations that dominant the area, with limbs that still reach the ground, run the risk of carrying a surface fire into the canopy of the stand.

Management recommendations

Fungal Pathogens

Laminated root rot

When laminated root rot is suspected within soils of a newly regenerating forest, its effects can be mitigated through planting a diversity of hardwood and conifer species, and avoiding reestablishing Douglas-fir, which is its primary host. In natural, mixed species forests, the effects of laminated root rot are greatly diminished by non-host species, which can serve as barriers to the fungus, preventing it from spreading from root to root amongst Douglas-fir. Containment and eradication of laminated root rot can require large patch cuts around the last known infected tree and replanting the site to a non-susceptible species such as red alder, western red cedar or western white pine. In larger stands and/or homogenous plantations, small patch cuts (1-2 acres) may be a desirable and effective strategy while also increasing harvest volumes. On smaller parcels, or where management objectives favor conservation, large patch cuts may not be desirable. Therefore, if evidence of laminated root rot is found, infected trees can be heavily thinned, retaining the most dominant and vigorous looking trees, and the site replanted with non-host species.

Given that trees may continue to die during the time between commercial harvests, trees that show signs of infection can be proactively salvage-logged if the owner wishes to capture their marketable value before they decay.

Invasive species

Controlling the invasive species across this property, in particular Himalayan blackberry and English ivy, will require intensive management for the first few years in order to ensure that native trees that are currently planted or naturally regenerating continue to thrive. Although hand and mechanical cutting and herbicides will be necessary to initially control the Himalayan blackberry, the long-term silvicultural strategy for limiting the impacts of this species is shade, and the development and maintenance of dense forest canopies. Given the shade tolerance of English ivy, and its capacity to perpetually regenerate in the understory, annual monitoring, hand cutting and herbicides will be necessary to limit the spread of this species. Both Tansy ragwort and Scotch broom will be hand-pulled as they occur.

Chemical use policy

Chemicals will only used where less environmentally hazardous techniques have been shown through research or empirical experience to be ineffective. Chemical use may be deemed necessary to control invasive weed species that have the potential to alter forest habitat function and in some cases where invasive or native species are aggressively encroaching on active forest roads. When chemicals are applied, the least environmentally hazardous option will be used to minimize effects on non-target organisms or ecological systems. Furthermore, where chemical use is deemed necessary, the landowner, or a trained applicator, will follow all applicable safety precautions. Chemicals will be stored and disposed of in a safe and environmentally appropriate manner.

Records of chemical use will be maintained, including the type of chemical, when and where it was applied, on what species it was applied and the effectiveness of the application.

All chemical use will be in accordance with FSC-US standards as per the following guidelines:

Chemical use guidelines	**Source**
Chemical pesticides, fungicides, and herbicides will be used only when and where research or empirical experience has demonstrated that less environmentally hazardous, non-chemical pest/disease management practices are ineffective.	FSC U.S. Standards 6.6.b.
When and where chemicals are applied, the most environmentally safe and efficacious chemicals are used. Chemicals are narrowly targeted, and minimize affects on non-target species.	FSC U.S. Standards 6.6.c.
Chemicals will be used only when and where they pose no threat to supplies of domestic water, aquatic habitats, or habitats of rare species.	FSC U.S. Standards 6.6.d.
When chemicals are used, the effects and impacts will be monitored and the results used for adaptive management. Records will be kept of pest occurrences, control measures, and incidences of worker exposure to chemicals.	FSC U.S. Standards 6.6.e.

Wildfire

The objective of fire management is not outright prevention, but rather to reduce its intensity and limit it to surface fires that do not reach the canopy, becoming catastrophic, stand-replacing events. Managing lower forest stocking densities, minimizing woody fuels in the understory, and maintaining fire breaks and buffers are all strategies for mitigating the risk of fire. Employing variable density thinning, in particular thinning from below, reduces the potential for a crown fire by increasing the spacing between trees. Thinning from below also creates larger, more vigorous, and fire resistant trees and raises the base of tree crowns, thus reducing ladder fuels. Further, maintaining a wider spacing on newly regenerating trees in the understory, and minimizing the connectivity between the crowns of low trees and the crowns of dominant canopy trees will further reduce the potential for surface fires from reaching the canopy. Additional recommendations include:

1. Maintain seasonal forest road access throughout property that is sufficient to allow emergency vehicle access (e.g. 4-wheel drive trucks).
2. Prune trees to a minimum of 20', in particular along edges of forest and/or forest roads.
3. Thin understory trees and naturally regenerating seedlings to minimize crown connection, as well as connectivity with canopy of overstory trees.
4. Minimize fine branches and slash on the forest floor. During pruning and both pre-commercial and commercial thinning, avoid contiguous slash mats that exceed 12" thick. Slash should be placed on skid trails and incorporated into the soil as equipment runs over it, and/or aggregated and piled in up to five wildlife habitat piles and constructed habitat logs per acre. Habitat structures should be located at least 15' – 20' away from any tree.
5. Create 100' wide fuel breaks along public roads and around habitable structures by thinning canopy trees to reduce stocking density, pruning limbs to reduce ladder fuels, and reducing understory vegetation.
6. Over time, manage for older, larger diameter trees with thicker bark that are more fire resistant. Fire resistant species include: Douglas fir, big leaf maple and red alder.
7. Retain hardwoods throughout the forest.

RESOURCE CATEGORY II – SOILS

See soils maps in Appendix IV.

Soil Types

Soils underlying this forestland include Centralia silt loam (30 to 60 percent slopes), which occur along the steeper slopes of the northern and eastern portions of the property, and Salkum silty clay loam (3 to 8 percent slopes), which occur throughout most of the southwest portion of the property. Soils beneath the 20 acre wetland at the base of the slope, and the valley in which it occurs, are comprised of Mukilteo Muck.

The following chart provides a summary of the main soil types across this forest. Only the most dominant soil types have been described in more detail below. For more information on soils and soil properties, please refer to the NRCS Soil Survey that accompanied this management plan.

Soil Type/ Map Unit	Acres	% of Area	Slope	Site Class	Site Index (50 year)	Site Productivity
Centralia Silt Loam 25	55	53	30 - 60	II	135 Douglas-fir	186 f^3/acre/year (930 bf/acre/year)
Salkum Silty Clay Loam 97	27.5	26	3 - 8	II	126 Douglas-fir	172 f^3/acre/year (860 bf/acre/year)
Mukilteo Muck 70	20	21	0	NA	NA	NA

Centralia silt loam

This very deep, well-drained soil is on back slopes and foot slopes in the uplands. It formed in residuum derived dominantly from highly weathered, micaceous marine sandstone. The native vegetation is mainly conifers and hardwoods. Elevation is 200 to 500 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is about 50 degrees F, and the average frost-free period is 150 to 200 days. Typically, the surface is covered with a mat of needles, leaves, and twigs about 2 inches thick. The upper part of the surface layer is very dark grayish brown silt loam about 5 inches thick, and the lower part is dark brown silt loam about 5 inches thick. The subsoil to a depth of 60 inches or more is dark brown and dark yellowish brown clay loam.

Permeability is moderate in the Centralia soil. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as woodland. Douglas-fir is the main woodland species. Among the trees of limited extent are red alder, western red cedar, western hemlock, and big leaf maple. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 180. On the basis of a 50-year site curve, it is 135. The highest average growth rate of an unmanaged, even-aged stand of Douglas-fir is 191 cubic feet per acre per year at 60 years of age.

Salkum silty clay loam

This deep, well-drained soil is on terraces. It formed in residuum derived dominantly from highly weathered, ancient glacial drift. The native vegetation is mainly conifers. Elevation is 200 to 600 feet. The average annual precipitation is 45 to 60 inches, the average annual air temperature is about 50 degrees F, and the average frost-free period is 150 to 200 days. Typically, the surface layer is dark brown silty clay loam about 12 inches thick. The upper 27 inches of the subsoil is reddish brown silty clay, the next 12 inches is yellowish red silty clay, and the lower part to a depth of 60 inches or more is yellowish red silty clay.

Permeability is moderately slow in the Salkum soil. Available water capacity is high. Effective rooting depth is 40 to 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Douglas-fir is the main woodland species on this unit. Among the trees of limited extent are red alder, western hemlock, grand fir, big leaf maple, western red cedar, and bitter cherry. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 164. On the basis of a 50-year site curve, it is 126. The highest average growth rate of an unmanaged, even-aged stand of Douglas-fir is 174 cubic feet per acre per year at 60 years of age. Common forest understory plants are salal, cascade Oregon grape, vine maple, red huckleberry, western sword fern, and western bracken fern.

Mukilteo muck

This very deep, very poorly drained soil is in upland depressions. Drainage has been altered by subsurface drains and open ditches. The soil formed in organic material derived dominantly from sedges, rushes, moss, Labrador tea, and other plants that tolerate wetness and have grown in standing water where they have accumulated to form peat in bog areas. The organic material ranges from 52 to more than 120 inches in thickness. The soils are strongly acid or very strongly acid. Slopes are 0 to 2 percent. The native vegetation is mainly sedges and rushes. Elevation is 50 to 700 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is about 50 degrees F, and the average frost-free period is 150 to 200 days. Typically, the surface layer is dark yellowish brown and dark reddish brown muck about 6 inches thick. Below this to a depth of 60 inches or more is dark reddish brown mucky peat.

Permeability is moderate in the Mukilteo soil. Available water capacity is high. Effective rooting depth is limited by a controlled water table that is at a depth of about 18 to 36 inches during the growing season. Runoff is slow, and water erosion is not a hazard.

Management Recommendations

The main limitation affecting the management and harvesting of timber is the muddiness caused by seasonal wetness. Use of wheeled and tracked equipment when the soil is wet results in ruts and soil compaction. Unsurfaced roads and skid trails are soft and can be impassable when wet. Logging roads require suitable surfacing material for year-round use. Establishing a plant cover on slopes that have been cut or filled reduces the hazard of erosion. Disturbance of the protective layer of duff can be minimized by the careful use of wheeled and tracked equipment.

Seedling establishment is the main concern in the production of timber. Reforestation following clearcut harvesting should be accomplished by hand planting seedlings. If the stand includes seed trees, natural reforestation by red alder occurs readily in cutover areas and on disturbed soils. When openings are made in the canopy, invading brushy plants can prevent the establishment of tree seedlings.

Natural tree regeneration will occur if the canopy is thinned and gaps are created to provide sunlight to the forest floor. Shade tolerant species, such as western red cedar, western hemlock, grand fir and big leaf maple will gradually colonize denser areas of the stand, whereas Douglas-fir and red alder will seed into more open areas. Mechanical disturbance of understory vegetation and soils creates mineral seed beds that stimulate natural regeneration. Shade from dominant canopy trees reduces drought stress on seedlings.

Additional management recommendations include:

1. Retention of Organic Debris:
   During timber harvest operations, logging slash will be redistributed throughout the forest to decompose and build soil. Debris will be well distributed spatially and by size and decay class, with a target of at least four large pieces (minimum 20” diameter x 15’ length) retained per acre.
2. Seasonal Restrictions
   Forest soils can be compacted when they are wet, reducing soil tilth and exacerbating soil-borne diseases. Therefore, any activities utilizing wheeled or tracked equipment should be scheduled for the summer or fall, or other periods when soil moisture is low. Additionally, skidder passes across the soil will be minimized through the use of frequent and small log landings located along the extensive network of forest roads.
3. Retention of Hardwoods

Hardwood trees such as red alder, big leaf maple and cottonwood provide a significant amount of annual leaf litter and woody debris to the forest floor, which quickly rots and is incorporated into the soil. Hardwoods also provide an important role in the nutrient cycle of the forest. Therefore, existing hardwoods will be maintained and favored during forest management activities (e.g. releasing maple in the understory) and the species composition of the forest will gradually be managed to a 25:75 hardwood to conifer mix over time.

4. Timber Harvest and Log Yarding Methods
   Commercial thinning entries will be limited on a single site to no less than 10 year intervals in order to minimize compaction of soils. No more than 30 - 40 percent of individual trees will be harvested at one time in order to minimize the potential for post-logging windthrow. Skid trails and yarding corridors will be limited to no more than 800 – 1,000 feet from harvest unit to roads or landings in order to minimize excessive skidder passes.

RESOURCE CATEGORY III – WATER QUALITY/ RIPARIAN AND FISH HABITAT/ WETLANDS.

See Water Type Map in Appendix IV.

Hydrology plays a significant role on this site, shaping the topography and influencing vegetation types and tree species. Seasonal stream drainages flow from both the north end of the property, and from the east-facing slopes near the south end of the property. The valley floor at the base of the hill is saturated during winter months and hosts wetland indicative vegetation.

The topography of the northwest corner of the property is entirely shaped around a multi-fingered seasonal stream drainage that reaches south up into the land. This stream appears to only flow during periods of high soil saturation (Nov – April), and a defined stream channel only becomes evident within a short distance upstream of the road crossing. According to the WA DNR water type map, this stream is classified as a Type N (non-fish bearing seasonal stream). Three additional seasonal streams drain from the slopes along the southeastern side of the land. They form deeply incised channels on the slopes, but these channels disappear once the gradient levels out, and do not directly connect with the wetland at the base of the hill. Given this lack of connectivity with the wetland along the valley floor, the WA DNR water type map does not identify these latter seasonal streams. The WA DNR water type map predicts a Type F (fish-bearing) stream that either flows along the base of the hill or through the valley bottom. The classification as fish-bearing is likely based on the gradient of the valley and the size of the drainage basin upstream. However, at the time of the site assessment in September 2018, this stream was entirely dry, and no defined channel was evident. Any seasonal surface water appears to saturate into and across the wetland environment without forming a distinct stream channel. Further, it is quite possible that the former stream channel was altered at some point in the past to improve the valley floor for farming.

The wetland across the valley floor is classified by the WA DNR as a Type A wetland, which is defined as any bog or wetland larger than five acres in size. The majority of this 20-acre wetland is comprised of a dense thicket of shrubs, including: spirea, dogwood and willow. There are very few to no hardwood trees and no conifers in this wetland. The southern six acres of this wetland is

Shrub-dominated wetland throughout valley floor.

comprised of an open field of grass that was likely annually mowed at some point, but has recently been left fallow.

Soil moisture is more abundant on north and east-facing slopes, as well as along the base of slopes. The red alder/salmonberry forest type is more common in these areas. Previous logging removed nearly all conifers in proximity to the seasonal streams and within the wetland buffer along the edge of the valley floor. Although Douglas-fir was replanted in many of these areas, due to wet soils it either did not have a high survival, or naturally regenerating alder outcompeted the fir. Currently, forest composition within the riparian area next to all streams and adjacent to the wetland is dominated by red alder and big leaf maple. Stocking density varies considerably, with areas of dense alder, areas dominated by sparse maple and areas dominated by dense brush.

Management Recommendations

The most important forestland protective measure for conserving sensitive hydrologic features is to manage for complex forest structure and multi-canopy stands, and avoiding the use of heavy equipment in their proximity. Within the first 50' – 200' of any shoreline, stream or wetland, forest management should shift towards uneven-aged practices using individual and small group tree harvest methods. The desired future condition is for a mixed species and multi-age class forest that is rich in snags and downed logs.

Washington Forest Practices Rules

The WA DNR regulates timber harvest and other forest management activities on all privately owned forestlands in WA State. The WA DNR enforces a minimum set of riparian, steep slope and other regulatory protections as established by the WA State Forest Practices Act. Before conducting any forest management activities in proximity to streams and wetlands, the WA DNR should be consulted for any requirements that need to be met. More information can be found online at: https://www.dnr.wa.gov/programs-and-services/forest-practices.

Applicable WA Forest Practices Rules

1. Type A wetlands larger than five acres require a forested buffer that varies from 50' – 200' in width, but must average 100'. This buffer can be commercially thinned, but a minimum of 75 TPA must be retained.
2. The Type N streams require a minimum 30' equipment limitation zone.

Forest Stewardship Council Standards

This forest will be managed to meet the U.S. Forest Management Standards of the Forest Stewardship Council (FSC). The FSC Standards emphasize management in riparian areas that meet the following objectives:

Forest management will retain and recruit sufficient large live trees, snags, understory vegetation, down logs, and other woody debris in riparian zones to provide shade, erosion control, and in-channel structures. Riparian specific objectives include:

a. *Increase coarse woody debris input and recruitment*
b. *Minimize sediment and runoff volume impacts from road and harvest infrastructure*
c. *Restore hydrologic functionality to support populations of salmonids*
d. *Create non-conifer forests in appropriate and strategic locations across the landscape*
e. *Optimize sequestration of carbon in balance with other ecosystem services and products*
f. *Create older forest structures and functions within managed stands*

Stream and wetland buffer widths and design will consider forest type, slope stability, slope angle, and terrain. For Np streams, a 25-foot (slope distance) inner buffer and 75-foot outer buffer will be created and managed according to provisions for inner and outer buffers for Type F and S waters. For Ns streams and for wetlands smaller than one acre, a buffer zone 75 feet wide is established that constrains management activities to those that are allowed in outer buffer zones of Type F and S streams.

The following chart provides a comparison between the WA State Forest Practices Rules and FSC's Standards pertaining to riparian forest management.

Water Type	WA State	FSC
Type Np Stream (Non-fish bearing, perennial)	RMZ width 80' 50' no-harvest zone 30' elz	25' inner buffer. 75' outer buffer. Single tree selection in inner buffer. Single & group tree selection in outer buffer
Type Ns Stream (Non-fish bearing, seasonal) Wetlands <1 acre	30' equipment limitation zone.	Stream supports aquatic species: 75' buffer. Single & group tree selection.
		Stream does not support aquatic species. BMP's

Riparian Buffer Zone Management Standards

<u>Core Zone</u>

- Release of co-dominant trees using cut-and-leave, felling trees, where practical, into the stream channel
- Exclude all equipment except for active stream restoration
- Avoid disturbance of mineral soil; where disturbance is unavoidable, mulch and seed are applied before the rainy season
- Avoid the spread of pathogens and noxious weeds

Inner Zone

- Retention of suppressed trees either standing or felled towards stream
- Retention and recruitment of large live and dead trees for shade and stream structure
- Retain canopy cover and shading sufficient to moderate fluctuations in water temperature
- Exclude use of heavy equipment, except where the use of such equipment is the lowest impact alternative
- Single-tree selection is allowed

Outer Zone

- Single-tree or group selection silviculture is allowed
- Post-harvest canopy cover maintains shading sufficient to moderate fluctuations in water temperature
- New road construction is avoided; reconstruction enhances riparian functions and reduces sedimentation

Other management recommendations include:

1. Where hardwoods dominate riparian zones, and/or where brush is the dominant vegetation, replant with conifers.
2. Exclude heavy equipment from wet soils and areas where wetland indicative plants occur. Trees may be felled away from these sites and/or cable yarded as an alternative to skidding with equipment.
3. Avoid herbicide use on wet soils or adjacent to streams or wetlands.
4. Retain and/or recruit additional snags and downed logs through either girdling up to four trees per acre that exceed 20” DBH, or importing logs from upland sites.

RESOURCE CATEGORY IV: FOREST INVENTORY/TIMBER/WOOD PRODUCTS

Overview

Forest cover across this property is comprised of a high diversity of stand types that include: newly established Douglas-fir, western red cedar and red alder plantations; young mixed hardwoods; young Douglas-fir plantation; and older mixed hardwoods and conifers.

The following chart summarizes the various forest management units (FMU):

FMU	Acres	Stand Type	Age
1	35	Douglas-fir plantation	24
2	11.9	Mixed hardwoods	18-20
3	9.5	Douglas-fir plantation	3
4	4.5	Douglas-fir/Red cedar	1-3
5	4.5	Red alder	3
6	2.5	Mixed hardwoods/conifers	40+
7	7.2	Mixed hardwoods/brush	18-20
RMZ	8.7	Mixed hardwoods/Brush	18-20
Wetland	13.5	Shrubs	NA
Field	5.5	Grass	NA
	102.8		

Nearly the entire upland portion of this property is well-stocked and currently growing timber of various species and ages, and, given the high site class of the soils, is capable of producing high volumes of timber on a sustained yield basis. An extensive network of forest roads and former skid trails provide access to approximatley 70 acres of manageable timber.

Inventory

During the site assessment in September 2018, randomly located 1/20th-acre plots (26.3' radius) were installed, within which a range of timber metrics were collected, including: trees per acre (TPA), diameter at breast height (DBH), live crown ratio (LCR), height, species and age. Additionally, qualitative information was collected both at plots, and between plots, including: forest health, wildlife habitat, understory species, snags and downed logs, and forest structure.

Desired future condition

The long-term desired future condition is a working forest that produces both a broad range of high quality forest products and optimal wildlife habitat. A key strategy to managing a forest that is resilient to constantly changing domestic and export markets is to manage for diversity, such as species, age, size and timber product. Additionally, by avoiding reliance on a single

species or age of trees, the forest is less susceptible to major natural disturbances such as wind, ice and pest and disease epidemics.

To achieve this desired future condition, the forest will be managed using “uneven-aged” management principles that promote stands that contain multiple species and ages of trees, as well as natural regeneration of both hardwoods and conifers in the understory. Uneven-aged management techniques will be used to improve forest ecosystem functions such as wildlife habitat, clean air, clean water and carbon sequestration.

It is recognized that the desired future condition is not necessarily the past, as climate change and other anthropogenic and environmental factors may not support the historic forest composition. Therefore this forest will be managed for resilience against climate change, fire, pests and disease by promoting a composition of diverse native hardwoods and conifers of multiple age classes that can be expected to tolerate increasingly drier and warmer summers and wetter winters. This may translate to concentrating red alder, red cedar, hemlock, grand fir, cedar and other drought intolerant species in the lower areas of the property, and favoring Douglas-fir, big leaf maple, madrone, Oregon oak, white pine and other drought tolerant species on drier sites.

Annual allowable harvest

Of a total of 102.25 acres, approximately 70 acres are accessible for sustained timber production. The remaining 32 acres comprise the open field, wetland, and the wetland and stream buffers that are restricted from timber harvest activities by state regulations.

Based on the NRCS soil productivity rates listed earlier in this document, the dominant soil type across this property is capable of producing 172 cubic feet of timber per acre per year, or approximately 860 board feet per acre per year, once the forest reachs approximately 50 years old. This volume of wood fiber is the yield likely to be produced by the most dominant tree species typical for this soil type, in this case Douglas-fir. This number is calculated at the age of culmination of the mean annual incremental growth (CMAI), which typically occurs between 45 – 60 years of age, and indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand. Therefore, this number can be conservative where forests are actively managed for timber production.

Calculating the short-term sustained yield for this forest is more complicated, given the diversity of stand ages and number of acres currently in hardwood production. Hardwoods tend to reach a merchantable age before conifers, and can outproduce conifers in volume/acre in the short term (<40 years), but conifers will outproduce hardwoods over the long-run (>40 years) and provide more opportunities for sustained harvesting.

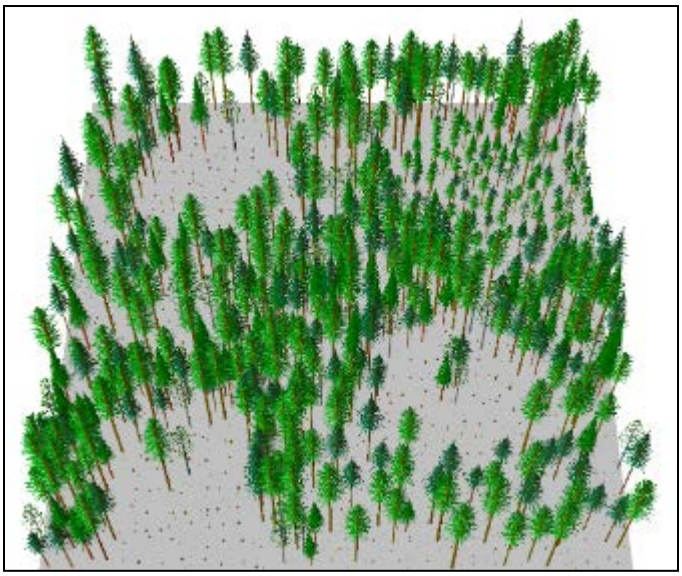
See Appendix X for an estimate of harvest volumes and values, as well as management costs, for the 30 year timeline of this plan.

Long-term Sustained Yield Harvesting

Once the average age of the forest reaches 40 years or older, the NRCS soil productivity rates can be used to estimate growth and sustained yield rates. The 70 acres of manageable forestland should be capable of growing at least 60 thousand board feet (MBF) of timber per year on a sustained yield basis. However, the basic definition of a "sustained yield" is harvesting less than annual growth. Therefore, given a maximum sustained yield of 90 percent of annual growth, with careful management this forest should be capable of producing approximately 54 MBF/year. If a commercial thinning is conducted every 10 years, this will yield 540 MBF of timber per harvest. At a conservative average of $550/MBF, and logging costs of 50%, this would result in a net return to the landowner of $148K every 10 years. From this income, other management costs may need to be extracted, such as road building, stream crossings, consulting foresters fees, planting, etc. The first-entry commercial thinning will yield a lower volume do to the younger age of the stand, and the focus on thinning from below where the least dominant and most defective trees are removed first.

Harvest systems

In order to achieve the desired future condition of a diverse stand that produces multiple timber products, a combination of individual tree selection, group selection and variable density thinning will be utilized. The clay/loam soils across this property are soft, in particular during the wet season. Therefore, logging should be limited to the driest time of year, and tracked equipment given preference over rubber-tired. Additionally, slopes that exceed 40% should be evaluated for cable logging in order to avoid damaging soils.



Example of pre-commercial thinning, variable density thinning and group selection harvesting. Image courtesy of the Rural Technology Initiative.

Slash management & wildlife habitat enhancement

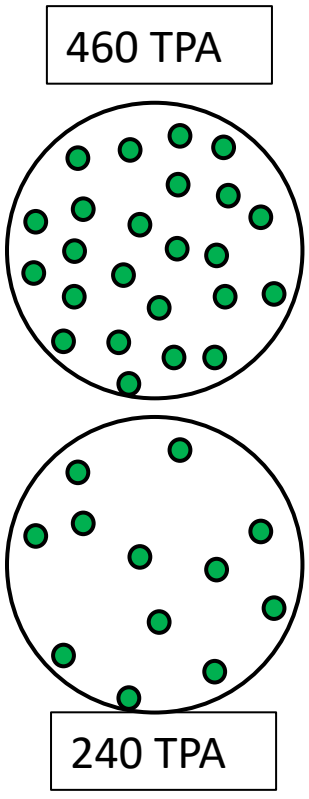
Slash (tree tops, branches, unmerchantable logs) produced during logging operations will be redistributed back into the woods to the extent practical to aid in soil development and minimize soil compaction by logging equipment. If timber is not processed in the woods, then

slash from the landing will be moved back onto skids trails and/or the forest floor during return trips by the skidder. Non-merchantable logs will also be scattered throughout the forest. Further, to the extent prudent, pulp and/or low value trees should be topped and left standing as snags, or cut and stacked into small wildlife habitat piles or constructed downed logs as per wildlife goals later in this document.

The following harvest methods will be used across the property:

Pre-commercial thinning

Pre-commercial thinning is recommended for both younger stands that exceed 350 tpa after canopy closure, and older stands where there is robust natural regeneration of conifers in the understory. Forest stands exceeding 350 tpa typically enter the stem exclusion phase between the ages of 10 – 20 years, depending largely on site productivity. This phase is characterized by a dense canopy with sufficient shade to kill lower branches, suppress understory vegetation, and eventually lead to suppression-based mortality. Live crowns gradually begin receding, and once they diminish below 35 - 40 percent, the basal growth of the tree diminishes. In order to keep these stands in optimum growth, and to minimize the risk for natural disturbance, they should be pre-commercially thinned.



Before and after pre-commercial thinning.

Young stands with diameters that average less than 10" DBH and that exceed 350 tpa should be thinned to 240 – 300 tpa depending on the shade tolerance of the tree (the less shade tolerant, the lower the residual density). It is crucial that the best trees of each species be retained rather than rigid adherence to an exact spacing requirement. If high quality leave trees occur in close proximity to each other, they may be left as a clump to increase spatial diversity. Leave trees shall be those that have the largest live crown, tallest height, straightest stem, and show no signs of defect, e.g. broken tops, scars, leaning. Thinning in this manner typically results in a variable density spacing amongst retained trees that averages approximately 12 ft – 15 ft.

Trees should be cut within six inches of the ground using either a chainsaw or handheld saw. Cut trees should be brought down so they are not leaning on the retained trees. Care should be taken not to damage the trunk of leave trees during thinning. The resulting slash can be managed in any of the following ways:

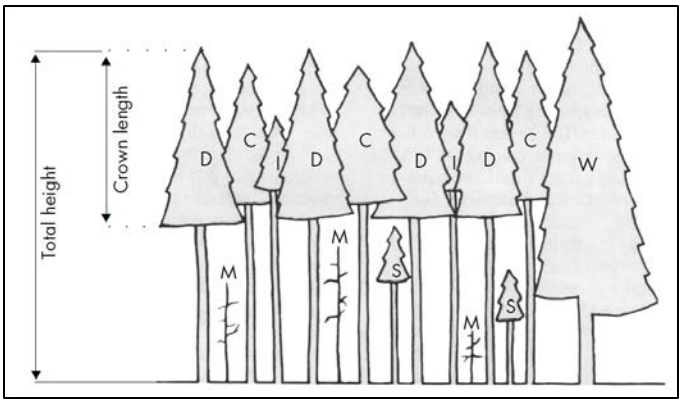
1. Lopped and scattered,
2. Piled into wildlife habitat piles measuring a minimum of 10 feet across and 6 feet high,

3. Constructed into downed logs measuring a minimum of 20 feet long and 20 inches in diameter,
4. Cut into firewood and removed,
5. Chipped.

Thinning should be avoided during the prime bird nesting season between March 15th-June 30th.

Thinning from Below

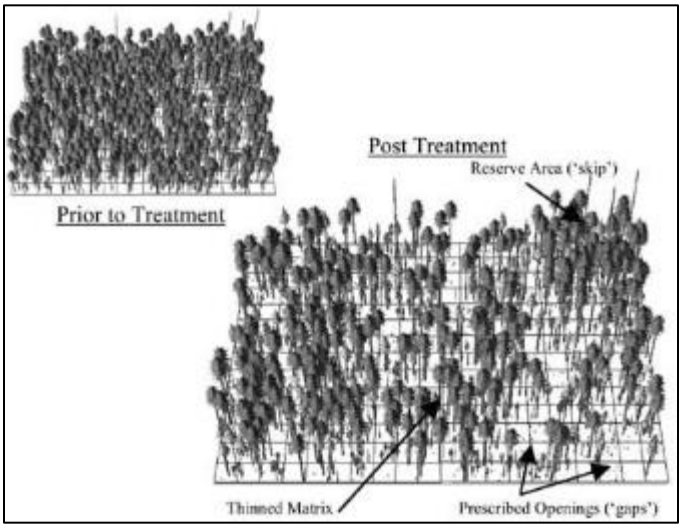
Thinning from below, or low thinning, is a technique typically used during the first commercial thinning entry in a stand or where high tree densities are causing mortality. Harvest tree selection is from the suppressed and intermediate canopy classes in order to promote the growth of the co-dominant and dominant trees, and approximately 30 – 40 percent of the total trees in a stand are removed. If pre-thinning stand density is approximately 300 - 350 tpa, then stands will be thinned to approximately 180 – 230 tpa. This approach to thinning employs a "best tree selection" method similar to pre-commercial thinning where the healthiest and most dominant trees of all species are retained. Groups of trees in root rot pockets, as well as poorly performing sites may be removed and the site replanted with more suitable species. Codominant or dominant trees may be removed if they have defect or will release more desirable species in the understory. Thinning can either select across different species evenly or be used to promote prefered minority species, e.g. hardwoods.



Crown type classes: D=dominant, C=co-dominant, I=intermediate, S=suppressed, W=wolf, M=mortality. Image courtesy of OR State University.

Variable density thinning

Variable density thinning techniques are typically employed during the second and subsequent thinning entries of a stand. Variable density thinning involves varying the thinning intensity to produce a mosaic of unthinned, moderately thinned, and heavily thinned patches. Thinning with skips and gaps can also create this mosaic. Variable density thinning helps generate a more complex forest structure by



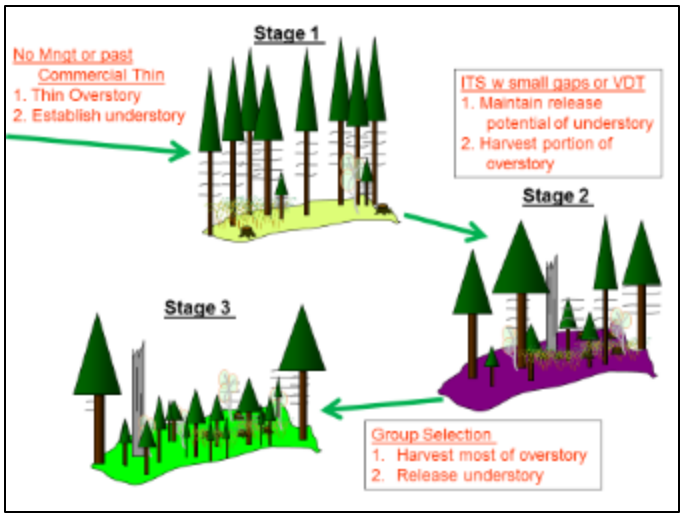
Before and after variable density thinning. Image courtesy of Forestnet.com.

promoting tree growth at different rates. It also encourages understory development through a diversity of species, a variety of patch types, and growth of tree seedlings and saplings. Variable-density thinning can improve forest health by increasing resistance to disturbance, ability to recover after disturbance, and biological diversity that allows ecosystems to function well through climatic variation.

Variable density thinning typically occurs across both species and diameters, reducing stand density by no more than one-third of the standing trees per entry. If stand density is approximately 180 – 230 TPA, then the 2nd entry will reduce the density to 120 – 150 TPA. During the third entry thinning, stand density will be reduced further to approximately 80 – 100 TPA. The following thinning entry will likely follow variable retention harvesting methods as per below. When selecting trees for harvest, most thinning is still conducted from below. However, dominant overstory trees may be selected for harvest if they will release a vigorous understory tree that has ample live crown. Thinning in this manner produces a more complex forest canopy and stimulates natural regeneration in the understory, thereby minimizing the need for manual planting.

Variable retention harvesting

Variable retention harvesting is typically applied to older stands during the third or fourth thinning entry. During a variable retention harvest (VRH), most of the dominant and co-dominant trees are removed, with the exception of up to 25 dominant trees per acre. These leave trees will be retained as permanent biological legacies, whether standing or downed. VRH objectives provide habitat for wildlife and retain some of the original forest floor, including shrubs, plants, and populations of beneficial mycorrhizal fungi. Retaining these "biological legacies" enhances the diversity of plant and animal life in the regenerating forest stand over a long time. Operationally, VRH must plan for future access to avoid injuring trees that are left on the site forever. Because the economic value of retained trees will not be realized, poor quality (from a market perspective) trees are typically chosen for retention.



Transitioning from variable density thinning to variable retention harvest to release understory trees. Image courtesy of Rolph Gersonde.

If, during previous harvests, the stand was thinned using variable density thinning techniques, then there may be sufficient natural regeneration in the understory to avoid manually

replanting the site. A post-harvest inventory must be made to quantify the species and stocking density to determine if the stand has a desirable composition. If planting will be used to regenerate the stand, retaining large, limby trees with thick, tapered boles reduces the likelihood of blow down. Trees with forked or dead tops are also good candidates for retention. These “defective” trees provide perching or nesting habitat for a variety of birds and small mammals.

Forest Management Units

FMU 1

Total acres	Age	Dominant spp.	Trees per acre	Average DBH	Avg. height	Avg. crown ration
35	26	Douglas-fir	360	8” – 10”	55’	40%

FMU 1 encompasses the majority of the upland portion of the southern half of the property. The majority of the unit is comprised of a fully stocked 26 year old Douglas-fir plantation that was manually replanted following clearcut harvesting. The stand retains nearly its original stocking density of 350 TPA (11’ x 11’) where the Douglas-fir is dominant, but stocking varies on the eastern slopes where alder is competitive with the fir, ranging from 300 – 420 TPA. The Douglas-fir dominant portion of the stand has been growing in the competitive exclusion stage for approximately 10 years, resulting in clearly dominant vs. suppressed trees, reduced live crowns on the most suppressed trees, die-off of lower limbs, and limited mortality amongst the most suppressed trees. Despite the years of competition, live crowns across the dominant and co-dominant trees still exceed 40 percent. However, the intermediate and suppressed trees have crowns of less than 30 percent. Annual leader growth on the dominant trees averages 30”. This, combined with the ample live crowns, indicates this stand is still in an optimal growth phase. Diameters amongst the Douglas-fir range from 5” – 12” DBH, but average 8” – 10”. Approximately 10 – 15 percent of the live trees show signs of storm damage in the form of broken or forked tops.

DF @ 400 TPA in SW corner of unit.

Red alder and small canopy gaps support limited understory vegetation.

Where Douglas-fir is dominant, the canopy is dense enough to fully suppress understory vegetation. Small canopy gaps, and the more porous portions of the canopy where red alder

occurs, provide openings where sunlight can penetrate the canopy and support the growth of a fairly diverse community of understory shrubs, including: sword fern, trailing blackberry, elderberry, red huckleberry, salal, Oregon grape and salmonberry.

Red alder is common throughout this unit. It has colonized all of the former skid trails, creating narrow bands of hardwoods that snake through the Douglas-fir. It also occurs as individuals and in small groups throughout the upland areas of this unit. As the topography slopes down towards the wetlands, and soil moisture increases, alder become much more prevalent, in many places occupying more than 50% of the total stocking density. Red alder quickly colonized the wet slopes following the previous clearcut, and have been very competitive with the planted Douglas-fir. In many areas Douglas-fir are subordinate beneath a dense alder canopy. Big leaf maple is also relatively common across the wetter slopes, comprising up to 30 TPA. Many of the maple were cut during the previous harvest, and now are comprised of coppicing stumps with multiple stems. Approximately three years ago the alder on the slopes was pre-commercially thinned, and many of the maples were girdled. Western red cedar, western hemlock and grand fir are naturally regenerating in small numbers throughout the alder dominated sites.

Red alder following a former skid trail downslope to the northeast.

Thinned red alder interspersed with Douglas-fir an east-facing slopes.

Mixed DF/RA near SE corner.

Both the wetter soils and the porous hardwood canopy support an extremely diverse and dense understory comprised of salmonberry, elderberry, hazelnut, vine maple,

cascara, bitter cherry and other native shrub species. Himalayan blackberry is also common along the former skid trails and throughout many areas of the understory.

Dense Himalayan blackberry beneath red alder.

There are effectively no functional snags throughout this unit, as most are too small in diameter to support wildlife use. Although large downed logs are fairly abundant, they're very old and very soft, and therefore provide limited wildlife habitat value.

The topography of the unit ranges from a broad, flat expanse across the western 2/3 of the site, and moderate slopes of less than 30 - 40 percent across the eastern third of the site that lead down to the wetland in the valley below. There are a few small areas where slopes exceed 40 – 50 percent, and these occur in the NE corner of the unit and within immediate proximity of the three seasonal drainages. A large, 1.5 acre "bowl" occurs in the southern portion of the unit where slopes are very steep at the headwall of the most southern seasonal stream.

Management Recommendations

This unit presents the best short-term opportunity for commercial timber harvesting given the age and size of both the Douglas-fir and red alder. The unit should be allowed to grow for another 4-5 years before commercially thinning in order to add diameter growth that will help transition more Douglas-fir volume from pulp to minimum saw log size. In about 2023, the unit should be commercially thinned from below, removing both Douglas-fir and red alder. The red alder dominated areas on the slopes can be underplanted following thinning in order to establish a second cohort in anticipation of removing the remaining merchantable alder in other 10 years. From that point forward, the unit can be commercially thinned every 10-12 years, removing no more than 1/3 of the trees during any single harvest. Ground disturbance from logging should stimulate natural conifer regeneration in the understory, and manually underplanting conifers beneath the alder following the first commercial harvest can provide a jump start on the next cohort in those areas.

1. 2019 – 2024: Reopen former forest access roads and skid trails
   Many of the former forest access roads and skid trails have become overgrown with red alder, native shrubs and Himalayan blackberry. In order to provide optimal access for forest management, these roads and trails should be reopened by removing non-

commercially viable trees and brush. Commercially viable trees can be left in place until the first timber harvest, at which time they can be removed as part of the harvest.

2. 2019 – 2024: Cut back Himalayan blackberry and coppicing maple
   Himalayan blackberry that occurs along forest access roads should be manually cut back to reduce its vigor and spread. Coppice maple should be thinned to a single stem, or cut back entirely if no stems present good timber quality. Maple should be reduced to no more than 20 TPA (50' x 50').
3. 2024 – 2029: Commercially thin from below
   Commercially thin from below by removing the most suppressed and defective trees first, then thinning for spacing. Thin across both Douglas-fir and red alder. This may result in removal of up to 50 percent of the trees, in particular in the Douglas-fir dominated areas, depending on stand density. Thin to release any vigorously growing conifers in the understory. Overall stand density will be reduced to 150 – 200 TPA.
4. 2024 – 2028: Underplant alder dominated areas with conifers
   Following commercial thinning, underplant alder dominated sites with a modest stocking of western red cedar and Douglas-fir. Plant no more than 100 TPA (20' x 20'), on a 50/50 ratio, concentrating Douglas-fir in the most open areas. Place tree protectors over seedlings to minimize deer browse.
5. 2024 – 2034: Monitor tree seedlings and natural regeneration
   For the next 10 years, planted tree seedlings and all naturally regenerating trees should be monitored for health, deer browse, and density. Periodically lift and/or straighten tree protectors in order to protect the leader of each seedlings. Once seedlings reach a minimum of 4' tall, protectors can be removed. If natural regeneration of either conifers or alder exceeds 350 TPA (11' x 11'), pre-commercially thin any dense patches to approximately 15' x 15' and retain the best, most vigorous trees of each species.
6. 2034 – 2039: Commercial variable density thin
   After 10 – 15 years of growth, this unit can be commercially thinned again in order to further reduce stocking densities, release vigorous understory trees and generate revenue. No more than 30 percent of the canopy trees should be removed by thinning "across the diameters". Dominant trees in the canopy should only be removed if they will release vigorously growing understory trees. The remainder of the stand should be thinned to spread remaining trees out and reduce density. Thin both Douglas-fir and red alder. Overall stocking of the dominant trees should be reduced to approximately 100 – 120 TPA.
7. 2034 – 2039: Evaluate understory trees and replant as necessary
   Following logging, evaluate the stocking and condition of understory trees. Cut out any trees that were damaged by logging. If there are less than an evenly distributed 100 TPA in the understory (20' x 20') throughout both the Douglas-fir and red alder dominated

sites, replant with Douglas fir and cedar to achieve that minimum stocking level. Trees may need to be caged to prevent deer browse. Any areas where natural regeneration is leading to high densities amongst seedlings and understory trees should be thinned to 15' x 15'.

8. 2044 – 2049: Commercial variable density thin
   Commercially thin the canopy trees using the variable density thinning guidelines earlier in this plan. Remove no more than 30 percent of the dominant trees, reducing canopy density to 50 – 80 TPA. Thin to release vigorous understory trees. Following logging, cut out any damaged understory trees, replant areas of low density, and/or pre-commercially thin any areas where natural regeneration is leading to excessively high densities of seedlings and understory trees.
9. 2054 – 2059: Commercial variable retention harvest
   Conduct final harvest across the canopy trees, reducing density to 20 TPA that will be retained indefinitely as long-term legacy trees. Understory trees may be reaching a merchantable age at this time, and can be thinned to optimize spacing and remove defect.

FMU 2

Total acres	Age	Dominant spp.	Trees per acre	Average DBH	Avg. height	Avg. crown ratio
11.9	18 - 20	Red alder Big leaf maple	785	8"	52' - 60'	35% - 40%

Dense red alder near NW property corner.

This FMU is comprised of several stands that are dominated by red alder and big leaf maple. These areas were likely clearcut approximately 20 years ago, and not replanted. Consequently, red alder, big leaf maple, bitter cherry, cascara and wide host of native shrubs quickly colonized the sites. The composition of the various units is highly heterogeneous, but dominated by dense thickets of red alder with up to 1,100 TPA. Interspersed with the red alder are big leaf maple and bitter cherry. Douglas-fir is also scattered throughout some of these units, as are naturally regenerating grand fir, western red cedar and western hemlock. A lone birch tree was identified beneath the canopy of the alder in the northern portion of the property. Maple occurs both as individual trees and coppicing stumps, the latter resulting from trees that were cut during the prior harvest. Coppicing stumps occur both singularly and in

groups. Were maple occurs in groups, they can dominate up to ½ acre, effectively suppressing other trees, as well as shrubs and groundcovers.

The red alder is growing rapidly, and competition is high in the dense thickets. Diameters range from 4" – 12" DBH, but average 6" - 8". Heights of dominant trees average 52 - 60'. There is a high degree of suppression mortality throughout the alder, as dominant trees become established, and subordinate trees begin to recede in the canopy. However, live crowns on dominant and codominant trees still exceed 40%, indicating these trees are still in an optimal growth phase.

Given the porous nature of hardwood canopies, ample sunlight reaches the forest floor and consequently supports a robust and diverse understory shrub layer. Species include: sword fern, salmonberry, elderberry, trailing blackberry, ocean spray, Himalayan blackberry, red huckleberry, vine maple, cascara, bitter cherry, and others. Thickets of cascara and vine maple can dominate small sites, even outcompeting alder.

Dense red alder in northern area of property with grand fir, hemlock and red cedar emerging in understory.

Dense RA stand in northern area of property with 1,050 TPA

Dense RA stand in SW corner of property with 750 TPA.

Management Recommendations

The loamy soils across this property are particularly suited to the production of high quality and high volumes of hardwoods. Therefore, improving the growth and value of the existing hardwoods through thinning is highly recommended. Stand improvement will be conducted through an initial pre-commercial thin, then the remaining alder will be allowed to grow for approximately 10 years to achieve optimal commercial size. From this point, the hardwoods will

be commercially thinned twice, before conducting a third and final harvest. The unit will be replanted following the first two commercial harvests, in order to augment naturally regenerating trees and achieve optimal spacing. Each timber harvest will be spaced 10-12 years apart. Approximately 10 years following the final harvest, the first generation of conifers planted on the site will be reaching a minimum merchantable age and can be commercially thinned, ensuring a sustained harvest from this site.

1. 2019 – 2024: Remove Himalayan blackberry
   Himalayan blackberry has colonized all forest edges of the hardwood dominated units, as well as the logging roads and margins of the roads that provide access to these units. Before other restoration or forest management activities are pursued, the blackberry should be manually cut back to provide optimal access to the units, and reduce its vigor and potential for spread. Continued annual monitoring and manual control of blackberry will be necessary to ensure it does not continue to compete with native vegetation or naturally regenerating conifers in the understory.
2. 2019 – 2024: Pre-commercially thin
   Following control of the blackberry, the dense red alder and coppicing big leaf maple should be pre-commercially thinned in order to promote the growth of the most dominant trees. Following the PCT guidelines earlier in this plan, these units should be thinned to 200 – 250 TPA (13’ – 15’), retaining the most dominant and highest quality trees. Big leaf maple coppice should be thinned to a single high quality stem (e.g. straight and no branching for at least 24’) where possible, or cut back entirely where no high quality stems are present. Retain no more than 20 maple per acre (50’ x 50’). Any conifers in the understory should be released by thinning more heavily along their southern side.
3. 2029 – 2034: Commercially thin from below
   Once average diameters reach 10” – 12” DBH, the alder across these units can be commercially thinned by removing 30 - 40% of the individual trees. In order to avoid windthrow, the stand should not be thinned more heavily than this. The stand should generally be thinned from below, removing the least dominant and most defective trees first. Further, alder should be removed where it will release vigorous understory conifers. Post-thinning stand density will vary from 120 – 150 TPA.
4. 2029 – 2034: Replant following thinning
   Following commercial thinning, any understory conifers damaged during logging should be removed, and the unit underplanted with western red cedar at 100 TPA (20’ x 20’). Plant no closer than 15’ to existing conifers. Trees should be caged to prevent deer browse.
5. 2029 – 2039: Monitor and maintain planted and naturally regenerating trees

Over the next 10 years following commercial thinning, both manually planted and naturally regenerating understory trees should be monitored for vigor, browse and density. Tree cages should be monitored annually and straightened and/or lifted to protect the terminal leader of the seedling. Naturally regenerating cedar or Douglas-fir should be caged when found. If natural hardwood or conifer regeneration leads to densities of understory trees that exceed 12' – 15' spacings (>350 TPA), they should be proactively pre-commercially thinned by removing the least dominant, most defective, or least desirable tree species. Monitor maple regeneration, but thin and manage for timber quality trees.

6. 2039 – 2044: Commercial variable retention harvest
   A second commercial harvest of the alder can be conducted by removing another 30 - 40% of the trees. However, harvesting should occur by creating gaps for replanting, and retaining moderately stocked clumps along road margins and unit boundaries where they are more accessible for final harvest in another 10 years. Thinning should occur more heavily around vigorously growing understory conifers, and residual density of thinned clumps should be approximately 60 – 80 TPA. Following harvest, replant gaps with Douglas-fir at 240 TPA (13' x 13'), and underplant residual red alder with cedar at an additional 100 TPA (20' x 20'). Cage trees to prevent deer browse.
7. 2039 – 2049: Monitor and maintain planted and naturally regenerating trees
   Over the next 10 years following commercial thinning, both manually planted and naturally regenerating understory trees should be monitored for vigor, browse and density. Tree cages should be monitored annually and straightened and/or lifted to protect the terminal leader of the seedling. Naturally regenerating cedar or Douglas-fir should be caged when found. If natural hardwood or conifer regeneration leads to densities of understory trees that exceed 12' – 15' spacings (>350 TPA), they should be proactively pre-commercially thinned by removing the least dominant, most defective, or least desirable tree species. Monitor maple regeneration, but thin and manage for timber quality trees.
8. 2049 – 2054: Final harvest of red alder
   Remove clumps of red alder, retaining up to 20 TPA as legacy trees. Remove damaged understory trees during thinning, and space remaining understory trees at approximately 13' – 15', retaining the highest quality and most dominant trees of each species.

FMU 3

Total acres	Age	Dominant spp.	Trees per acre	Average DBH	Avg. height	Avg. crown ratio
9.5	3	Douglas fir	350	1”	2’ – 4’	100%

This unit is comprised of a new Douglas-fir plantation that was planted following clearcut harvesting of an approximately 90 year old stand of Douglas-fir in 2015. The topography of the unit is very steep, exceeding 40 – 50% slopes. The unit was originally ground-logged with a shovel, with logs removed both at landings at the top of the slope, and a via forest access road along the base of the slope. The road along the base of the slope was abandoned following logging as a requirement by the WA DNR to alleviate erosion and minimize future impacts to the wetland in the valley. Logging slash was distributed across the unit, and aggregated at the landing in large piles.

View North across slopes of FMU 3, with BM coppice.

32"+ diameter stumps remaining from harvest of 90 year old Douglas-fir.

The unit was planted at a standard restocking density of 350 TPA (11’ x 11’) and the seedlings have enjoyed nearly a 100% survival rate since planting. Deer browse is evident on many seedlings, but even so many have grown to 3’ – 4’ in height, which nearly puts them beyond browse susceptibility. Browsed trees will eventually develop a dominant leader that exceeds browse height. Although there is a robust and dense community of brush and groundcover species, there is, as of yet, very little direct competition with the Douglas-fir seedlings. Big leaf

Slash piles at landing with Himalayan blackberry.

maple that was cut during harvesting three years ago has resprouted, creating thick coppice bushes from each of the stumps. These account for as many as 30 coppicing stumps per acre, each currently average 15’ high and 15’ wide. If left uncontrolled, the maple coppice will directly compete with the Douglas-fir seedlings, and effectively shade out large portions of this unit. Red alder is also naturally regenerating across the unit, and will likely require pre-commercial thinning to avoid competition with the Douglas-fir and to maintain optimal density.

24" DF seedling with forked top resulting from deer browse.

Native shrub and groundcover species include: sword fern, vine maple, elderberry, red huckleberry, trailing blackberry and Oregon grape. Himalayan blackberry has heavily colonized the margins of this unit along the top of the slope adjacent to the road, as well as each of the landings.

Management Recommendations

Given the highly productive quality of the soils on this site, tree seedlings across this unit should grow rapidly and close canopy within 10 years. Red alder naturally regenerating across the site should also be retained in order to diversify the unit, optimize the growth potential of the site, and improve forest health and resilience. The unit should be evaluated for pre-commercial thinning in approximately 10 years, removing defective trees and thinning for optimal spacing. Coppicing maple and Himalayan blackberry will need to be controlled in order to optimize timber production. Given the higher cost of cable logging, which will likely be necessary on the steep slopes, this unit should be grown out longer in order to achieve both higher volume and higher quality log grades before thinning. Further, this unit should be thinned more heavily, and less frequently, in order to balance logging costs with timber revenue.

1. 2019 – 2024: Control Himalayan blackberry and maple coppice
   Himalayan blackberry along unit boundaries and at log landings should be manually cut back, then sprayed. Maple coppice should be either manually cut back or basal sprayed.
2. 2029 – 2034: Evaluate for pre-commercial thinning
   Monitor both Douglas-fir and naturally regenerating red alder for competition. Pre-commercially thin if alder competition becomes excessive with Douglas-fir, or if red alder forms thickets that exceed 350 TPA (11’ x 11’). Further, monitor canopy closure on Douglas-fir. PCT should occur before live crowns begin to recede to less than 40%. In order to optimize longer term growth on the unit before the first cable thinning, this unit

should be pre-commercially thinned to a slightly lower density, in the range of 220 – 240 TPA (13' – 15'). Remove any defective trees at this time.

3. 2049 – 2054: Commercial variable density thin
   Commercially thin across the diameters and species by removing 40 - 50% of the existing trees, reducing overall stand density to 120 – 140 TPA. Given the higher cost of cable thinning on this steep unit, a higher volume of timber may need to be harvested to improve the economic viability of the project.

FMU 4

Total acres	Age	Dominant spp.	Trees per acre	Average DBH	Avg. height	Avg. crown ratio
4.5	1-3	Douglas fir Red cedar	350	<1"	12" – 16"	100%

DF & RC seedlings with tree protectors in FMU 4.

Caged DF & RC with mound of Himalayan blackberry behind.

This FMU is comprised of a newly established plantation of Douglas-fir and western red cedar. The unit was originally cleared, along with FMU 5, of nearly all trees, vegetation and stumps to prepare the site for a Xmas tree plantation. However, the previous landowner instead planted the site to western red cedar at 350 TPA in 2015. Concerned that the plantation had failed, the unit was replanted in 2018 to Douglas-fir at 350 TPA. Although heavily browsed, the majority of the cedar in fact survived. Due to a late planting (April) and an unprecedented dry summer, the majority of the Douglas-fir seedlings died, leaving a variable stocking of 300 – 450 TPA (cedar and Douglas-fir) across most of this unit. Scattered throughout this unit are a handful of 15 – 20 year old red alder and Douglas-fir. These trees were presumable retained when the site was cleared for growing Xmas trees. Most of the red alder is in poor form, with storm damaged tops and heavy branching. Red alder is also beginning to naturally regenerate across the unit.

This unit is heavily colonized by grasses and native groundcovers, including bracken fern, Oregon grape and trailing blackberry. Himalayan blackberry has also heavily colonized this unit. It is rampant across nearly their entire area, and is beginning to form dense and tall masses both along the edges of the unit, and in places within the unit. The blackberry has overgrown much of the original cedar planting, making it difficult to find seedlings and suppressing their growth.

Scattered 15 - 20 year old RA throughout FMU 4.

In 2018 the current owners began locating the tree seedlings and staking and caging them to prevent further deer browse.

Management Recommendations

In order to ensure the planted conifer seedlings survive and prosper, the Himalayan blackberry across the unit will need to be controlled. This will require a combination of mechanical and herbicide treatment. Once the seedlings are released, they should grow vigorously, along with naturally regenerating alder, to form a relatively dense stand. In approximately 10 years the stand should be evaluated for pre-commercial thinning for spacing, to remove defect and to retain the desired species composition. In 20 - 25 years the first commercial thinning could occur amongst the red alder and Douglas-fir. From that point forward, the unit can be commercially thinned every 10 – 12 years, promoting species and structural diversity.

1. 2018 – 2019: Identify, stake and/or cage tree seedlings
   Attempts should be made to identify cedar, Douglas-fir and red alder seedlings throughout the unit and, at a minimum, flag the seedlings for future identification. Cedar should be caged to prevent deer browse.
2. 2019 – 2024: Control Himalayan blackberry
   Once tree seedlings have been identified, Himalayan blackberry should be mechanically cut back in June/July, allowed to regrow, then sprayed in late summer. Care should be taken to minimize inadvertently cutting conifer or alder seedlings when mechanically cutting blackberry. Further, care should be taken to not spray hardwoods when blackberry is being sprayed. Follow-up mechanical treatment of blackberry may be required during subsequent years until conifers and hardwoods close canopy.
3. 2029 – 2034: Evaluate stand for pre-commercial thinning

Once canopy closes and competition begins between hardwood and conifers, evaluate unit for pre-commercial thinning. Thin before live crowns recede to less than 40%. Remove any defective trees, then thin to favor the most dominant trees of each species. Total stocking density should be reduced to no more than 350 TPA.

4. 2039 – 2043: Commercially thin from below
   Once average diameters reach 10" – 12" DBH, this unit should be commercially thinned by removing 30 – 40% of the trees. Thin across the species to promote stand diversity, releasing cedar. If pre-harvest stand density was 350 TPA, thin to 180 – 220 TPA.
5. 2049 – 2053: Commercial variable density thin
   Using guidelines earlier in this plan, commercially thin across the species and diameters to promote a species and structurally diverse stand. Remove no more than 30% of the trees, reducing stand density to 120 – 140 TPA. Thin to release any vigorously growing understory conifers.

FMU 5

Total acres	Age	Dominant spp.	Trees per acre	Average DBH	Avg. height	Avg. crown ratio
4.5	3	Red alder	<90	<1"	3' – 4'	100%

Sparse RA seedlings (160 TPA) amongst dense grasses and blackberry along western edge of FMU.

This FMU is comprised of a red alder plantation that was established on a site that had originally been cleared of all vegetation and stumps for the purposes of growing Xmas trees. The previous property owner planted the unit to red alder in 2015 at 350 TPA. Subsequently, the alder experienced high mortality across the majority of the unit. Mortality tended to occur in discrete areas, rather than evenly across the unit, and consequently there are some areas where alder is still surviving and well-stocked, and some areas where no alder has survived. On average across the entire unit, there is only an average of 90 surviving TPA. Limited natural regeneration of alder was observed, but this was insufficient to bring the total stocking density up to the desired minimum 190 TPA. Scattered throughout this unit are 20 year old alder and Douglas-fir, mostly as individuals, but alder does occur in small clumps.

Unlike FMU 4, this unit has not become colonized by dense groundcovers and shrubs. A mix of grasses is the primary ground cover. However, similar to FMU 4, Himalayan blackberry is beginning to colonize the unit and is very widespread. The blackberry hasn't achieve the dominance it is exhibiting in FMU 4 quite yet, but does occur as small vines across the majority of the unit, as well as in large masses both along unit boundaries and in discrete places within the unit.

Area with no surviving RA in southern end of FMU.

Management Recommendations

Although there is a modest stocking of red alder across this unit, the majority of the seedlings died and therefore the site should be replanted in order to optimize timber production. Before replanting, the Himalayan blackberry should be mechanically cut back and spot sprayed. Care should be taken to avoid either cutting or spraying the existing alder. Once the site prep has been completed, the unit should be replanted with a 50/50 mix of Douglas-fir and red cedar at 260 TPA (13' x 13') for a total stocking density of 350 TPA. Cedar should be caged to prevent deer browse. Within 10 years the unit should be evaluated for pre-commercial thinning, and a best tree selection approach used to retain both hardwoods and conifers. In 20 – 25 years the unit should be ready for its first commercial thinning, primarily alder and Douglas-fir. From that point, the unit can be commercially thinned every 10 – 12 years following the guidelines in this plan.

1. 2019 – 2024: Control Himalayan blackberry
   Himalayan blackberry should be mechanically cut back in June/July, allowed to regrow, then sprayed in late summer. Care should be taken to minimize inadvertently cutting alder seedlings when mechanically cutting blackberry. Further, care should be taken to not spray hardwoods when blackberry is being sprayed. Follow-up mechanical treatment of blackberry may be required during subsequent years until conifers and hardwoods close canopy.
2. 2019 – 2024: Replant with Douglas-fir and red cedar
   Following blackberry control, this unit should be replanted with a 50/50 mix of Douglas-fir and western red cedar at 260 TPA (13' x 13'). Cedar should be caged to prevent deer browse.
3. 2019 – 2029: Monitor planted and naturally regenerating seedlings

Over the next 10 years both manually planted and naturally regenerating trees should be monitored for vigor, browse and density. Tree cages should be monitored annually and straightened and/or lifted to protect the terminal leader of the seedling.

4. 2029 – 2034: Evaluate for pre-commercial thinning
   After this unit closes canopy and live crowns begin to recede to 40%, the unit should be evaluated for pre-commercial thinning. Remove defective trees, then thin for spacing, retaining the most dominant and highest quality trees of each species. Post-thinning stand density should average 250 - 350 TPA.
5. 2039 – 2043: Commercially thin from below
   Once average diameters reach 10" – 12" DBH, this unit should be commercially thinned by removing 30 – 40% of the trees. Thin across the species to promote stand diversity, releasing cedar. If pre-harvest stand density was 350 TPA, thin to 180 – 220 TPA.
6. 2049 – 2053: Commercial variable density thin
   Using guidelines earlier in this plan, commercially thin across the species and diameters to promote a species and structurally diverse stand. Remove no more than 30% of the trees, reducing stand density to 120 – 140 TPA. Thin to release any vigorously growing understory conifers.

FMU 6

Total acres	Age	Dominant spp.	Trees per acre	Average DBH	Avg. height	Avg. crown ratio
2.5	50+	Douglas-fir Red alder	100	14"	80'	>40%

Modest stocking of Douglas-fir towards southern end of FMU.

This small FMU, located along the southwestern property line, is comprised of a residual stand of mature mixed conifers and hardwoods that were retained during the previous harvest of the adjacent unit approximately 24 years ago. The unit is primarily comprised of Douglas-fir and red alder, but also hosts big leaf maple and grand fir. Most of the red alder is in a decadent growth phase and of poor commercial value. Red alder is more prevalent towards the northern end of the unit, and Douglas-fir is more prevalent towards the southern end of the unit. Diameters amongst the Douglas fir range from 8" – 18"

DBH, but average 14”. Given the current modest stocking, this unit was likely commercially thinned at least once in the past.

Understory vegetation throughout this unit is diverse, but not particularly dense. Species include: hazelnut, elderberry, Oregon grape, salmonberry, ocean spray, Nootka rose and others.

Mature Douglas-fir interspersed with mature red alder.

Management Recommendations

This unit represents a good example of a mature mixed conifer/hardwood stand that has been thinned at least once during its lifetime. As a reference stand, and given its small size and location immediately along a property line, it should be retained indefinitely for its conservation and research values without further management.

FMU 7

Total acres	Age	Dominant spp.	Trees per acre	Average DBH	Avg. height	Avg. crown ratio
7.2	18 - 20	Red alder Big leaf maple Brush	<50	6”	52’	>40%

This unit is comprised of two noncontiguous units, one located in the northwest corner of the property and the other to the southeast of FMU 4. The northern subunit spans relatively steep slopes (>40%), though there is ample access to the unit as forest roads bisect it in multiple places. In contrast, the southern subunit is entirely flat, save for its northwestern and southwestern edges, which rise steeply to meet FMU’s 4 and 1 respectively. Both units were logged approximately 20 years ago, and apparently not replanted, as there is little to no evidence of planted Douglas-fir. This FMU is currently stocked with a very light component of naturally regenerated red alder and big leaf maple, but heavily dominated by Himalayan blackberry and native brush, cascara and vine maple, along with

Heavy brush and blackberry interspersed with sparse maple and dense thicket of red alder.

salmonberry and elderberry. The alder occurs in discrete, dense thickets, and the majority of the maple is comprised of coppicing stumps. Grand fir and western hemlock are beginning to naturally regenerate in the understory of the alder, but otherwise conifers are entirely lacking in this unit. The topography across the majority of the unit is relatively flat, but along the northwestern edge a slope rises steeply up to meet FMU 4. This slope is heavily colonized by Himalayan blackberry.

Dense cascara and vine maple upslope from road.

Dense Himalayan blackberry on slope leading up to FMU 4.

Sparse big leaf maple coppice occupying large gap downslope from forest access road in north.

Management Recommendations

This FMU is in dire need of extensive restoration, primarily through the removal of Himalayan blackberry and control of dense native understory brush, and replanting to mixed conifers. The unit should be planted densely in order to achieve canopy closure as soon as possible and thereby shade out the invasive vine. The dense thickets of alder should be pre-commercially thinned to promote better timber quality, and the coppice maple should either be thinned to a single high-quality stem, or cut back entirely. The long-term goal for this unit is to restore it to a mixed conifer/hardwood stand that produces high quality timber and optimal wildlife habitat.

1. 2019 – 2024: Site preparation and replanting
   This site will require intensive site preparation due to the dense shrub layer, presence of Himalayan blackberry, and frequent big leaf maple coppice. Although all of the blackberry should be cut back, the native shrubs can be cut back to residual “islands” around which seedlings can be planted, individual planting spots cut into it (ensuring

each seedling has at least a 45 degree opening at least to the West, South and east, or a combination of both. Patches of dense alder should be pre-commercially thinned to 13' – 18' spacing and back big leaf maple coppice should be limited to no more than 20/acre (50'x50') and the remaining coppice cut back to single stems. Immediately prior to planting, the soil should be scarified of all vegetation within a 2' radius of the planting spot. The unit should be replanted to a mix of Douglas-fir and western red cedar at 300 TPA in order to achieve a per acre total of 350 TPA, including red alder. No conifer seedling should be planted within 12' – 15' of an existing conifer. Cedar should be caged in order to prevent deer browse.

2. 2019 – 2029: Monitor planted and naturally regenerating seedlings
   Over the next 10 years both manually planted and naturally regenerating trees should be monitored for vigor, browse and density. Competing vegetation should be cut back until the seedlings reach a free-to-grow height of at least two feet above surrounding vegetation. Tree cages should be monitored annually and straightened and/or lifted to protect the terminal leader of the seedling.
3. 2029 – 2034: Evaluate for pre-commercial thinning
   After this unit closes canopy and live crowns begin to recede to 40%, the unit should be evaluated for pre-commercial thinning. Remove defective trees, then thin for spacing, retaining the most dominant and highest quality trees of each species, including hardwoods. Post-thinning stand density should average 250 - 350 TPA.
4. 2039 – 2044: Commercially thin from below
   Once average diameters reach 10" – 12" DBH, this unit should be commercially thinned by removing 30 – 40% of the trees. Thin across the species to promote stand diversity, releasing cedar. If pre-harvest stand density was 350 TPA, thin to 180 – 220 TPA.
5. 2049 – 2054: Commercial variable density thin
   Using guidelines earlier in this plan, commercially thin across the species and diameters to promote a species and structurally diverse stand. Remove no more than 30% of the trees, reducing stand density to 120 – 140 TPA. Thin to release any vigorously growing understory conifers.

RMZ/WMZ

Total acres	Age	Dominant spp.	Trees per acre	Average DBH	Avg. height	Avg. crown ratio
8.7	18 - 20	Red alder Big leaf maple Brush	<50	<10”	52’	>40%

This FMU is comprised of three subunits that occur within both the riparian zone of the northern seasonal stream and along the western edge of the wetland in the valley. The topography across the northern unit, surrounding the seasonal stream, is relatively steep, exceeding 40 percent in most places. The units have a very similar stand composition to FMU 7, as they were also likely logged approximately 20 years ago and not replanted. The units are stocked with a very light component of red alder and big leaf maple, but, due to a very open canopy, are mostly dominated by native brush, particularly dense thickets of cascara and vine maple, along with salmonberry and elderberry. Himalayan blackberry is rife throughout these units, occurring both along the edges of the units, in discrete dense clumps, and in throughout many places in the understory. Oregon ash and black cottonwood occur in the zone along the western edge of the wetland at the base of the hill. There is a very small component of conifers in this unit, including lone young Douglas-fir, western red cedar and western hemlock, as well as an occasional grand fir regenerating in the understory of the limited patches of alder.

Forested buffer along western edge of wetland with mixed hardwoods and gaps supporting blackberry.

View upstream from road crossing over seasonal stream in north end of property. Open canopy, Himalayan blackberry, sparse hardwoods.

Management Recommendations

This FMU is also in dire need of extensive restoration if it is to provide optimal protections for the streams and wetlands on the property. Restoration will be similar to FMU 7, and will primarily involve the removal of Himalayan blackberry, cutting back the dense thickets of native shrubs, and replanting to mixed conifers. Given that this unit will not be managed for timber production, it should be planted at a modest density that minimizes post-planting maintenance. Any dense thickets of alder should be pre-commercially thinned to promote better timber quality, and the coppice maple should either be thinned to a single high-quality stem, or cut back entirely. The long-term goal for this unit is to restore it to a mixed conifer/hardwood stand that provides shade, bank stability and optimal wildlife habitat.

1. 2019 – 2024: Site preparation and replanting
   This site should be prepared for replanting by mechanically cutting back all Himalayan blackberry and the majority of the native shrubs, pre-commercially thinning the alder to 13’ – 18’ spacing and cutting back big leaf maple coppice to single stems. Immediately prior to planting, the soil should be scarified of all vegetation within a 2’ radius of the planting spot. The unit should be replanted to a mix of Douglas-fir, western red cedar and western hemlock at 240 TPA. No conifer seedling should be planted within 12’ – 15’ of an existing hardwood. Cedar should be caged in order to prevent deer browse.
2. 2019 – 2029: Monitor planted and naturally regenerating seedlings
   Over the next 10 years both manually planted and naturally regenerating trees should be monitored for vigor, browse and density. Competing vegetation should be cut back from around each for a few years, or until the seedling reaches a free-to-grow height of at least two feet above surrounding vegetation. Tree cages should be monitored annually and straightened and/or lifted to protect the terminal leader of the seedling.
3. 2029 – Ongoing: Monitor
   Once conifers have reached a free-to-grow height of at least 2’ above surrounding vegetation, the unit can be left to naturally develop under normal disturbance regimes. No further management should be necessary other than periodically removing invasive species that colonize edges or seed in to the understory.

Wetland

Total acres	Age	Dominant spp.	Trees per acre	Average DBH	Avg. height	Avg. crown ratio
14	NA	Spirea Willow	<20	NA	20’	NA

Wetland in valley at base of hill with reed canary grass in foreground and dense native shrubs beyond.

Dense native shrubs, dominated by spirea, willow and red osier dogwood, at southern edge of unit.

This property includes approximately 20 acres of land at the bottom of the valley, of which 14 acres are comprised of a dense jungle of native shrubs and low trees common to wetland soils. These species include spirea, willow, red osier dogwood, cottonwood, Oregon ash and red alder. Shrubs dominate the wetland, and trees only occur very sparsely, and in discrete locations vs. ubiquitously across the site. Patches of reed canary grass occur in places along the eastern edge of the wetland, adjacent to O’Connor Road, but appear to be gradually succeeding to native shrubs. During winter months the wetland is entirely saturated and surface water is common. However, during summer months the site drains rapidly and no surface water is evident. Although the WA DNR water type map indicates a Type F (fish-bearing) stream flowing from north to south through the middle of this wetland, there is in fact no defined channel, and any seasonal water appears to saturate throughout the site as hyporheic flow during summer months and broadly across the surface during winter months.

Management Recommendations

Given the sensitive nature of this site, little to no management is recommended. Although it is likely that the historic condition of this site was as a cedar, hemlock and hardwood dominated forested wetland with a defined stream channel, active restoration to this historic condition would require significant effort. Native hardwood trees are gradually finding their way back in

amongst the dense shrubs, and over time it is possible that this wetland will gradually succeed towards conditions that support conifers once again.

Field

Total acres	Age	Dominant spp.	Trees per acre	Average DBH	Avg. height	Avg. crown ratio
6	NA	Reed canary grass	0	NA	NA	NA

At the southern end of the aforementioned wetland is a 6-acre field comprised entirely of reed canary grass. Interviews with neighbors indicate that this field was historically mowed for hay, but it appears to have been several years since this last occurred. There is some evidence that vehicles (e.g. logging equipment) may have traversed this field in the past as well, likely during the driest parts of the year, as a forest road terminates at the base of the hill along the western edge of the field. The field is saturated during winter months, making even passage by foot difficult to impossible. Himalayan blackberry occurs along the road margins at the eastern edge of the field.

Management Recommendations

For the foreseeable future this field will be left unmanaged and in its current condition. Restoration of the site to native trees and shrubs will be considered, but is not an immediate priority. Consultation with the Thurston Conservation District on restoration options is recommended.

RESOURCE CATEGORY V: PROPERTY ACCESS/ ROADS AND TRAILS

Primary access to this property is from O'Connor Road, a paved county-maintained road that runs along the eastern side of the valley. From O'Connor Road a gravel road extends southwest across the valley before curling south and entering the property through the northern property line. This road crosses the adjacent property to the north, and permanent use has been secured via a legal easement. However, this easement restricts access to forest management activities only. Midway across the valley, the road crosses a narrow channel of water via a heavy wooden bridge.

Easement road heading west across wetland.

1Heavy wooden bridge over channel of water midway across valley.

Nearly all portions of this property, with the exception of the wetlands, are accessible by an extensive network of roads that were originally carved into the clay/loam soils to provide access for timber harvesting over the past several decades. The majority of the roads are unsurfaced, with the exception of short stretches at the entrance to the property, and the steeper grade along the western edge of FMU 3, which had a light layer of crushed basalt applied during the most recent timber harvest approximately 3 years ago.

Forest access road looking north towards entrance to property. Seasonal stream is to right.

The condition of the road surfaces across the property varies considerably. Grasses have colonized most of the surface of the main access road, and both native shrubs and Himalayan blackberry are aggressively encroaching on the road from the margins. Blackberry is most prolific within 25' on either side of most forest roads, including roads that run through hardwood dominated stands. Blackberry

can also be found beneath the alder that has colonized the former roads through the dense Douglas-fir stand in FMU 1 owing to the porous canopy of the hardwoods. The blackberry likely migrated into the forest on logging equipment during the recent timber harvest, as well as through birds.

During summer months the main entrance road is passable by two-wheel drive vehicles from the entrance all the way to the northern edge of FMU 1. However, during winter months the clay surface of this road becomes slick where gravel is missing or inadequate, and therefore is only passable by four-wheel drive vehicles. Nearly all steep grades show signs of rutting and erosion, with the worst conditions occurring on the steep grade leading south down along the western edge of FMU 3.

Forest access road up northern slope with light gravel surfacing, erosion and grasses on surface.

Where forest access roads enter the forested areas of this property they have become severely overgrown with dense shrubs and red alder after nearly 20 years of no use. Although the current owners have begun to reopen this road network, many segments continue to be inaccessible due to overgrown vegetation. Further, the road segment through FMU 5 is nearly impassable as it was severely damaged during the process of clearing this unit for Xmas trees approximately five years ago. A former road along the base of FMU 3 was actively decommissioned following the logging of this unit, as required by the WA DNR in order to prevent impacts to the adjacent wetland.

Steep road to southern portion of property. Surface heavily rutted and eroded, colonized by grasses.

There are currently two active stream crossings associated with this property. The first occurs on the easement road on the northern adjacent property and is comprised of a wooden bridge that crosses an open channel of water flowing through the wetland. The second is an

16" corrugated plastic culvert beneath northern access road.

18” corrugated plastic culvert beneath the main entrance road where it crosses the seasonal stream in the northern end of the property. Other than a short outfall drop, this culvert appears to be clear of debris and functioning as designed. A third stream crossing was abandoned following the previous logging three years ago. This crossing occurs shortly after entering the property from the north where the road makes a 90 degree turn to the east, crosses the seasonal stream, then continues around the base of the hill. A temporary culvert was likely installed at this crossing, with the approaches graveled. The culvert was then pulled, and the stream channel restored.

The forest access road through FMU 1 midway across the eastern slope crosses three seasonal streams in four places. No culverts exist at any of these crossings. The road crosses the first two northernmost streams immediately uphill from where their channels first begin. Seasonal water draining across these road crossings is actively eroding the surface of the road. The third stream crossing appears to have been used only during the dry season, as the road leads down into the broad channel, then back up the other side before continuing towards the southern property line. The fourth stream crossing occurs where the road curves downslope, then back north before crossing the second seasonal stream again near the base of the hill. The stream has created a narrow, incised channel that may have been filled when the road was last used, then eroded through the fill during subsequent years to reestablish the channel.

Management recommendations

A well-constructed and maintained forest access road and trail system is critical to the efficient management of forests and effective response of public services in an emergency. Most forests already have at least a rudimentary road and trail system that was constructed during the initial timber harvests. This network should be evaluated for seasonal use, and maintained as appropriate for this use. If year-round use is desired, surfacing (e.g. gravel) may be necessary on soft soils.

1. 2019 – 2024: Locate and reopen forest access roads that are overgrown
   Over time all forest road sections through the forested areas of this property should be reopened by cutting back brush and removing alder that has become established on the road bed. Temporary access can be restored by simply cutting back brush and thinning the alder to a degree sufficient to allow four-wheel drive vehicles, then the remaining alder removed during the next commercial harvest. The access road across FMU 5 can either be proactively graded to restore passage, or wait to be graded smooth until the next logging cycle between 2024 – 2029.
2. 2019 – 2024: Cut back Himalayan blackberry along road margins
   Blackberry within 25’ of either side of roads should be mechanically cut back and sprayed as appropriate if impacts to hardwoods can be minimized.

3. 2019 – 2024: Install culverts at seasonal stream crossings
   Prior to commencing commercial logging, culverts should be installed at each of the four seasonal stream crossings across the eastern slopes of FMU 1. 18" corrugated plastic culverts should be installed at each location in order to adequately pass storm water and protect the surface of the road.
4. 2019 – 2024: Grade steep sections of forest access roads and install proper drainage structures
   All steep road sections should be regraded to fix surface erosion, then water bars installed at most 100' apart to direct storm water off road surface and prevent future erosion.

<u>Other management recommendations</u>

1. Annually mow or brush-out forest roads and trails to keep clear of encroaching vegetation.
2. Avoid logging or other heavy equipment on roads during the wet season to avoid damage to road surface.
3. Reseed all forest roads, skid trails and log landings following timber harvest.

RESOURCE CATEGORY VI: WILDLIFE

Overview

Thurston County has a wide variety of habitats for fish and wildlife. These habitats support many interesting and valuable species. They range from saltwater tidelands and shorelines on Puget Sound to the forest plant communities in the Black Hills and the foothills of the Cascade Mountains. Elevation of these areas ranges from 0 to 2,984 feet. Most of the land is privately owned, but there are large parcels of state, federal, and industrial forest property.

Habitat is the arrangement of three essential ingredients: food, cover, and water-required to meet the biological needs of one or more species. Generally, for mammals and birds the critical limiting factor is the availability of their preferred food. Shelter or escape cover is of secondary importance. For salmon and other aquatic species, the most severe limiting factors generally are the sedimentation caused by erosion, the blocking of stream passage by debris, and various forms of water pollution.

Most of the county is woodland. The principal conifer species are Douglas fir and western hemlock. Conifer species of lesser extent are western red cedar and grand fir. The principal deciduous species are red alder and big leaf maple. Deciduous species of limited extent are black cottonwood. Oregon white oak, bitter cherry, and Pacific madrone. These wooded areas have a diverse understory of salal, cascade Oregon grape, huckleberry, and other species. Wildlife attracted to these areas include raccoon, black-tailed deer, woodpeckers, owls, and songbirds.

Appropriate woodland management practices can greatly enhance wildlife abundance. Small-scale clearcutting creates a diversity of successional stages in the vegetation and provides food adjacent to cover. Leaving strips of undisturbed vegetation along stream corridors helps to protect spawning gravel and other aquatic habitats from smothering sedimentation; provides shade, which helps to maintain a cold water temperature; and provides food and cover for terrestrial species. Standing snags provide sites for cavity nesting birds and provide food for other animals. The needs of fish and wildlife should be considered when logging roads and skid trails are constructed. Seeding burns, roads, skid trails, and other disturbed areas to grasses and legumes helps to stabilize soils, provides food, and reduces water pollution. Logging practices that help to keep debris from blocking streams and reduce the risk of erosion should be used.

Current habitat

This property hosts a wide breadth of habitat types that make it suitable for many different species of wildlife. The shrub dominated wetland in the valley provides shelter and forage for a diverse bird population, as well as habitat for aquatic and semi-aquatic species, in particular amphibians. The seasonal streams that reach south and west up into the slopes of this property

also support amphibians and provide a seasonal water source to birds and foraging animals. Both the young and dense, and maturing and sparser alder and maple stands on the slopes, with their attendant diverse shrub layer, also provide forage and nesting opportunities for many bird species, as well as browse for ungulates. The ~20 acres of young plantations provide early seral habitat with abundant mast producing shrubs and low trees, as well as browse. The dense, young Douglas-fir stands are the most simplified habitats on the property, with a highly suppressed understory, limited tree diversity and single age. However, this type of habitat does provide thermal cover for nesting and bedding animals, and the dense canopy provides shelter for both birds and small mammals. A few acres of mature mixed conifer/hardwood stands exist on the property, with complex canopies and some level of decay.

The most lacking habitat type on this property, however, is mature forest. There are few trees that exceed 50 – 60 years old, canopies are horizontally simple without multiple layers, and there are very few snags or large downed logs. What dead would does exist in the forest is largely small diameter (<8" DBH).

Forage species that occur across this property include:

type	common name	latin name	exposure	moisture	height (ft)
Tree	**bigleaf maple**	*Acer macrophyllum*	sun - shade	dry - moist	100
Tree	**red alder**	*Alnus rubra*	sun - part shade	dry - wet	120
Tree	**Pacific dogwood**	*Cornus nuttallii*	part shade	dry - moist	60
Tree	**Pacific dogwood**	*Cornus nuttallii*	part shade	dry - moist	60
Tree	**black hawthorn**	*Crataegus douglasii*	sun - part shade	moist - wet	30
Tree	**black cottonwood**	*Populus balsamifera*	sun - part shade	moist - wet	160
Tree	**bitter cherry**	*Prunus emarginata*	sun - part shade	dry - moist	30
Tree	**Douglas-fir**	*Pseudotsuga menziesii*	sun - part shade	dry - moist	250
Tree	**cascara**	*Rhamnus purshiana*	sun - shade	dry - wet	30
Tree	**Pacific willow**	*Salix lasiandra*	sun - part shade	moist - wet	40
Tree	**yew**	*Taxus brevifolia*	part shade - shade	dry - moist	40
Tree	**Western hemlock**	*Tsuga heterophylla*	part shade - shade	moist - wet	225
Shrub	**red-osier dogwood**	*Cornus sericea*	sun - shade	moist - wet	15
Shrub	**beaked hazelnut**	*Corylus cornuta var. californica*	sun - shade	dry - moist	20
Shrub	**salal**	*Gaultheria shallon*	part shade - shade	dry - moist	5
Shrub	**oceanspray**	*Holodiscus discolor*	sun - shade	dry - moist	15

Shrub	**low Oregon grape**	*Mahonia nervosa*	part shade - shade	dry - moist	3
Shrub	**indian plum; osoberry**	*Oemlaria cerasiformis*	part shade - shade	dry - moist	15
Shrub	**devil's club**	*Oplopanax horridus*	sun - shade	moist - wet	9
Shrub	**black gooseberry**	*Ribes lacustre*	sun - shade	moist - wet	5
Shrub	**red-flowering currant**	*Ribes sanguineum*	sun - part shade	dry - moist	6
Shrub	**nootka rose**	*Rosa nutkana*	sun - part shade	moist - wet	10
Shrub	**thimbleberry**	*Rubus parviflorus*	sun - shade	dry - moist	8
Shrub	**salmonberry**	*Rubus spectabilis*	sun - shade	moist - wet	10
Shrub	**red elderberry**	*Sambucus racemosa*	sun - shade	dry - moist	15
Shrub	**spiraea; hardhack**	*Spiraea douglasii*	sun - part shade	moist - wet	12
Shrub	**snowberry**	*Symphoricarpos albus*	sun - shade	dry - moist	5
Shrub	**evergreen huckleberry**	*Vaccinium ovatum*	part shade - shade	dry - moist	6
Shrub	**red huckleberry**	*Vaccinium parvifolium*	part shade - shade	dry - moist	10
Groundcover	**bleeding heart**	*Dicentra formosa*	part shade - shade	dry - moist	1.5
Vine	**blackberry, trailing**	*Rubus ursinus*	sun - shade	dry - moist	0.5

Managing for Wildlife

This forest will be managed to optimize wildlife habitat and plant species diversity. Common management practices will include:

1. Maintaining a broad range of habitat types, from early to late seral,
2. Retaining old growth trees and managing for older forest conditions,
3. Planting and/or conserving a diversity of conifers and hardwoods, including western red cedar, big leaf maple and Madrone,
4. Creating and maintaining horizontal heterogeneity (e.g. both gaps and areas of higher stand density)
5. Conserving and/or recruiting larger diameter snags and downed coarse woody debris,
6. Planting and/or conserving mast (seed, berry and nut) producing species for bird forage,
7. Promoting understory shrub and ground cover diversity by managing canopy density,

Snags and downed logs

Snags and downed logs are two critical habitat components that are commonly missing or in inadequate numbers or sizes in second and third growth forests. West of the Cascade Mountains 39 species of birds and 14 species of mammals depend on tree cavities for their survival. East of the Cascades 39 bird species and 23 mammal species depend on these snags. In total, more than 100 species of birds, mammals, reptiles, and amphibians need snags for

nesting, roosting, shelter, denning, and feeding; nearly 45 species alone forage for food in them. Hollow snags and large knot-holes are used by many species of mammals such as squirrels, marten, porcupine, and raccoons. In winter when snow covers the ground, northern flickers and other common backyard wildlife depend heavily on insects and other foods found in snags. Brown creepers, bats, and other small animals will roost behind loose bark and bark slits for winter warmth and shelter. Hollow snags are very valuable in winter as they are used by many species such as squirrels, raccoons, owls, and bear for denning and roosting.

Snags fall into two primary decay class categories:

a. Hard snags, with the bark is still intact and with firm heart and sapwoods, and
b. Soft snags, which may have some bark remaining but with the wood beginning to soften.

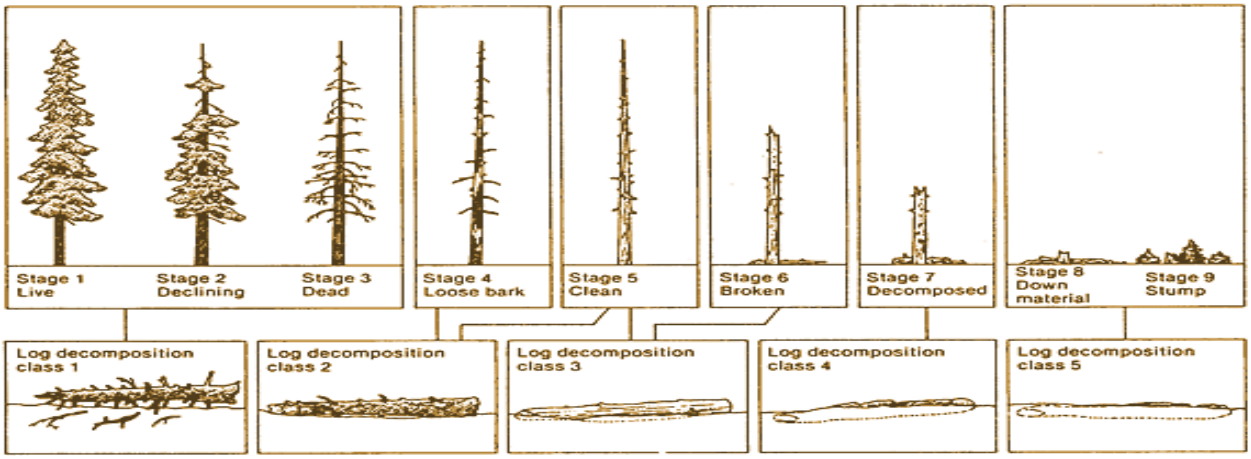
Large snags more than 12 inches in diameter and 15 feet tall offer ideal hunting perches for hawks, eagles, and owls. They function as resting perches for swallows, band-tailed pigeons, mourning doves and other birds; food storage areas for mice, squirrels, woodpeckers, and jays; and song perches for tanagers and flycatchers. Woodpeckers use large dead tree trunks as a way to announce their presence during courtship, hammering their bills against the tree's resonating surface. Small snags may be used as song posts by bluebirds, hummingbirds, and other songbirds to attract mates and proclaim nesting territories. This high use of snags by a myriad of species underscores the importance of preserving snags and including them in your landscape.

Natural recruitment of snags requires forest conditions that allow for a certain percent of trees to grow old and senesce, succumb to diseases or pests, or be subject to natural disturbance events such as wind and ice storms. High quality snags for our region are defined as standing dead conifers larger than 12" DBH and at least 15' high. These types of snags can remain standing for decades. Even more enduring are wildlife trees that contain portions of large diameter dead wood. Old-growth Douglas-firs and cedars (typically with multiple dead tops) are good examples of this. They are rarer but also very important due to their long expected life span.

Downed logs, aka coarse woody debris, fall into five primary categories based on their decay class:

a. Class 1, bark is still intact and heart and sapwood is still firm
b. Class 2, log is in contact with ground; bark is beginning to deteriorate and inner wood is soft.
c. Class 3, log is in contact with ground; bark has completely fallen off and log is beginning to become incorporated into the forest floor
d. Class 4, log is partially buried and wood is very soft

e. Class 5, log is barely distinguishable from surrounding forest floor



Snag and downed log classifications

Coarse woody debris includes fallen trees and large branches as well as logs and large pieces of wood left from logging operations. This habitat component serves many of the same purposes as snags: nesting, denning, roosting, foraging, and hiding cover and shelter from inclement weather. At least as many vertebrate species use coarse woody debris as use snags. Some are the same species, such as black bears using large hollow logs and woodpeckers foraging for insects. Some are seen on the exterior such as ruffed grouse using logs for drumming sites as part of their mating ritual. A lot of small mammals use this habitat type for hiding and food caches. Probably the most unique life form using coarse woody debris is several salamander species. Some may spend just their adult life phase in a rotting log foraging for invertebrates and hiding, whereas a few species may spend their entire life in a single log from egg phase through adulthood. Coarse woody debris is host to a huge number (about 400 known) of insects and an unknown but large number of non-insect invertebrates. These are used as food sources by many of the vertebrate species found on and in coarse woody debris. The ultimate fate of all these species, in conjunction with the decomposing forces of fungi is to break down the woody fiber into organic matter that is utilized by the surrounding growing forest.

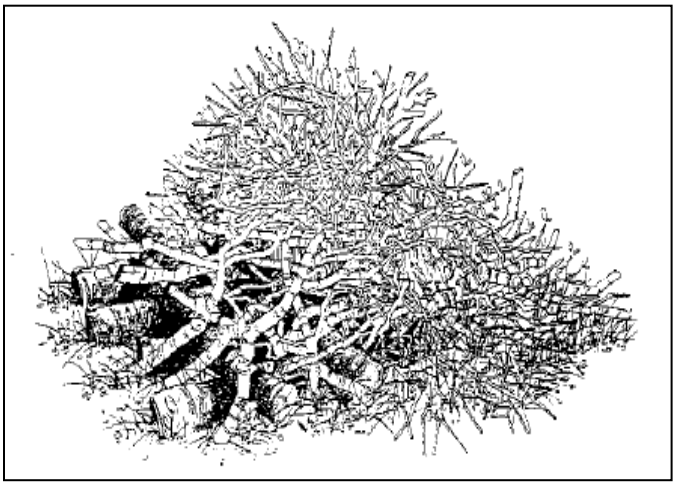
A short and long-term snag and downed log recruitment program will be initiated. Measurements from undisturbed forests indicate that an average of 16 snags/acre and 50-140 downed logs per acre were present in stands containing healthy populations of all snag-dependent wildlife species expected in that area. Short-term snag/log recruitment will be achieved by protecting existing snags and logs during harvest activities at levels as close to the listed targets as possible. Long-term snag/log recruitment will be achieved by retaining defective trees at various stages of deterioration during harvesting activities. Root rot and windthrow will naturally recruit snags and logs, and non-merchantable log sections will be redistributed throughout the forest during harvest activities.

Through conservation and continuing natural recruitment, the forest will be managed for the following minimum targets for snags and downed logs:

Snag	**Minimum Size**	**#/acre**
Hard	20’ tall x 12” DBH	2-5
Soft	20’ tall x 12” DBH	2-5
Downed woody debris	**Minimum size**	**#/acre**
Class 1	20’ x 20” dia.	1-3
Class 2	20’ x 20” dia.	1-3
Class 3	20’ x 20” dia.	1-3
Class 4	20’ x 20” dia.	1-3
Class 5	20’ x 20” dia.	1-3

Wildlife Habitat Piles

In the short term, wildlife habitat piles and constructed downed logs can be created to provide some of the functions of large downed logs. Wildlife habitat piles are typically built from either undesirable or other small diameter trees removed while thinning overstocked stands. Dimensions of the pile should be approximately 10’ across the base by 6’ tall. Larger poles are placed on the ground in 2-3 layers laid perpendicular to each other, then branches and finer slash is laid on top. Constructed logs can be built solely from small diameters poles that are laid parallel to create a log with dimensions at least 20” in diameter and 20’ long.



Wildlife habitat pile

Wildlife habitat logs

Manually placed habitat logs provide an immediate opportunity to create an important forest habitat structure until natural recruitment can sustain a constant influx of dead wood onto the

Wildlife habitat log in foreground with wildlife habitat pile in background.

forest floor. Natural log recruitment from blow down or mortality is the preferred method of maintaining downed wood habitat on the forest floor. The long-term target for habitat logs is a minimum of five logs per acre that are a minimum of 20" in diameter and 20' long. Over time logs will decay, and additional natural or manual recruitment will be necessary to insure continued inputs. Habitat logs can be created in a managed stand by using smaller logs obtained during pre-commercial thinning activities and stacking them parallel to each other. To maximize habitat, logs should be a minimum of 20-foot long with a minimum diameter of 20-inches. Habitat is increased when logs retain some limbs and bark.

Additional Management Recommendations

1. Retain all snags and minimize disturbance of large downed logs during forest management and timber harvesting activities. Over time, manage to retain and/or recruit snags and downed logs to the aforementioned targets. Distribute non-merchantable log sections back out into the woods during logging.
2. Install up to three bird nesting boxes/acre throughout the open areas (FMU's 4 & 5) to provide short term nesting opportunities until larger diameter snags can be recruited into the forest. Consult with WA Dept of Fish & Wildlife, local Conservation District or Audubon Society for native bird species and bird box recommendations.
3. Avoid significant forest management activities during the prime bird nesting season March 15th – June 15th. This time also corresponds with the period of greatest bark vulnerability during the spring as sap begins rising in trees.
4. Landings and skid trails can be broadcast to a browse mix following logging activities to provide forage for deer and elk.
5. Over time, manage forest towards a mixed hardwood and conifer stand with approx. 30% of the stocking being comprised of hardwoods such as red alder, big leaf maple, bitter cherry and cottonwood.
6. Trees with significant defect (forked or broken tops or doglegs below 26', excessive wane, excessive branching, etc.) can be girdled and turned into a short-term snags.

RESOURCE CATEGORY VII: PROTECTION OF SPECIAL RESOURCES

"There are no known threatened or endangered species, cultural, or historical resource protection issues on this property. A formal review, to identify these resources, if any, and their potential protection requirements, will be conducted by the State Department of Natural Resources if and when the landowner proposes to conduct significant forestry activities which require a DNR-approved Forest Practices Application".

APPENDIX I. NRCS RESOURCE CONCERNS

NRCS Biological Technical Note 14 (attached as appendix to plan) was used as an inventory and analysis tool to identify the following resource concerns on this property.

Site Specific Concern	Resource Concern	Addressed with NRCS Practice Code
There are a lack of snags and large downed logs for wildlife habitat.	INADEQUATE HABITAT FOR FISH AND WILDLIFE: Habitat degradation	649
Riparian areas are dominated by brush and limited hardwoods, with very few conifers	INADEQUATE HABITAT FOR FISH AND WILDLIFE: Habitat degradation	490 612
Overstocked hardwood stands are limiting growth and future yield of timber products.	DEGRADED PLANT CONDITION: Inadequate structure and composition	666
Understocked stands limit growth and future yield of timber products.	DEGRADED PLANT CONDITION: Inadequate structure and composition	490 612
Replanted alder stand failed to establish.	DEGRADED PLANT CONDITION: Inadequate structure and composition	490 612
Riparian and wetland buffer zones have inadequate tree stocking, lack conifers and are dominated by brush and invasive species	DEGRADED PLANT CONDITION: Inadequate structure and composition	490 612
Coppicing big leaf maple stumps will inhibit growth of planted Douglas-fir if not treated	DEGRADED PLANT CONDITION: Undesirable plant productivity and health	666
Himalayan blackberry is competing with and overtopping conifer seedlings	Degraded Plant Condition – Undesirable Plant Productivity and Health	666
Himalayan blackberry has colonized understory of hardwood stands, in particular along forest access roads.	Degraded Plant Condition – Plant Pest Pressure or Composition and Structure	666
Seasonal surface water flow is degrading forest roads,	SOIL EROSION: Concentrated flow erosion	560

causing gullies and soil erosion.		

APPENDIX II. MANAGEMENT PLAN IMPLEMENTATION TIMETABLE (30 years)

Year	Management Practice or Activity	FMU	# of acres	NRCS Practice Code	Comments
2019 - 2024	Identify and mark property lines and corners in the field				
2018 - 2024	Reopen remaining forest access roads	All			In order to provide optimal access for forest management, these roads and trails should be reopened by removing non-commercially viable trees and brush. Commercially viable trees can be left in place until the first timber harvest, at which time they can be removed as part of the harvest.
2018 - 2019	Identify, stake and/or cage tree seedlings	4	4.5		Attempts should be made to identify cedar, Douglas-fir and red alder seedlings throughout the unit and, at a minimum, flag the seedlings for future identification. Cedar should be caged to prevent deer browse.
2019 - 2024	Grade roads experiencing erosion and install water bars		1,616’	560	Road surfaces on grades exceeding 20% should be resurfaced by a dozer to eliminate ruts and any damage caused by surface water erosion. Water bars should be installed every 100’ at a minimum in order to direct storm water onto the forest floor.
2019 - 2024	Install 16” culverts where roads cross stream channels	1		560	Three culverts 18” diameter x 16’ long.
2019 - 2024	Cut back Himalayan blackberry within 25’ of either side of forest access roads.	1			Blackberry should be mechanically cut back. Coppicing maple should be reduced to no more than 20 TPA (50’x50’). Thin remaining coppice to single stems.

	Cut back coppicing maple.				
2019 - 2024	Control Himalayan blackberry &	2	11.9		Himalayan blackberry has colonized all forest edges of the hardwood dominated units, as well as the logging roads and margins of the roads that provide access to these units. Before other restoration or forest management activities are pursued, the blackberry should be manually cut back to provide optimal access to the units, and reduce its vigor and potential for spread. Continued annual monitoring and manual control of blackberry will be necessary to ensure it does not continue to compete with native vegetation or naturally regenerating conifers in the understory.
2019 - 2024	Pre-commercially thin	2	11.9	666	Following control of the blackberry, the dense red alder and coppicing big leaf maple should be pre-commercially thinned in order to promote the growth of the most dominant trees. Following the PCT guidelines earlier in this plan, these units should be thinned to 200 – 250 TPA (13' – 15'), retaining the most dominant and highest quality trees. Big leaf maple coppice should be thinned to a single high quality stem (e.g. straight and no branching for at least 24') where possible, or cut back entirely where no high quality stems are present. Retain no more than 20 maple per acre

					(50’ x 50’). Any conifers in the understory should be released by thinning more heavily along their southern side.
2019 - 2024	Build wildlife habitat piles and constructed logs	2, RMZ, WMZ	19.8	649	Build up to 3-5 wildlife habitat piles or constructed downed logs per acre using material generated from pre-commercial thinning and site preparation.
2019 - 2024	Stand release	3	9.5	666	Manually cut back blackberry encroaching from roads and landings in mid-summer, allow to regrow, then spray in late summer. Spray/inject coppicing maple stumps.
2019 - 2024	Seedling release	4	4.5	666	Manually cut back blackberry in mid-summer, allow to regrow, then spray in late summer.
2019 - 2024	Control Himalayan blackberry	5	4.5		Himalayan blackberry should be mechanically cut back in June/July, allowed to regrow, then sprayed in late summer. Care should be taken to minimize inadvertently cutting alder seedlings when mechanically cutting blackberry. Further, care should be taken to not spray hardwoods when blackberry is being sprayed. Follow-up mechanical treatment of blackberry may be required during subsequent years until conifers and hardwoods close canopy.
2019 - 2024	Site preparation and planting	5, 7, RMZ, WMZ	20.4	490 612	Prepare sites for planting by removing invasive species and cutting back competing vegetation. Plant each site as per guidelines for each FMU earlier in this plan.
2019 - 2029	Monitor planted and naturally regenerating seedlings	5, 7, RMZ, WMZ	20.4		Over the next 10 years both manually planted and naturally regenerating trees should be monitored for vigor, browse and

					density. Tree cages should be monitored annually and straightened and/or lifted to protect the terminal leader of the seedling.
2024 - 2029	Commercially thin from below	1	35		Commercially thin from below by removing the most suppressed and defective trees first, then thinning for spacing. Thin across both Douglas-fir and red alder. This may result in removal of up to 50 percent of the trees, in particular in the Douglas-fir dominated areas, depending on stand density. Thin to release any vigorously growing conifers in the understory. Overall stand density will be reduced to 150 – 200 TPA.
2024 - 2029	Underplant hardwood dominated sites on slopes with conifers.	1	~15		Following commercial thinning, underplant alder dominated sites with a modest stocking of western red cedar and Douglas-fir. Plant no more than 100 TPA (20’ x 20’), on a 50/50 ratio, concentrating Douglas-fir in the most open areas. Place tree protectors over seedlings to minimize deer browse.
2024 - 2034	Monitor tree seedlings and natural regeneration	1	~15		For the next 10 years, planted tree seedlings and all naturally regenerating trees should be monitored for health, deer browse, and density. Periodically lift and/or straighten tree protectors in order to protect the leader of each seedlings. Once seedlings reach a minimum of 4’ tall, protectors can be removed. If natural regeneration of either conifers or alder exceeds 350 TPA (11’ x 11’), pre-commercially thin any dense patches to approximately 15’ x 15’ and retain

					the best, most vigorous trees of each species.
2029 - 2034	Commercially thin from below	2	11.9		Once average diameters reach 10" – 12" DBH, the alder across these units can be commercially thinned by removing 30 - 40% of the individual trees. In order to avoid windthrow, the stand should not be thinned more heavily than this. The stand should generally be thinned from below, removing the least dominant and most defective trees first. Further, alder should be removed where it will release vigorous understory conifers. Post-thinning stand density will vary from 120 – 150 TPA.
2029 - 2034	Replant following thinning	2	11.9		Following commercial thinning, any understory conifers damaged during logging should be removed, and the unit underplanted with western red cedar at 100 TPA (20' x 20'). Plant no closer than 15' to existing conifers. Trees should be caged to prevent deer browse.
2029 - 2034	Evaluate for pre-commercial thinning	3, 5, 7	21.2		After this unit closes canopy and live crowns begin to recede to 40%, the unit should be evaluated for pre-commercial thinning. Remove defective trees, then thin for spacing, retaining the most dominant and highest quality trees of each species. Post-thinning stand density should average 250 - 350 TPA.

2029 - 2034	Evaluate stand for pre-commercial thinning	4	4.5		Once canopy closes and competition begins between hardwood and conifers, evaluate unit for pre-commercial thinning. Thin before live crowns recede to less than 40%. Remove any defective trees, then thin to favor the most dominant trees of each species. Total stocking density should be reduced to no more than 350 TPA.
2029 - 2039	Monitor and maintain planted and naturally regenerating trees	2	11.9		Over the next 10 years following commercial thinning, both manually planted and naturally regenerating understory trees should be monitored for vigor, browse and density. Tree cages should be monitored annually and straightened and/or lifted to protect the terminal leader of the seedling. Naturally regenerating cedar or Douglas-fir should be caged when found. If natural hardwood or conifer regeneration leads to densities of understory trees that exceed 12' – 15' spacings (>350 TPA), they should be proactively pre-commercially thinned by removing the least dominant, most defective, or least desirable tree species. Monitor maple regeneration, but thin and manage for timber quality trees.
2034 - 2039	Commercial variable density thin	1	35		After 10 – 15 years of growth, this unit can be commercially thinned again in order to further reduce stocking densities, release vigorous understory trees and generate revenue. No more than 30 percent of the canopy trees should be removed by thinning "across the diameters". Dominant

					trees in the canopy should only be removed if they will release vigorously growing understory trees. The remainder of the stand should be thinned to spread remaining trees out and reduce density. Thin both Douglas-fir and red alder. Overall stocking of the dominant trees should be reduced to approximately 100 – 120 TPA.
2034 - 2039	Evaluate understory trees and replant as necessary	1	35		Following logging, evaluate the stocking and condition of understory trees. Cut out any trees that were damaged by logging. If there are less than an evenly distributed 100 TPA in the understory (20' x 20') throughout both the Douglas-fir and red alder dominated sites, replant with Douglas fir and cedar to achieve that minimum stocking level. Trees may need to be caged to prevent deer browse. Any areas where natural regeneration is leading to high densities amongst seedlings and understory trees should be thinned to 15' x 15'.
2039 - 2044	Commercial variable retention harvest	2	11.9		A second commercial harvest of the alder can be conducted by removing another 30 - 40% of the trees. However, harvesting should occur by creating gaps for replanting, and retaining moderately stocked clumps along road margins and unit boundaries where they are more accessible for final harvest in another 10 years. Thinning should occur more heavily around vigorously growing understory conifers, and residual density of thinned clumps should be approximately 60 – 80 TPA. Following harvest, replant gaps with Douglas-fir at 240 TPA (13' x

					13'), and underplant residual red alder with cedar at an additional 100 TPA (20' x 20'). Cage trees to prevent deer browse.
2039 - 2044	Commercially thin from below	4, 5, 7	21.2		Once average diameters reach 10" – 12" DBH, this unit should be commercially thinned by removing 30 – 40% of the trees. Thin across the species to promote stand diversity, releasing cedar. If pre-harvest stand density was 350 TPA, thin to 180 – 220 TPA.
2044 - 2049	Commercial variable density thin	1	35		Commercially thin the canopy trees using the variable density thinning guidelines earlier in this plan. Remove no more than 30 percent of the dominant trees, reducing canopy density to 50 – 80 TPA. Thin to release vigorous understory trees. Following logging, cut out any damaged understory trees, replant areas of low density, and/or pre-commercially thin any areas where natural regeneration is leading to excessively high densities of seedlings and understory trees.
2049 - 2054	Final commercial harvest of alder	2	11.9		Remove clumps of red alder, retaining up to 20 TPA as legacy trees. Remove damaged understory trees during thinning, and space remaining understory trees at approximately 13' – 15', retaining the highest quality and most dominant trees of each species.
2049 - 2054	Commercial variable density thin	3, 4, 5, 7	25.7		Commercially thin across the diameters and species by removing 40 - 50% of the existing trees, reducing overall stand density to 120 – 140 TPA. Given the higher cost of cable thinning on this steep

					unit, a higher volume of timber may need to be harvested to improve the economic viability of the project.
2054-2059	Commercial variable retention harvest	1	35		Conduct final harvest across the canopy trees, reducing density to 20 TPA that will be retained indefinitely as long-term legacy trees. Understory trees may be reaching a merchantable age at this time, and can be thinned to optimize spacing and remove defect.

APPENDIX III: TIMBER HARVST REVENUE PROJECTION

Harvest Year	FMU	Acres	Species	Harvest Volume	Gross Value	Net Value
2024-2029	1	35	Douglas-fir Red alder	105 MBF	$68K	$40K
2029 – 2034	2	11.9	Red alder	60 MBF	$44K	$26K
2034 - 2039	1	35	Douglas-fir Red alder	175 MBF	$114K	$68K
2039 - 2044	2, 4, 5, 7	33.1	Douglas-fir Red alder	165 MBF	$107K	$64K
2044 - 2049	1	35	Douglas-fir Red alder	350 MBF	$227K	$136K
2049 – 2054	2, 3, 4, 5, 7	26.6	Douglas-fir Red alder	260 MBF	$169K	$101K
						$335K

APPENDIX IV. FOREST MONITORING PLAN

A basic monitoring program will document the following forest management attributes:

1. Yield of all forest products harvested.
2. Growth rates, regeneration and condition of the forest.
3. Composition and observed changes in the flora and fauna.
4. Environmental impacts of harvesting and other operations.
5. Costs, productivity, and efficiency of forest management.

Additional qualitative forest monitoring will be conducted during regular walks through the forest. Field notes will be collected and periodically added as an appendix to this management plan. The following attributes will be monitored, at a minimum, via observations:

1. Forest roads and trails (e.g. erosion, invasive species, etc.)
2. Growth of newly planted seedlings
3. Presence of invasive species, in particular along forest access and haul roads and along margins of forest.
4. Wildlife presence and impacts to flora
5. Snag and downed log recruitment

Monitoring record

Date	Observation	Note taker

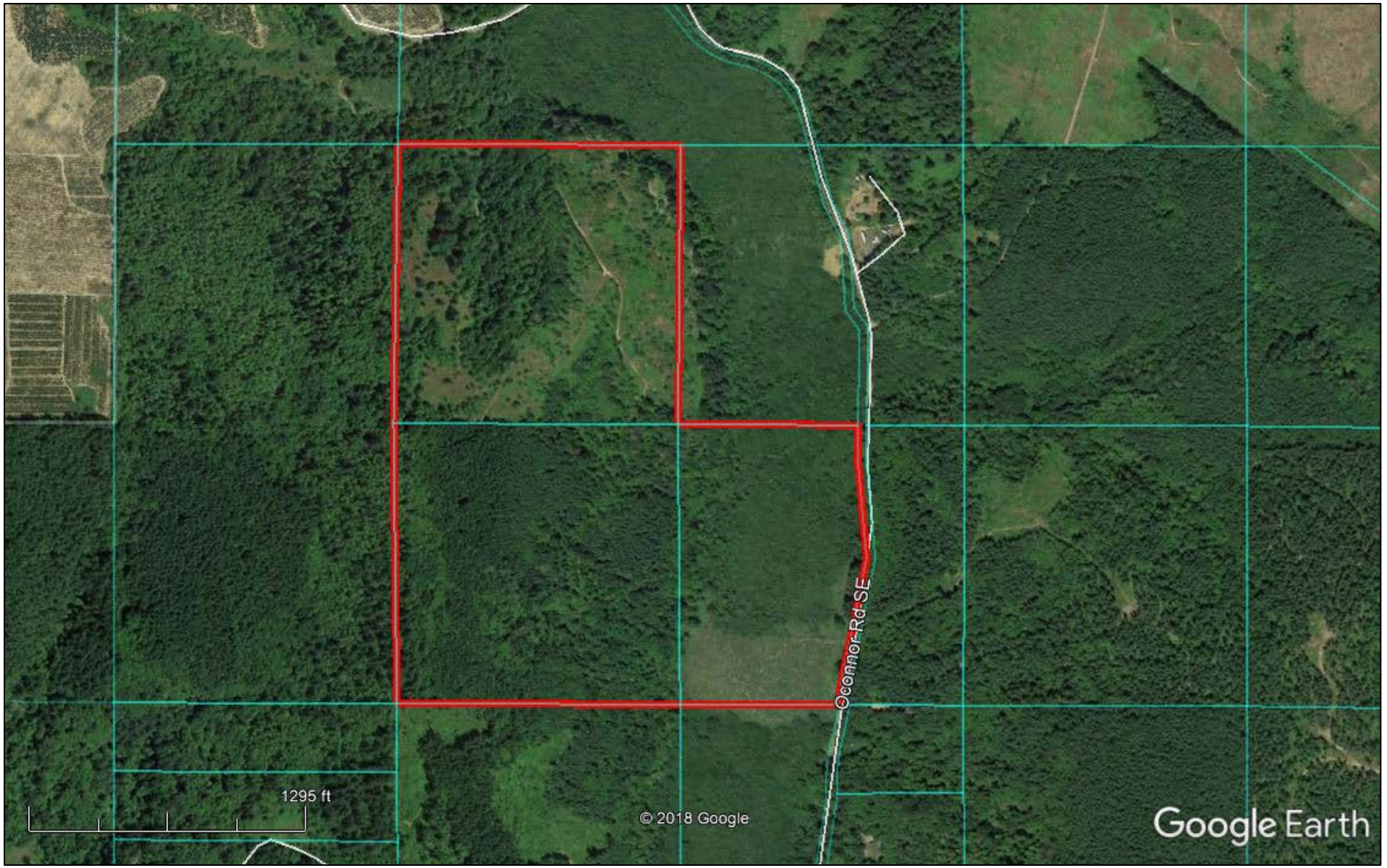
Road Monitoring

The overall goal of monitoring roads is to detect any road deterioration, maintenance needs, or negative environmental impacts so any issues can be addressed before they become significant problems. Per the FSC-US Forest Management Standard, Indicator 8.2.d.2: Landowners need to have a forest road monitoring program in place to assess the condition and environmental impacts. As such, NNRG's FSC-certified members will annually monitor their forest's road system.

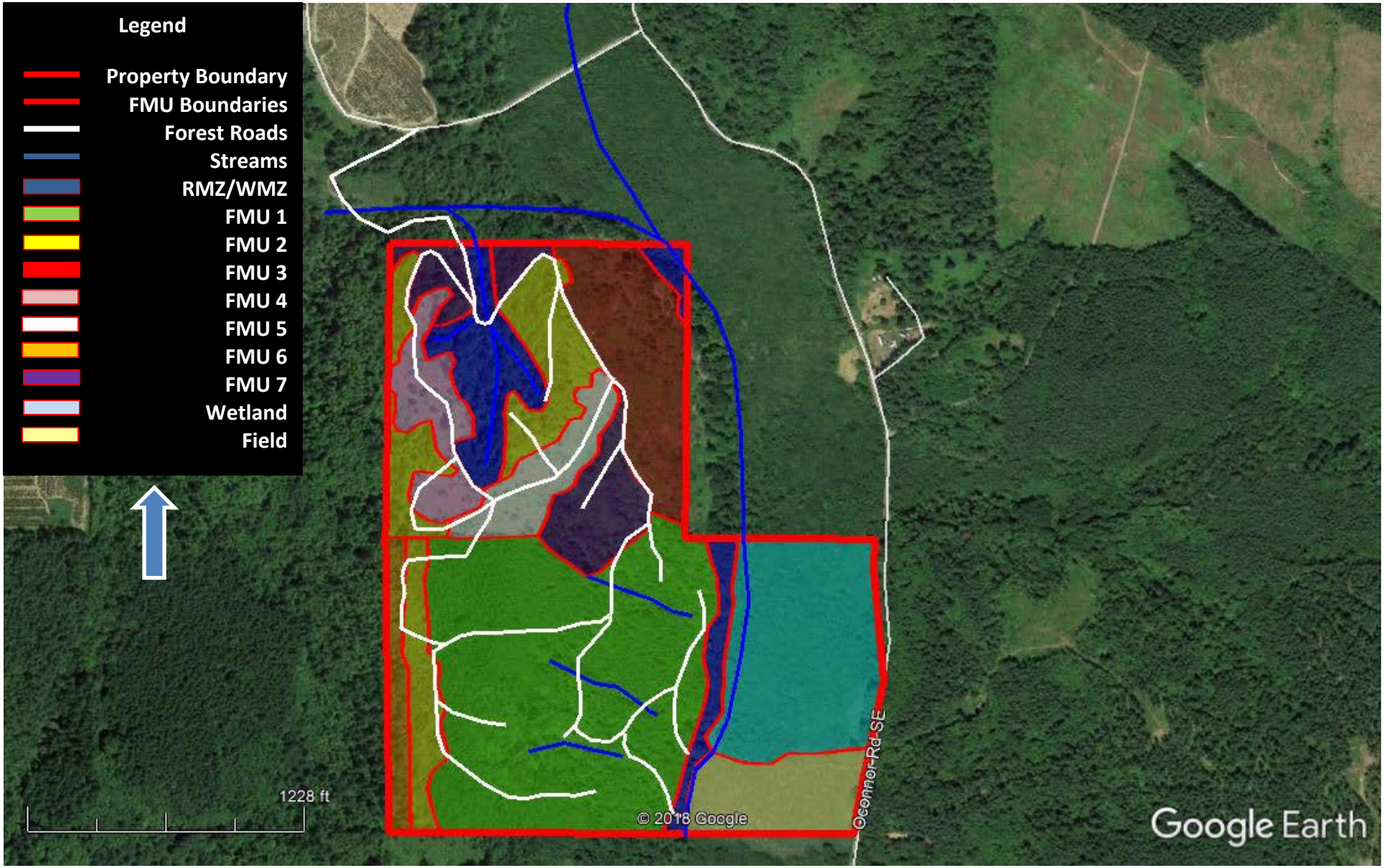
Location: (FMU, road segment, etc.)	Date	Inventoried Structure (Culvert, Drainage, Road Surface)	Water from the road or ditch runs directly into typed water. (Y/N)	Water flows under, over, or around the culvert. (Y/N)	Culvert keeps filling with dirt. (Y/N)	Road has large cracks. (Y/N)	Road has undrivable sinkholes. (Y/N)	Scheduled for maintenance or repair. (Y/N)	Dirt from the uphill side of the road keeps falling into the ditch-line before regularly scheduled maintenance. (Y/N)	Dirt from the cut-slope keeps falling downhill into or near a stream, pond, or wetland. (Y/N)	The road crosses typed water (a culvert, bridge or ford exists). (Y/N)	Orphaned Roads (Y/N)	Additional Notes

APPENDIX V. AERIAL PHOTO(S)/PROPERTY MAP(S)

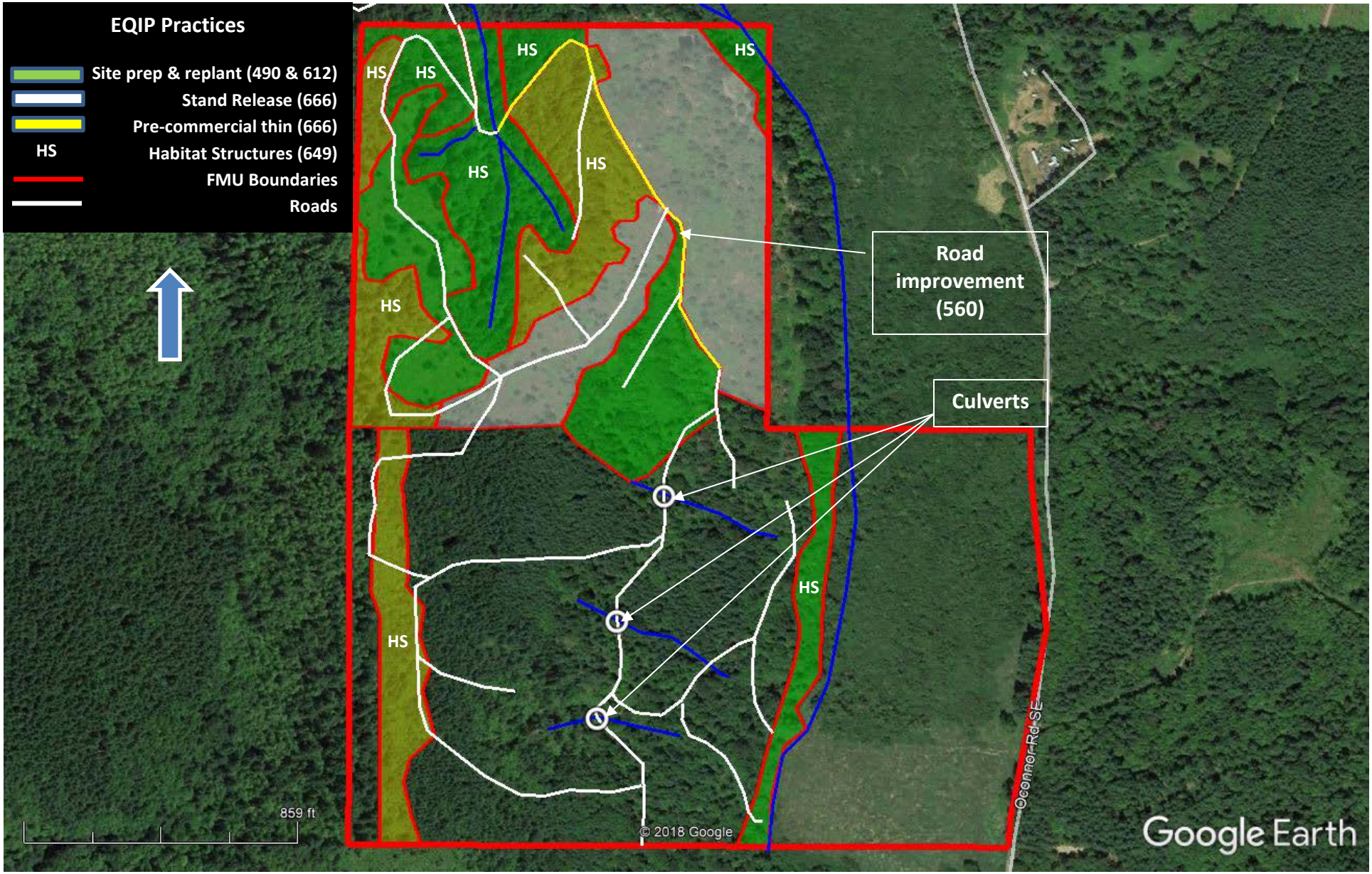
Aerial & Parcel Photo



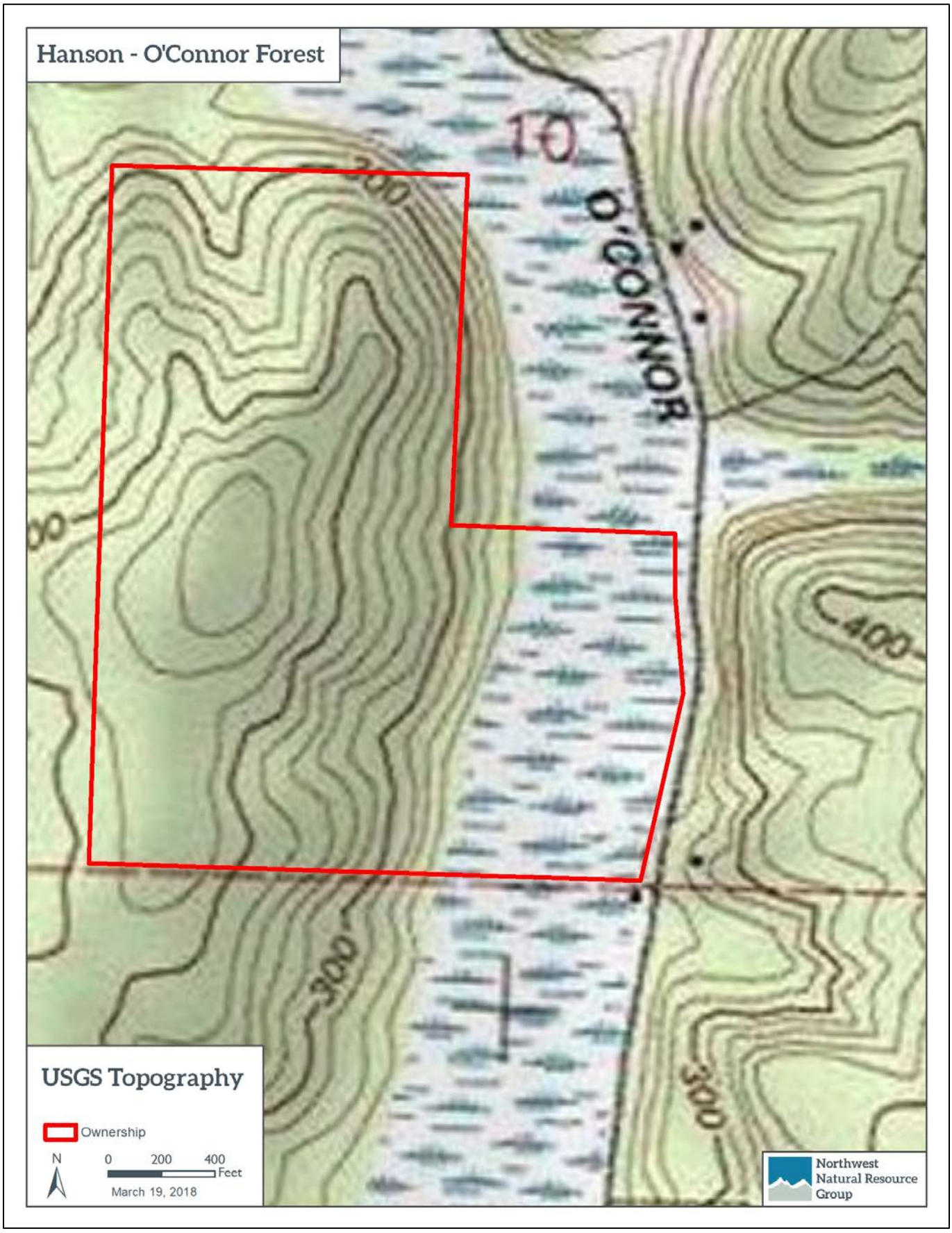
Forest Management Unit Map



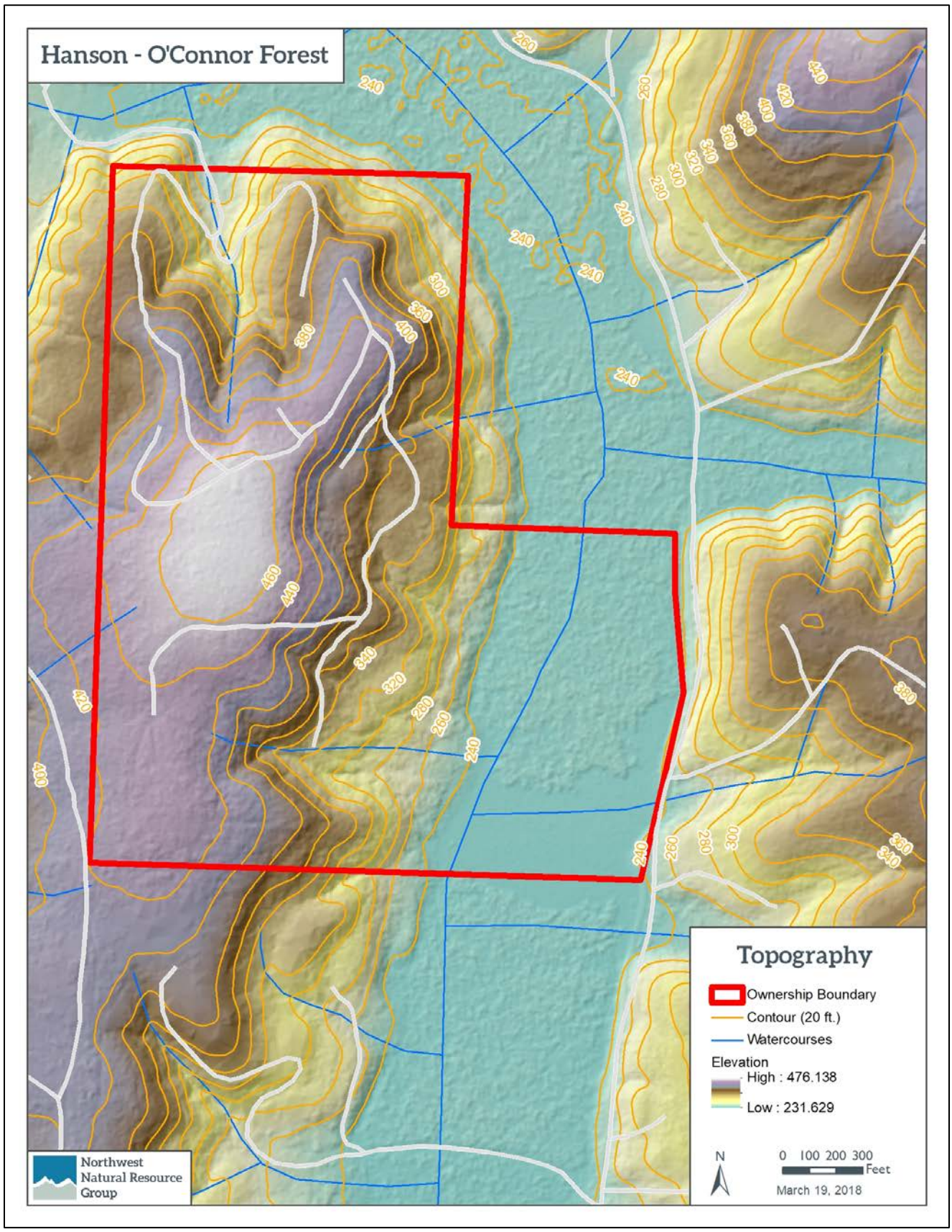
EQIP Practice Map



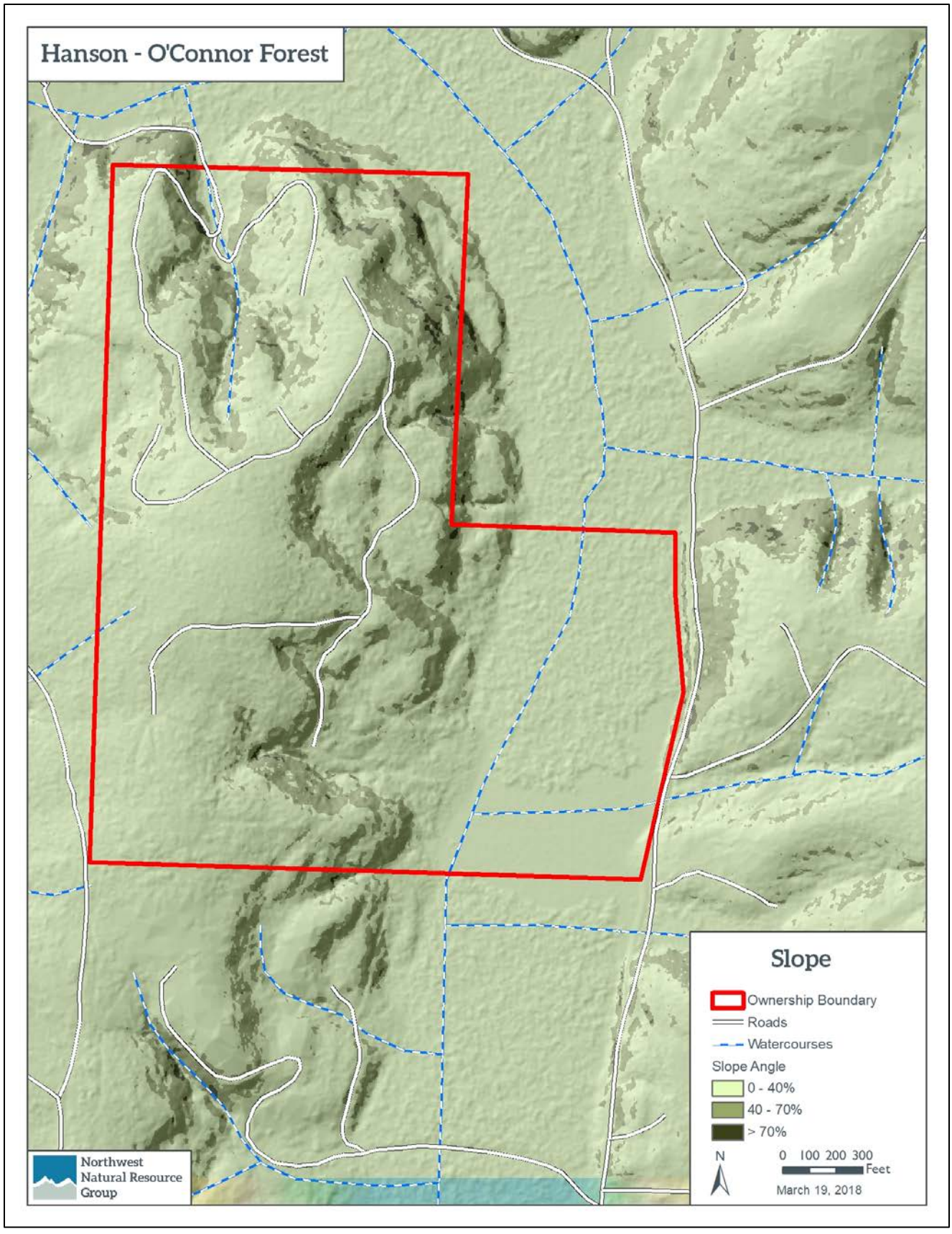
USGS Topo Map



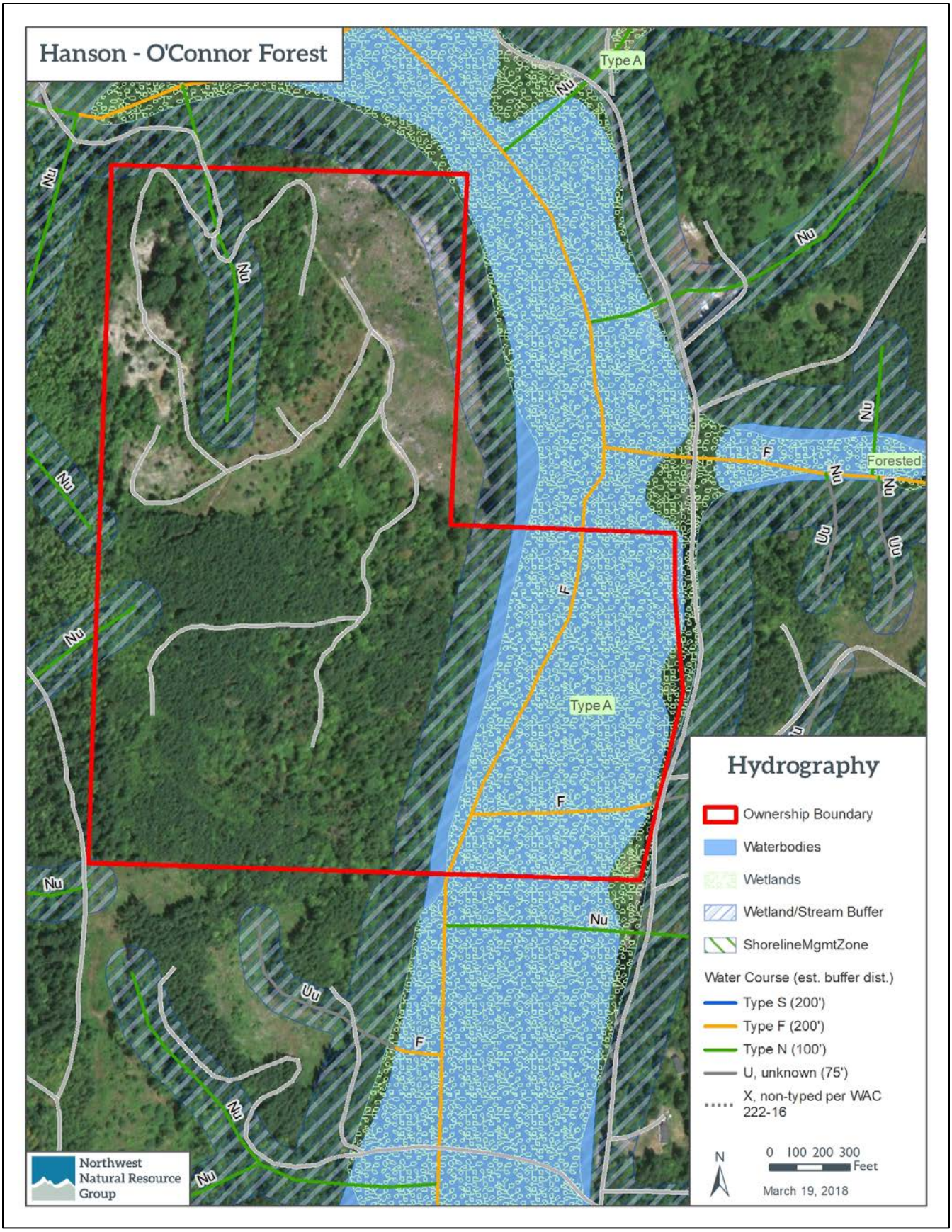
LIDAR Topography Map



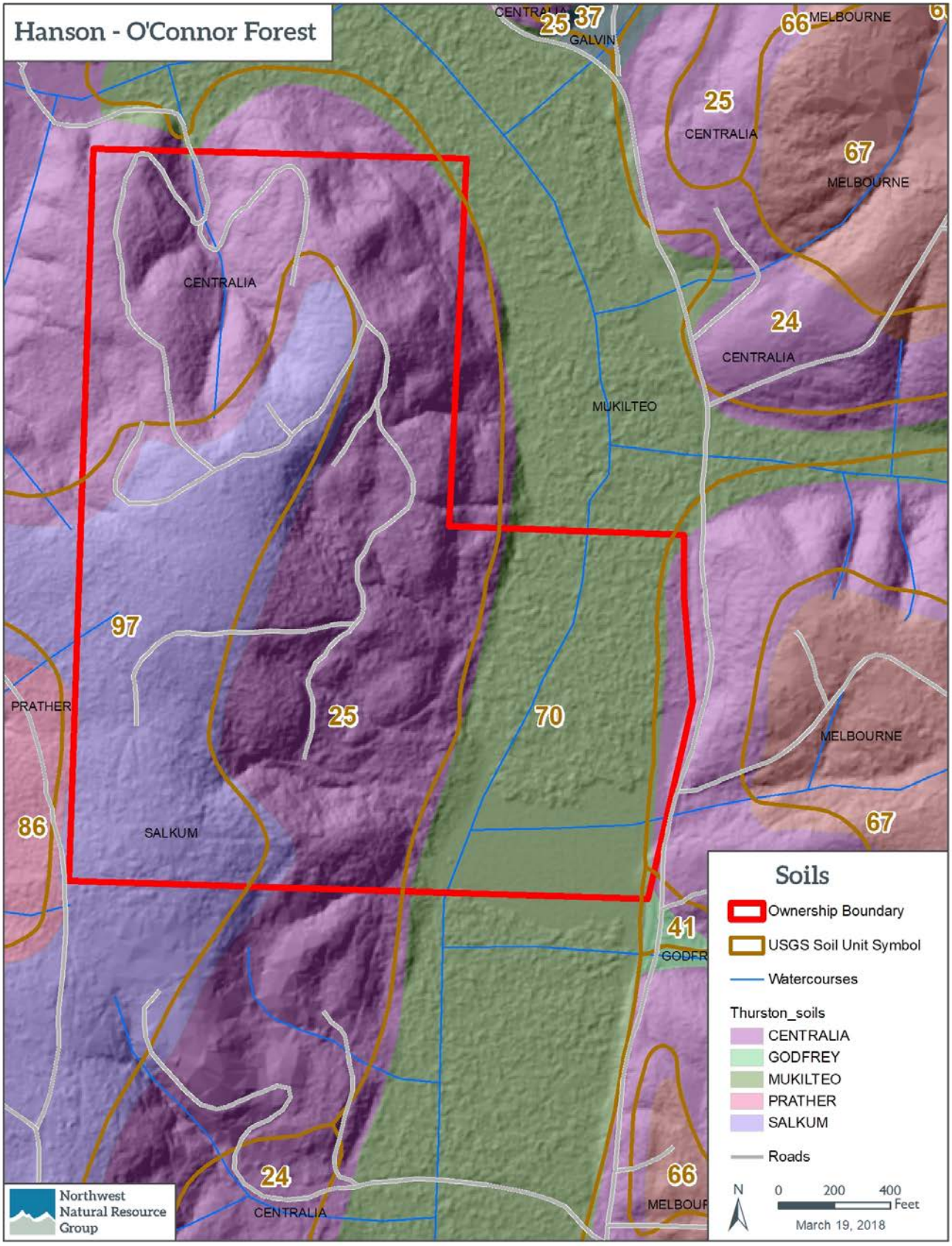
Slope Map


Hanson - O'Connor Forest
Slope
Ownership Boundary
Roads
Watercourses
Slope Angle
0 - 40%
40 - 70%
> 70%
N
0 100 200 300
Feet
March 19, 2018
Northwest
Natural Resource
Group

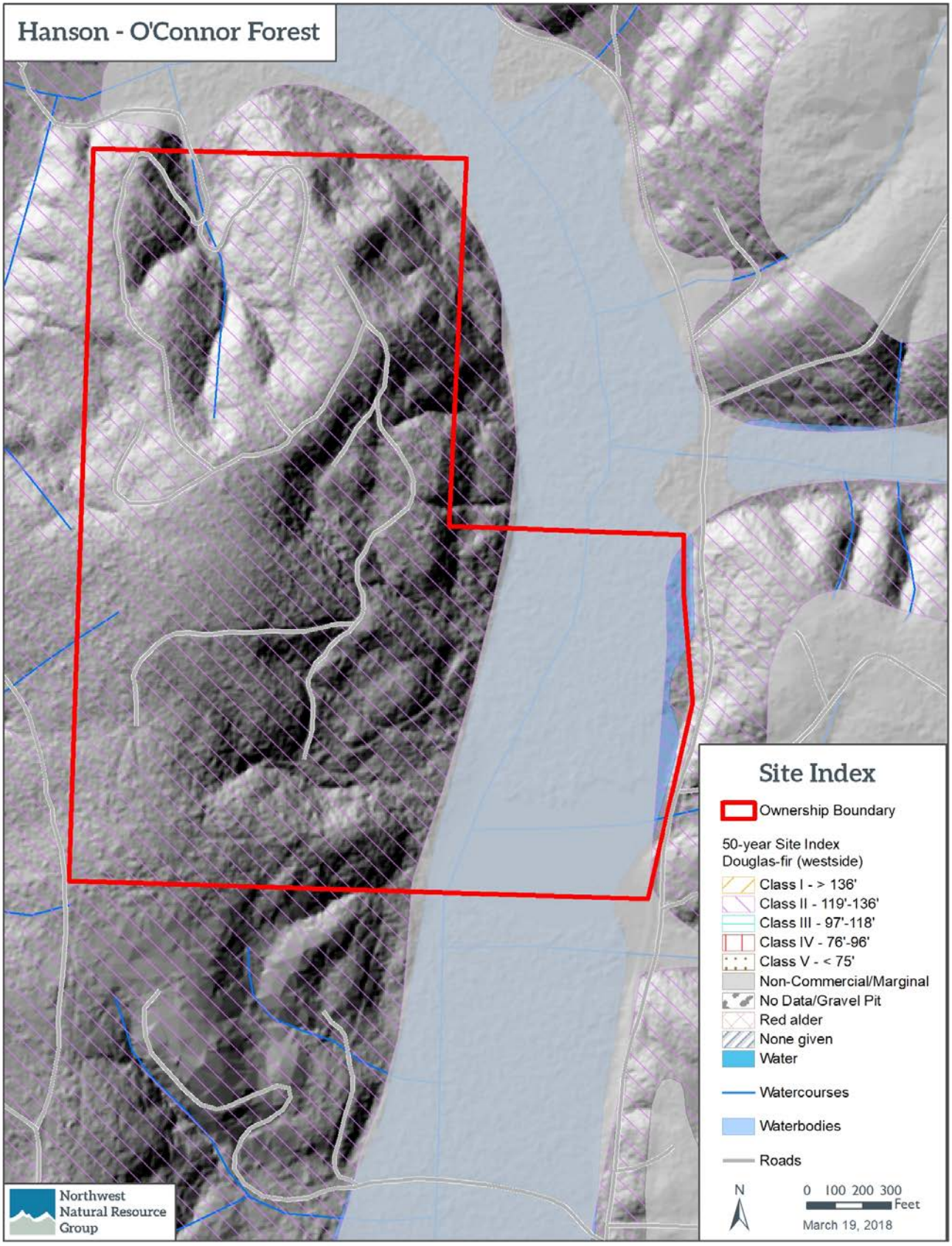
Hydrography Map



Soils Map

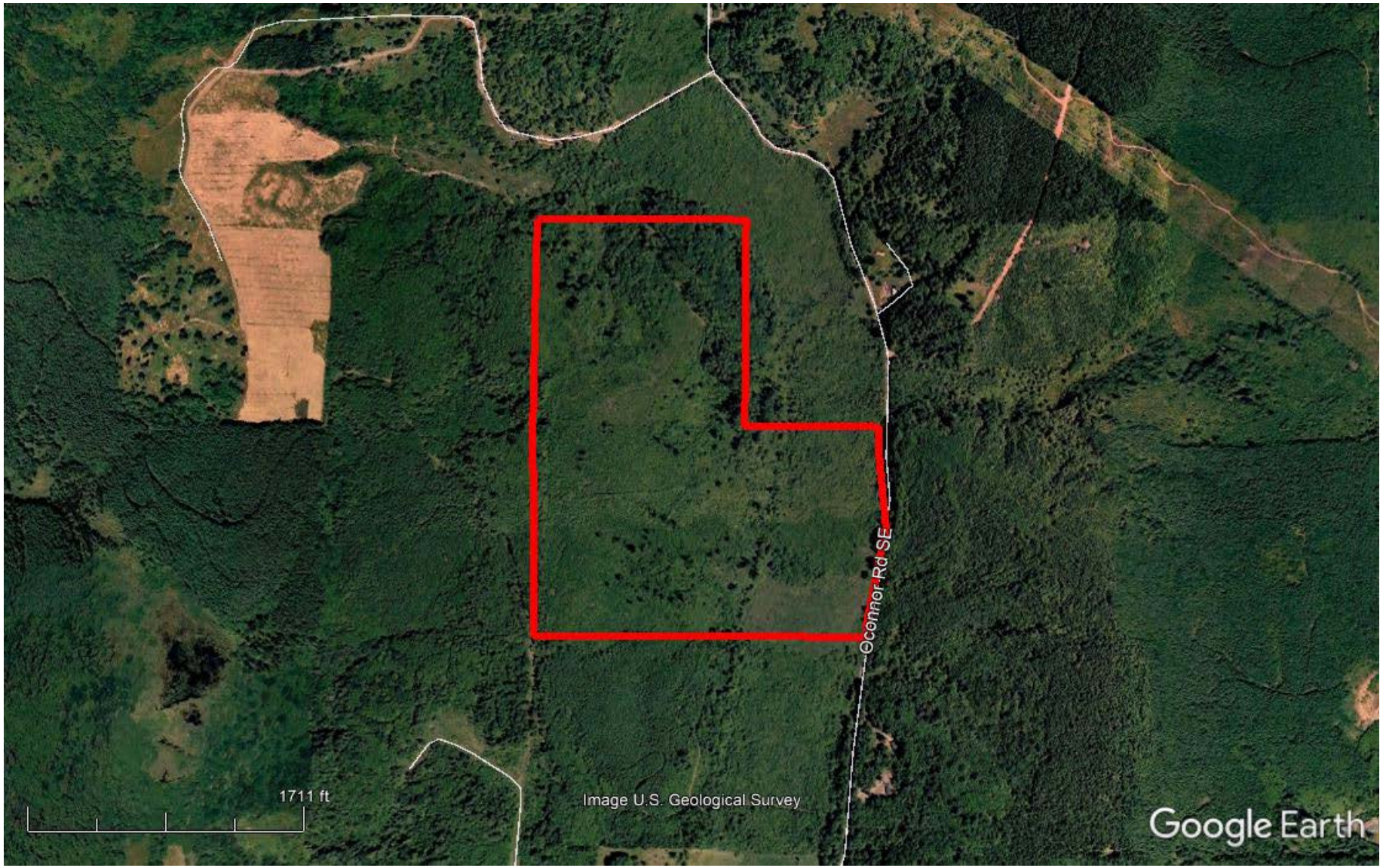

Hanson - O'Connor Forest
CENTRALIA
25
37
GALVIN
66
MELBOURNE
25
CENTRALIA
67
MELBOURNE
CENTRALIA
24
CENTRALIA
MUKILTEO
97
PRATHER
25
70
MELBOURNE
86
SALKUM
67
41
24
CENTRALIA
66
Northwest Natural Resource Group
Soils
Ownership Boundary
USGS Soil Unit Symbol
Watercourses
Thurston_soils
CENTRALIA
GODFREY
MUKILTEO
PRATHER
SALKUM
Roads
N
0
200
400
Feet
March 19, 2018

Soil Site Index Map



1990 Aerial Photo

2003 Aerial Photo



2014 Aerial Photo

PLAN APPROVAL SIGNATURES

DNR FOREST STEWARDSHIP PLAN APPROVAL (IF APPLICABLE)

This plan meets the requirements for a Forest Stewardship Plan.

_____WA State Department of Natural Resources Authorized Representative Date

Print Name:

Affiliation:

Address:

Phone :

E-mail:

USDA-NRCS CONSERVATION ACTIVITY PLAN APPROVAL (IF APPLICABLE)

This plan meets the requirements for a USDA-NRCS Conservation Activity Plan.

_____

Signature of USDA-NRCS Authorized Representative Date

Print Name:

Title:

Affiliation:

Address:

Phone:

E-mail:

CERTIFICATION MANAGEMENT PLAN APPROVAL (IF APPLICABLE)

This plan meets the requirements for XXX CERTIFICATION PROGRAM.

_____

Signature of XXX CERTIFICATION Program Authorized Representative Date

Print Name:

Title:

Affiliation:

Address:

Phone:

E-mail:

CURRENT USE TIMBER MANAGEMENT PLAN APPROVAL (IF APPLICABLE)

This plan meets the requirements for a Timber Management Plan for current use property tax programs.

_____

Signature of Authorized County Government Representative Date

Print Name:

Title:

Affiliation:

Address:

Phone:

E-mail: