Kachess Ridge Management Association

Easton, WA

August 2016

Landowner:
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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.

Kachess Ridge Management Association Forest Management Plan

Lodge Creek, Kachess Lake - Upper Yakima Watershed

# of acres plan covers:	223
County and state:	Kittitas County, WA
Forest certification number:	
USDA Farm & Tract #:	
Date plan prepared:	August 2016
Plan Preparers	
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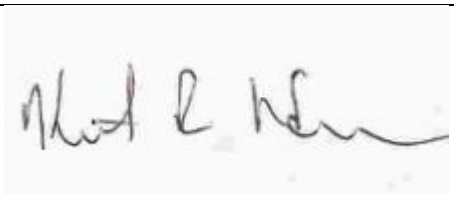
Signatures	
Date: 8/16/2016	Date:
 Kirk Hanson Northwest Certified Forestry	Forest Owner

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

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Date:

Natural Resource Conservation Service

TABLE OF CONTENTS

BACKGROUND AND SITE INFORMATION:

Physical location:
4731 Kachess Lake Road, Easton, WA 98925

Legal Description:
All the real property, and each lot, within the plat of Kachess Ridge, as recorded in Volume 7 of Plats at pages 21-26, Records of Kittitas County, Washington; together with that portion of Government lot 1 described as Parcels 1, 2, 3 and 4 of that certain Survey recoded on May 13, 1991 in Book 17 of Surveys, page 105, under Auditor's File No. 539270, of Kittitas County, being a portion of the Northeast ¼ of Section 7, Township 21 North, Range 13 East, W.M., in the County of Kittitas, State of Washington.

Nearest City or Town:
Easton, WA

Parcel Number:
Kittitas County parcel numbers: 016635, 026635, 256635

Property Size
223 acres of community property within a 579-acre private residential community
256635 – 82.4 acres
026635 – 138.09 acres
016635 – 2.5 acres

Date of Land Acquisition
1977

Watershed
Lodge Creek, Kachess Lake in the Upper Yakima Basin

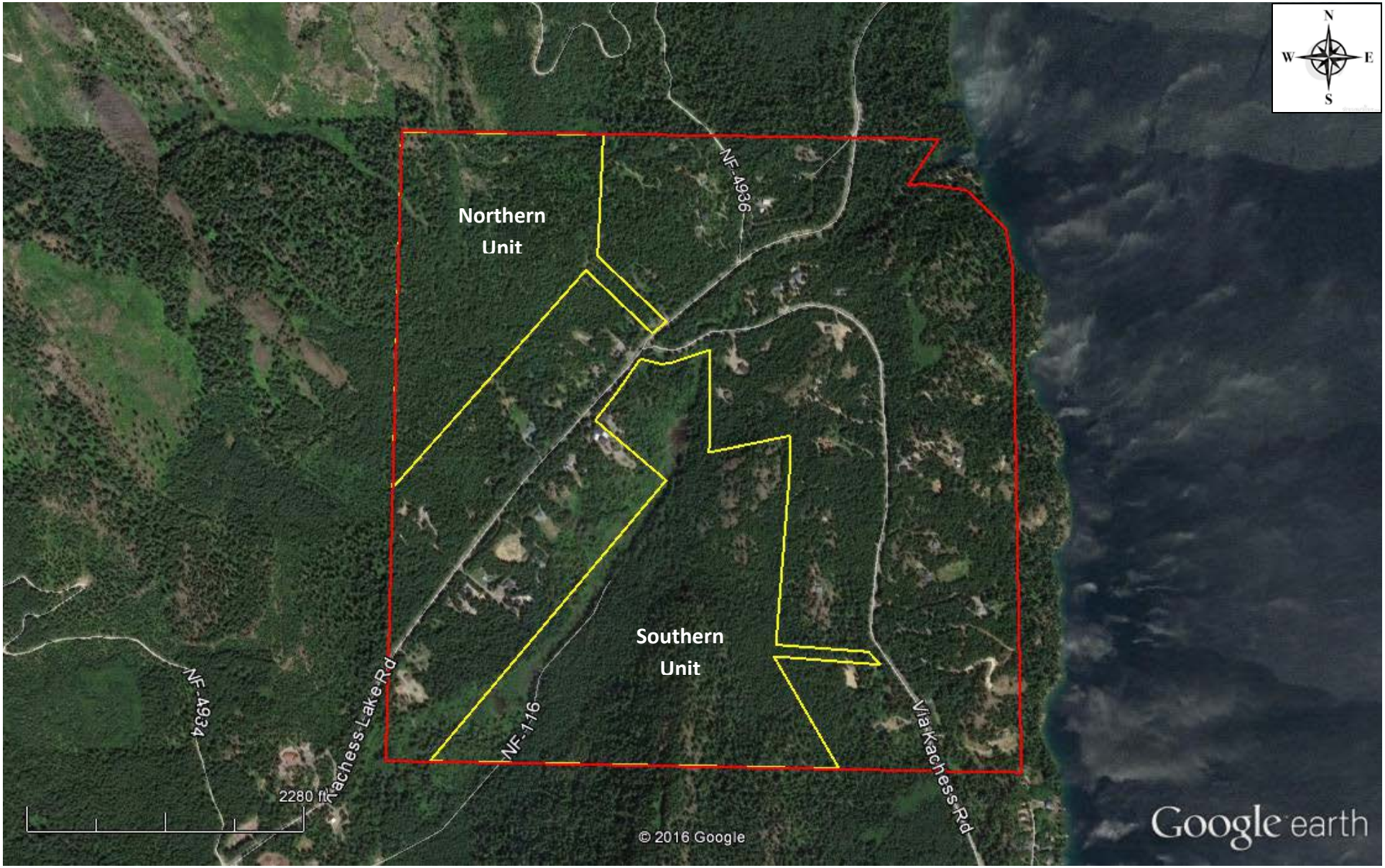
Tax Designation
The Kittitas County Assessor currently classifies parcels 016635, 026635, and 256635 to land use code 96 – "not presently assigned". Parcel 016635 is within the Forest and Range Zone and has a land use of Rural Working. Parcel 026635 is within the Rural 5 Zone, and has a land use of Rural Residential. Parcel 256635 is within the Commercial Forest, Rural 5, and Forest and Range Zones and has a land use of Commercial Forest and allowed use of Rural Working.

The purpose and intent of the Rural-5 Zone (Kittitas County Code (KCC) Chapter 17.30A) is to provide areas where residential development may occur on a low density basis. A primary goal and intent in siting R-5 zones will be to minimize adverse effects on adjacent natural resource lands.

The purpose and intent of the Forest and Range Zone (KCC Chapter 17.56) is to provide for areas of Kittitas County wherein natural resource management is the highest priority and where the subdivision and development of lands for uses and activities incompatible with resource management are discouraged.

The purpose and intent of the Commercial Forest Zone (KCC Chapter 17.57) is to provide for areas of Kittitas County wherein natural resource management is the highest priority and where the subdivision and development of lands for uses and activities incompatible with resource management are discouraged consistent with the commercial forest classification policies of the comprehensive plan. The commercial forest classification applies to lands which have long-term commercial significance for the commercial production of timber, and which have been designated as commercial forest in the comprehensive plan. Nothing in this chapter shall be construed in a manner inconsistent with the Washington State Forest Practices Act. Nothing in this chapter shall be construed in a manner to prohibit uses permitted prior to the effective date of this chapter.

Property Map



LANDOWNERS OBJECTIVES

Short term

1. Reduce fir risk across forest, in particular near residences and public areas.
2. Commercially thin to reduce tree stocking densities, improve species composition and generate revenue.
3. Reopen overgrown and neglected forest roads and skid trails, and construct new roads, as necessary, to improve access across property.
4. Mitigate mistletoe populations by removing infected trees.
5. Create downed logs and snags to improve wildlife habitat.
6. Develop annual firewood program for residences and neighbors.
7. Improve wildlife habitat by retaining snags, constructing wildlife logs and thinning forest to improve understory diversity

Long term

1. Preserve and protect the forest, wetlands, and riparian areas
2. Provide and enhance wildlife habitat for small animals, birds, and deer
3. Provide an attractive and natural environment for family residences on private lots
4. Develop trails and other recreation improvements for the benefit of the community
5. Reduce wildfire risk by actively applying Firewise practices
6. Implement state-of-the-art and cost effective forest management practices.
7. Conduct periodic selective timber harvests, consistent with wildlife, soil, water, wetland, and riparian resource values

INTRODUCTORY OVERVIEW OF THE PROPERTY

Overview

The property consists of 579 acres of private forest surrounded by National Forest adjacent to Lake Kachess and located three miles north of I-90 on the west side of the lake. There are 223 acres of community property known as tracts A, B, and C, and 356 acres in individual ownership of approximately 66 members. The property includes portions of Lodge Creek, riparian areas, and some steep, rocky slopes most of which are in various stages of regrowth from previous clear-cut timber harvesting practices.

Past Management History

Site evidence and aerial photography indicate the ownership remained old-growth forest until the property and adjacent lands were mostly clearcut from the 1930's through the 1960's. At that time replanting was not required by law, so the land gradually naturally regenerated to a mix of conifer species. The current forest is therefore comprised of a mix of tree ages that span 45 – 65+ years of age.

Photo courtesy of Central Washington University, "Sunset Highway" 1928. Frederick Krueger Photographs. Paper 695. Motoring along highway in 1928. The highway has seen some improvements since first crossing Snoqualmie Pass in 1915, later named US Route 10.

The checkerboard ownership of the Central Washington Cascades, with its square mile sections of forest interspersed between U.S. Forest Service lands and other public lands, is a legacy of the 1864 Northern Pacific Land Grant. That year, Congress authorized legislation to build the Northern Pacific Railway from Lake Superior to Puget Sound. Instead of direct public funding for the railroad, the land grant was intended to underwrite the expenses of the rail line. For every mile of completed track, Northern Pacific received every other square mile section in a corridor 40 miles on either side of the track (25,600 acres of land per mile of track). The land grant transferred 40 million acres in a checkerboard swath from St. Paul to Seattle-2 percent of the landmass of the contiguous United States.

While much of its eastern holdings were sold to fund the railroad, Northern Pacific recognized the value of the Cascades forests and kept much of the timberland on the western end of the land grant. The 1865 Charter of the Northern Pacific Railroad Company described the land and its value: *"These magnificent fir forests, adjacent to the Northern Pacific Railroad, are not only the wonder of travelers, but, what is more the present point, they constitute an element of vast wealth to the Company, and hence of security to its creditors."*

In the late 1870s Northern Pacific began harvesting timber on its lands, including Central Cascades Forest, to supply lumber for extensive railway infrastructure and commodities to

further expand and build the rail line. Logging camps were established along Keechelus, Kachess, and Cle Elum lakes and sawmills soon followed. Much of the early timber logged in Kittitas County was cut into railroad ties, as well as to build mills to manufacture ties, supply lumber for coal mine shaft construction, to build housing for workers, and sold as raw material for commodities for the growing settlements in the surrounding area.[1]

Current Management Practices

Since the KRMA was incorporated in 1977, there have been no significant forest management activities. The forest, and forest access roads, have solely been used for recreational purposes, such as hiking, off road vehicle use, and horse-back riding.

[1] As acknowledged in Mason and Lippke (2009), the railroads were significant consumers of wood products for fuel, car construction, and ties. Track required 2,640 ties per mile and, because of decay; these ties had to be replaced every six to seven years (Olson 1971). Just replacing rotten railroad ties on a sustained basis required a national equivalent harvest of between 15 and 20 million acres of forest land per year in 1900 (MacCleery 1992). Railroads at one time consumed almost one fourth of the nation's annual lumber production.

Region

The Central Cascades region

The Kachess Ridge Management Association (KRMA) forest is located in Washinton State's Central Cascade Mountains. The property is flanked by Wenatchee National Forest to the north, east, south and west. Kachess Lake is to the east, Amabalis Mountain is to the south, and Keechelus Ridge is to the northwest. The Nature Conservancy of Washington owns a section kitty-corner to KRMA on Keechelus Ridge. The KRMA property ranges in elevation from 2,300 feet of elevation near the shores of Kachess Lake and rises up to 3,300 feet along the north ridge of Amabilis Mountain. The area exemplifies a mid-elevation montane forest ecosystem.

Interstate 90 spans the Cascade Mountains through this area and provides year-round access to the region. With extensive public lands, glacially-formed lakes, rugged mountains and parklands the area is a recreation destination for Puget Sound and Yakima Basin residents interested in many passive and motorized recreational activities.

Vegetation zone & forest processes

Vegetative cover is influenced primarily by soils, moisture, and temperature, all of which vary with topography. The Keechelus Ridge and Kachess Ridge area is just east of the Cascade Crest along the lower boundary of the North Cascades province – a region of rugged topography and glacially influenced landscapes. The forest is situated in the North Cascades province and straddles the *Abies amabilis* (Pacific silver fir) and *Tsuga heterophylla* (western hemlock) climate vegetation zones (Franklin and Dyrness 1973).

The Pacific silver fir zone lies between the temperate mesophytic zone of the western hemlock and the subalpine mountain hemlock zone. It occurs between 2,000-4,200 feet (600-1,300 meters) in northern Washington. The Pacific silver fir zone is wetter and cooler than the western hemlock zone and receives more precipitation in the form of snow. Tree species typically include Pacific silver fir, western hemlock, noble fir, Douglas-fir, western redcedar, and western white pine. The understory is dominated by *Vaccinium* (huckleberries)*, Menziesia* (fool's huckleberry)*, Cornus canadensis* (bunchberry)*, Clintonia uniflora* (queen's cup)*, Rubus lasiococcus* (dwarf bramble)*, Rubus pedatus* (strawberryleaf raspberry or five-leaved bramble)*, Linnaea borealis* (twinflower), *Xerophyllum tenax* (bear grass)*,* and *Viola sempervirens* (evergreen violet).

The western hemlock zone is the most extensive vegetation zone in western Washington and Oregon. The zone ranges from sea level and rises up to about 3,000 feet. Major tree species include western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseuduotsuga menziesii*), western redcedar (*Thuja plicata*), grand fir (*Abies grandis*), and Pacific silver fir (*Abies amabilis*). Hardwoods are not common in forests in this zone, unless they occupy recently disturbed sites or specialized habitats such as riparian areas. Dominant tree species are western hemlock, Pacific silver fir, and noble fir, interspersed with Douglas-fir.

Natural history of dominant tree species

Pacific silver fir's scientific name, *Abies amabilis*, means lovely or beautiful fir and the species is considered to be one the most handsome of its kind. Pacific silver fir is a monoecious, long-lived, native conifer. At maturity, it can reach heights of 100 to 230 feet (30-70 m) and diameters of 36 to 44 inches (90-110 cm). The average maximum age for Pacific silver fir is 400 to 500 years on good sites, and 250 to 350 years on more adverse sites. The maximum recorded age is 540 years. As Pacific silver fir becomes older, growth is commonly deformed. The crown is rigid and symmetrical with lateral branches perpendicular to the stem. Young trees have resin-filled blisters protruding from the smooth, thin bark. The bark of older trees is rough textured and flaky. Pacific silver fir reproduces only from seed. Seed production begins at 20 to 30 years of age. Pacific silver fir is an indicator of very moist soils and is very shade tolerant and has low spatial requirements. Pacific silver fir can survive in the shade and emerge in stands that are uneven-aged.

Western hemlock is a large, native, evergreen tree. At maturity it is generally 100 to 150 feet (30-46 m) tall and 2 to 4 feet (0.6-1.2 m) in trunk diameter. On best sites, old-growth trees reach diameters greater than 3.3 feet (1 m); maximum diameter is about 9 feet (3 m). Heights of 160 to 200 feet (49-61 m) are not uncommon; maximum height has been reported as 259 feet (79 m). Western hemlock is shallow rooted and does not develop a taproot. The roots, especially the fine roots, are commonly most abundant near the surface and are easily damaged by harvesting equipment and fire. Maximum ages are typically over 400 years but less than 500 years. The maximum age recorded is in excess of 700 years.

Climate

The vicinity of Keechelus Ridge and Kachess Ridge is just east of the Pacific Crest and with more alpine conditions. The property is within area that exhibits a cool maritime shadow effect; as such, the weather patterns in this part of the Central Cascades are more similar those found on the westside of the mountains. It is typical for westside weather systems to produce storms that roll over Snoqualmie and Stampede Pass and influence the area; thus resulting in the greater overall precipitation that the area receives.

The average maximum monthly temperatures at Stampede Pass range from 29.1 to 65.2° F. The lowest average monthly minimum temperature is 20.0°F and typically occurs in January. In the winter, lows average between 20-24 degrees F, and highs range from 33-45 degrees F. In the summer, lows average 44-50 degrees F and highs range an average 60-78 degrees F. The area receives 100-140 inches per year of precipitation. Snow depth in is greatest January-March with an average of 27-33 inches.

Mountainous areas in the Upper Yakima basin receive most of their precipitation in the form of snow from November to March, and as rain during the rest of the year. Snowpack is generally retained through late spring with isolated areas of perennial snow fields remaining all year in the mountains. Chinook winds (i.e., warm air that descends down the eastern slopes of the Cascades) and rain-on-snow events often cause rapid melting of the snowpack, which can lead to severe soil erosion and stream channel flooding in the valleys.

Rain-on-snow events happen when warm marine air from the south pushes into Washington and Oregon and brings a rapid rise in temperatures and atmospheric rivers with heavy amounts of rain that fall over existing snow. This weather can dramatically reduce the amount of snow that is on the ground and in such a manner that this event can compound the risk of erosion-as well oversaturation of soil-potentially causing rapid soil movement.

The climatic conditions also greatly influence the amount of surface waters that run through the area. Due to the drainage to the lake most of these drainages are somewhat short in nature and therefore do not have the opportunity to be perennial in nature or habitat for migrating fish. Below the road crossing on the north end of the wetland there may be some fish habitat that is used but the rest of the streams seem to be non-fish habitat in nature.

RESOURCE CATEGORY I – FOREST HEALTH/WILDFIRE/INVASIVE SPECIES

Forest health

Laminated root rot

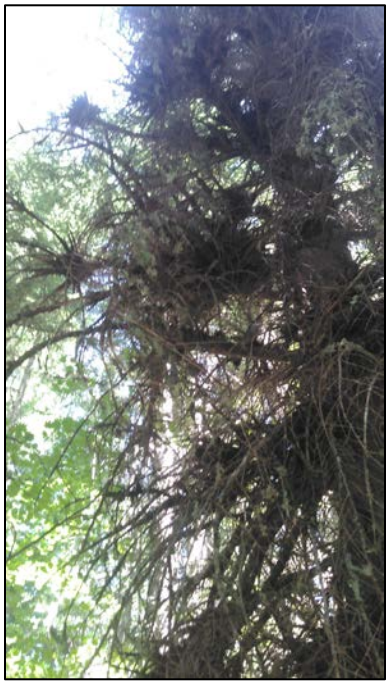
Group of standing dead Douglas fir on SE side of Amabilis Ridge indicative of root rot.

Laminated root rot was observed in various locations across the property. Root rot is a native soil borne fungal disease ubiquitous across northwest forests, in particular in Douglas fir plantations or stands that are dominated by Douglas fir. The fungus primarily attacks Douglas fir, but also can impact western hemlock and grand fir. Indicators of the disease include:

- Groups of dead trees,
- Individual trees setting large numbers of cones,
- Trees with sparse and yellowish needles, and
- Boles of trees that are weeping significant amounts of pitch.

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.

Mistletoe



Mistletoe "brooms" on western hemlock SE of Amabilis Ridge.

Dwarf mistletoe was observed in western hemlock in various locations across the property, but in particular throughout the east-facing slopes of the southern unit. Dwarf mistletoe can be very damaging to trees, causing growth loss, wood quality reduction and tree killing. Dwarf mistletoe is a plant, but is entirely dependent on its host tree. Death of the tree also means death of the mistletoe, so mistletoes tend to coexist with their hosts. Dwarf mistletoes are fairly host specific; there is limited crossover from one species of tree to another. Seeds are sticky and are forcibly shot from shoots growing on swellings. These seeds may travel up to 100 feet depending on the species and wind. When they land on the proper host, they sprout in the spring and penetrate the thin bark, forming a new infection. Spread is fastest in multi-storied stands that are somewhat open; in single-story stands the spread averages 1-2 feet per

year. Birds may be responsible for long-distance spread by carrying seeds stuck to their feet or feathers. Trunk infections cause swelling and cracking that permits rot fungi to be introduced into the heartwood. Trees that are less than 3 feet in height or 10 years in age generally escape infection.

Management Recommendations

1. Root rot

   Containment and eradication of 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 or western red cedar. In natural, mixed species forests, the effects of 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. On smaller parcels, large patch cuts may not be desirable. Therefore, if evidence of root rot is found, efforts should be made to heavily thin infected trees around the site and quickly replant the area 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. Alternately, root rot can be accepted for its inherent ecological function as an agent of stand diversification – creating opportunities for enhanced wildlife structure and introduction of more diverse tree and shrub species. Snags created by the disease can be retained for their wildlife value.

Abbreviated roots of Douglas fir indicative of root rot in Northern unit.

2. Mistletoe

   With middle-aged stands, efforts are usually directed towards reducing infection levels and halting spread. When the stand has reached harvest age, the objective is to eliminate mistletoe and thus prevent the subsequent crop from becoming infected. When evaluating the condition of the stand, determine two things: whether the stand is made up of more or less than 50% of the host species, and whether more or less than 50% of the trees of the host species are infected. As the infection may be clumped inside a stand, sometimes it is easier to subdivide the stand and deal with small areas separately.

- Light sanitize: This is a good option if the stand is made up of less than 50% of the host species, and less than half of the host species is infected. Remove the diseased individuals to halt the spread. This can be done by combining sanitizing with a commercial thinning or selective harvesting operation. It may be necessary to return a couple of years later to remove trees that were not noticeably infected until thinning allowed more light into the stand and stimulated shoot growth.
- Heavy sanitize: If the stand is made up of more than 50% of the host species, and less than half of the host species are infected, a thinning/sanitation cut of diseased individuals would be appropriate in a well-stocked or overstocked stand. In an understocked stand it may be better to wait until a commercial harvest may be made, especially if the stand is nearing rotation age.

Invasive species

Remarkably, no non-native invasive species were observed within the forested portions of this property.

Wildfire

Although this area is located on the eastside of the Cascade Range, the frequency and intensity of natural fire disturbance events does not fall into the category of traditional fire frequencies that would normally be found in most of the Eastern Washington forest types. This is due to the maritime effect that drifts over the Cascades, and the higher amount of precipitation that normally falls in the area.

All forest ecosystems in the Pacific Northwest have a historical range of fire frequency associated with them. This can range from as frequent as 7-15 years for the dry forest types across much of eastern Washington and Oregon, to as long as 300-500 year stand replacing fires that occurred in some of the wetter forest types on the west side of the Cascades. The natural fire return interval for this area likely falls within a 25-50 year cycle, which means that some of the area did experience some replacement level of intensity thereby providing for a mosaic of diversity over time and space.

Historically low intensity fires were fairly frequent, and started either by lightning strike or in some cases intentionally set by Native Americans to manipulate understory habitat to improve forage conditions. These fires typically were confined to slow moving ground-based fires that cleared understory brush and fine woody debris, but left larger, more fire resistant trees relatively unscathed. Over time this resulted in forests that had a lower stocking density of dominant trees that were arranged in an open-savannah composition.

Presently, with modern day aggressive fire suppression practices, many forests are now highly overstocked and contain both ladder fuels, in the form of branches that reach the ground and standing dead trees, and increasing amounts of dead wood on the forest floor. Therefore, both the risk of fire and the intensity or destructive potential of fires is rapidly increasing in many unmanaged forests.

Managing hazardous woody fuels along with providing vehicular access to key areas are two of the best ways to help prevent catastrophic wildfire. Not all woody fuels are alike. In a typical Douglas-fir forest, much of what is considered "woody fuel" (essentially all woody biomass above ground) is not hazardous and does not warrant any management action. In general, the types of fuel to be concerned with are the following:

- **Fine fuels.** These are grasses, needles, and small twigs up to ¼ inch in diameter; all of which dry out very quickly and burn hot and fast. Fine fuels are most abundant on the edge of clearings and next to buildings.
- **Small diameter branches.** Material larger than fine fuels but less than 3 inches in diameter. This is usually the bulk of logging slash and blow downs. Once it dries out, it can be a major source of fuel in an unwanted wildfire. This is the fuel that, if it has accumulated to high levels, can feed fires enough to initiate the transition from surface fire to partial crown fire—an extremely dangerous situation.
- **Ladder fuels.** Ladder fuels are most commonly small live trees that grow underneath and close to mature trees, creating a continuous vertical arrangement of fuel from the ground into the canopy. Ladder fuels can also include: low sweeping limbs on mature cedars, dead trees, vines, and tall shrubs.

Management recommendations

1. The best tool for reducing fire risk is successive thinning to reduce stand density and favor larger, more fire resistant trees. To minimize the potential for wind throw, it is recommended that no more than 30 - 50 percent of the individual trees be thinned at any one time. Edges of the forest should be thinned more lightly to serve as a buffer to winds entering the stand. Thinnings should be spaced at least five years apart in order to give the residual trees sufficient time to stabilize. Thinning should primarily be from below, selecting the suppressed and intermediate trees first and retaining the more dominant trees with larger diameters and more robust live crowns.
2. To minimize the risk of fire entering the forest from adjacent properties or roads, a 30' – 50' wide fire break should be created along relevant forest edges where understory brush is largely cut back, understory trees are removed, and residual trees are limbed to at least 20'.

3. Material thinned from the forest should be dealt with using any combination of the following methods:
    a. Remove entirely from the site (e.g. commercial firewood),
    b. Lopped and scattered. Resulting slash mat should not exceed 12" thick.
    c. Small diameter poles can be piled parallel to create habitat logs that are a minimum of 20" in diameter and 20' long.
    d. Chipped on site using a mobile chipper or masticating machine, with chips distributed back into the forest to aid in soil development,
    e. Poles and slash can be piled throughout the forest in habitat piles of approximately 10' wide and 6' tall. Piles should be located no closer than 50' apart to minimize potential for ground-based fires, and placed in gaps away from trees where possible.
4. To facilitate the adaptation of the forest to longer, drier summers that are presumed to result from climate change, forest composition may need to be shifted towards more drought tolerant species such as Douglas fir, lodgepole pine, Ponderosa pine and big leaf maple. On the drier sites, such as slopes and ridges, grand fir should be selected for removal over time, or allowed to die and stand in limited numbers as wildlife snags, as it is drought intolerant and already beginning to die in significant numbers.

RESOURCE CATEGORY II – SOILS

See soils maps in Appendix IV.

Geology and Soils

The property is situated just north and east of Stampede Pass in the mountainous region that is part the North Cascades uplift. The North Cascades ecoregion extends from Snoqualmie Pass to the Canadian border. This province is a topographically mature area of great relief. Valleys are uniformly very deep and steep sided. Glaciers scoured these areas and the valley bottoms are filled with debris from terminal moraines that formed Keechelus, Kachess and Cle Elum lakes.

The gradual uplifting of the Cascade Range, intermixed with intrusions of granite, granodiorite, and quarter diorite along with volcanic andesite flows and extensive glaciation have produced a soil pattern across the North Cascades province that is bewildering in complexity. Soils east of the Cascade Crest reflect the drier conditions under which they were formed. Most abundant are Haploxerolls (Chestnut and Brown soils) formed on a variety of parent materials but generally influenced to some extent by volcanic ash and, in some areas, loess. Textures range from stone-free silt loams to very cobbly loams. Other soils present in the eastern portion of the province include Xerochrepts (Regosols) and Haploxeralfs (Noncalic Brown soils).

The soils in this area fall into just a few classifications. While these soils tend to be shallow in their overall nature, due to the amount of moisture and nutrients found within them, they range from the poor to moderate levels of production. There are a few rock outcrops in the area that will limit timber production due to steep slopes and sensitive thin soils. Most of these outcroppings can be found along the northern areas of Amabilis Ridge. Soil productivity is defined by “site class”, which ranges from 1 (most productive) to 5 (least productive). Based on the Site Class Map in Appendix IV, the soils across the forested portions of this property range from 2 – 5, with the most productive soils occurring along the east facing slopes of the norther parcel, and the least productive soils occurring around Amabilis Ridge.

Soil Types

The following chart provides a summary of all of the soil types across the subject property. Only the two most dominant soil types have been described below.

Soil Type/ Map Unit	Slope	Site Class	Site Index (50 year)	Site Productivity
Kachess gravelly ashy sandy loam 254 *~72.2% of forest*	5-25%	II	Douglas-fir: 88 Pacific silver fir: 60 Western hemlock: 65	Douglas-fir: 99.0 cu ft/ac/yr
Thetis ashy sandy loam 255 *~20.6% of forest*	45-65%	V	Douglas-fir: 58 Pacific silver fir: 80 Western hemlock: 92	Douglas-fir: 41.0 cu ft/ac/yr
Gilpar ashy sandy loam 347 *~4.0% of forest*	45-65%	III	Douglas-fir: 67 Pacific silver fir: 86 Western hemlock: 102	Douglas-fir: 56.0 cu ft/ac/yr
Thetis ashy sandy loam 241 *~2.0% of forest*	25-45%	V	Douglas-fir: 58 Pacific silver fir: 80 Western hemlock: 92	Douglas-fir: 41.0 cu ft/ac/yr
Stirrup ashy sandy loam 333 *~1.3% of forest*	30-65%	Non commercial	Douglas-fir: 64 Pacific silver fir: 80 Western hemlock: 85	Douglas-fir: 51.0 cu ft/ac/yr

254—Kachess gravelly ashy sandy loam, 5 to 25 percent slopes

The Kachess series consists of very deep, well drained soils formed in ablation glacial till over glacialfluvial deposits and an admixture of volcanic ash. Kachess soils are on glacial valley floors and toeslopes. Slopes are 5 to 25 percent. The average annual precipitation is about 65 inches and the average annual temperature is about 43 degrees F.

Range in Characteristics: The mean annual soil temperature ranges from 40 to 44 degrees F. The soils are usually moist but are dry in all parts in the moisture control section for 30 to 45 consecutive days during summer and fall. Solum thickness ranges from 26 to 38 inches. The exchange complex is dominated by amorphous material in the particle-size control section. It has an estimated moist bulk density of 0.6 to 1.2 g/cc, volcanic glass content of 30 to 60 percent, acid-oxalate extractable aluminum plus one-half iron of greater than 2.0 percent, and 15-bar moisture retention of 10 to 12 percent. Thickness of the spodic horizon ranges from 1 to 4 inches.

Geographic setting: Kachess soils are on glacial valley floors and toeslopes. Slopes are 5 to 25 percent. They formed in ablation glacial till over glacial-fluvial deposits with an admixture of volcanic ash. Elevations are 2,100 to 3,200 feet. The soils are in a marine influenced climate

with relatively cool dry summers and cool wet winters. The average annual precipitation is 50 to 80 inches. The average January temperature is about 25 degrees F; and the average July temperature is about 61 degrees F. The mean annual temperature is 38 to 43 degrees F. The growing season at 28 degrees F is 130 to 170 days.

Drainage and permeability: Well drained; permeability is moderate in the subsoil and moderately rapid in the substratum.

Use and vegetation: Used for timber production, summer homesites, recreation and wildlife habitat. Native vegetation is Douglas-fir, western hemlock, and Pacific silver fir, with an understory of western bracken fern, huckleberry and boxwood (paxistima, aka *Pachystima myrsinites*).

Typical pedon: Kachess gravelly ashy sandy loam under a coniferous forest on a 9 percent south facing slope at an elevation of 2,440 feet. The soil was moist when described. (Colors are for dry soil unless otherwise stated. All textures are apparent field textures).

- **0i**--0 to 2 inches; fresh and slightly decomposed forest litter; abrupt smooth boundary. (1 to 3 inches thick)
- **E**--2 to 3 inches; dark grayish brown (10YR 4/2) gravelly ashy sandy loam (volcanic ash) light gray (10YR 6/1) dry; massive; soft, very friable, nonsticky and nonplastic; common fine and medium roots; 15 percent gravel; strongly acid (pH 5.2); abrupt smooth boundary. (1 to 2 inches thick)
- **Bs**--3 to 5 inches; dark brown (7.5YR 3/4) gravelly ashy sandy loam, (dominated by volcanic ash) brown (7.5YR 5/4) dark brown (7.5YR 4/4) dry; weak very fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; weakly smeary; common fine and medium roots; 15 percent gravel; NaF pH 12.0; moderately acid (pH 5.6); abrupt smooth boundary. (1 to 4 inches thick)
- **Bw1**--5 to 10 inches; dark yellowish brown (10YR 3/4) gravelly ashy sandy loam (dominated by volcanic ash) yellowish brown (10YR 5/4) dry; moderate fine subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; weakly smeary; common fine, medium and few coarse roots; 25 percent gravel; NaF pH 12.0; moderately acid (pH 6.0); gradual wavy boundary. (5 to 9 inches thick)
- **Bw2**--10 to 21 inches; dark brown (7.5YR 3/4) very gravelly ashy loam, yellowish brown (10YR 5/4) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and slightly plastic; weakly smeary; common very fine and fine roots; 35 percent gravel and 10 percent cobbles; NaF pH 12.0; slightly acid (pH 6.2); gradual wavy boundary (10 to 12 inches thick)
- **Bw3**--21 to 30 inches; dark yellowish brown (10YR 3/4) very cobbly ashy loam, yellowish brown (10YR 5/4) dry; weak medium subangular blocky structure; soft, very friable, nonsticky and slightly plastic; weakly smeary; few very fine roots; 25 percent gravel, 25 percent cobbles; NaF pH 12.0; moderately acid (pH 6.0); clear wavy boundary. (8 to 14 inches thick)

- **2C1**--30 to 39 inches; light olive brown (2.5Y 5/4) extremely cobbly ashy sandy loam, olive brown (2.5Y 4/4) moist; massive in place when disturbed single grain; loose, nonsticky and nonplastic; weakly smeary; few very fine roots; 50 percent gravel and 20 percent cobbles; NaF pH 10.0; moderately acid (pH 6.0); clear wavy boundary. (0 to 12 inches thick)
- **3C2**--39 to 62 inches; light olive brown (2.5Y 5/4) extremely cobbly loamy sand, olive brown (2.5Y 4/4) moist; massive in place when disturbed single grain; loose nonsticky and nonplastic; 55 percent gravel and 25 percent cobbles; NaF pH 10.0; moderately acid (pH 5.8).

255—Thetis ashy sandy loam, 45 to 65 percent slopes

The Thetis series consists of deep, well drained soils formed in loose glacial till with an admixture of volcanic ash. Thetis soils are on mountainsides and in valleys at elevations of 2400 to 4000 feet. Slopes are 25 to 65 percent. The average annual precipitation is about 65 to 80 inches, and the mean annual air temperature is about 43 degrees F.

Range in characteristics: The mean annual soil temperature is 44 to 46 degrees F. Except for bulk density, the exchange complex is dominated by amorphous material in the particle-size control section. Solum thickness is 28 to 50 inches. The spodic horizon thickness is 5 to 10 inches. The soils are usually moist but are dry in all parts of the moisture control section for 15 to 30 days. The particle-size control section averages 35 to 60 percent rounded rock fragments of mixed lithology. Reaction is strongly acid or medium acid throughout.

Geographic setting: Thetis soils are on mountainsides and have slopes of 25 to 65 percent. These soils formed in loose glacial till with addition of volcanic ash. Elevation is 2,400 to 4,000 feet. These soils are in a marine influenced climate with cool, dry summers and cool, moist winters. The average annual precipitation is 65 to 80 inches. The mean January temperature is about 26 degrees F and the mean July temperature is about 51 degrees F. The mean annual temperature is about 43 degrees F. The growing season at 28 degrees F is 130 to 170 days.

Drainage and permeability: Well drained; medium to rapid runoff; permeability is moderately rapid.

Use and vegetation: Used for woodland, wildlife habitat, and watershed. Vegetation is Douglas-fir, western hemlock and Pacific silver fir with an understory of huckleberry, boxwood (paxistima, aka *Pachystima myrsinites*), Oregon-grape, princes pine, pyrola, western rattlesnake plantain, and common beargrass.

Typical: Thetis gravelly sandy loam - under a coniferous forest on a 62 percent northeast facing slope at an elevation of 2,920 feet. The soil was dry when described. (Colors are for dry soil unless otherwise stated. All textures are apparent field textures.)

- **0e**--2 to 0 inch; partially decomposed forest litter; abrupt wavy boundary. (1 to 3 inches thick)

- **E**--0 to 4 inches; light brownish gray (10YR 6/2) loamy sand, (volcanic ash) dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky, nonplastic; few very fine roots; common very fine tubular pores; 5 percent pebbles; strongly acid (pH 5.2); abrupt wavy boundary. (0 to 4 inches thick)
  Bs1--4 to 7 inches; yellowish brown (10YR 5/4) gravelly sandy loam, dark yellowish brown (10YR 4/4) and dark grayish brown (10YR 4/2) moist; weak coarse granular structure; soft, very friable, nonsticky, nonplastic, weakly smeary; common very fine roots; many very fine irregular pores; few dark yellowish brown (10YR 4/6) moist iron concretion, 1 to 2 mm in diameter; (10 percent light brownish gray (10YR 6/2) volcanic ash mixed throughout horizon) 30 percent pebbles; NaF pH 11.4; strongly acid (pH 5.4); abrupt wavy boundary. (2 to 4 inches thick)
- **2kBs2**--7 to 10 inches; brown (7.5YR 4/4) gravelly sandy loam, dark brown (10YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, nonsticky, nonplastic, weakly smeary; common very fine roots, common very fine tubular pores; few dark yellowish brown (10YR 4/6) moist iron concretion 1 to 2 mm in diameter; 30 percent pebbles; NaF pH 10.5; medium acid (pH 5.6); abrupt wavy boundary. (3 to 6 inches thick)
- **2Bw**--10 to 20 inches; light yellowish brown (10YR 6/4) very gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, nonsticky, nonplastic, weakly smeary; common very fine roots, common very fine tubular pores; 45 percent pebbles, 5 percent cobbles; NaF pH 10.5; strongly acid (pH 5.4); clear wavy boundary. (6 to 10 inches thick)
- **2BC**--20 to 46 inches; light yellowish brown (10YR 6/4) very gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky, nonplastic, weakly smeary; few medium and fine roots; few fine tubular pores; 30 percent pebbles, 10 percent cobbles; NaF pH 10.5; medium acid (pH 5.6); clear wavy boundary. (12 to 26 inches thick)
- **2C**--46 to 60 inches; pale yellow (2.5Y 7/4) very gravelly sandy loam, olive brown (2.5Y 4/4) moist; weak fine subangular blocky structure; soft, very friable, nonsticky, nonplastic, weakly smeary; very few very fine roots; many very fine irregular pores; 30 percent pebbles, 10 percent cobbles; NaF pH 10.6; medium acid (pH 5.8).

Management Recommendations

Given that the long-term health and productivity of the forest is dependent largely on the quality and condition of the soils, soil conservation shall be of the utmost importance during all timber management operations. The following best management practices will apply:

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. In the absence of larger logs, logs can be constructed by stacking together numerous smaller diameter poles to meet the above dimensions.

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 can be minimized through the use of frequent and small log landings located along edges 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 harvesting & 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 - 50 percent of individual trees will be harvested at one time in order to minimize the potential for post-logging windthrow. Logging slash will be distributed throughout the site, vs. piled and burned, in order to aid in soil development. 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 Wetland Water Type Map in Appendix IV.

The property is situated on the eastern slopes of the Cascade Mountains that comprise the headwaters of the Upper Yakima River Basin; part of the greater Columbia Basin. The property has both west and east facing slopes off of Amabilis Mountain and Keechelus Ridge that direct water to Lodge Creek which feeds into Kachess Lake.

Keechelus, Kachess, and Cle Elum lakes are natural bodies of water in the Yakima-Cle Elum watershed, raised by storage dams and used as irrigation reservoirs. The seasonal snowpack acts a temporary store of moisture during winter months. This snowpack is a vital source of water on the flanks of the Cascades. Precipitation that falls as snow does not immediately enter the stream system, much is stored until spring. In winter, streams are often reduced to baseflow (groundwater discharge at surface), except during periods of heavy rainfall with warm winter temperatures. From April to July, snowmelt runoff and precipitation combine with baseflow to create large peaks in stream discharge. This also occurs in November and December during heavy rainfall. Groundwater discharge to streams is important in this region. A portion of the annual precipitation in subalpine areas infiltrates the surface and reaches aquifers. These aquifers are tapped in surrounding areas and are important resources in the more arid east slope foothills.

There are some instances where, due to the temperature changes, there can be a high risk of *rain-on-snow* events. This type of event happens when warm marine air from the south pushes into Washington and Oregon, bringing a rapid rise in temperatures as well as heavy amounts of precipitation in the form of rain over snow that has already fallen. This weather event can dramatically reduce the amount of snow that is on the ground rather quickly, thereby compounding risks of erosion, as well as over-saturation of the soil that can lead to landslides.

Streams

The WA DNR Water Type Map in Appendix IV identifies a number of non-fish bearing seasonal streams that occur on both the northern and southern units. The northern unit has a more extensive network of streams, mostly occurring throughout its western half, whereas seeps and springs tended to occur only along the lowest points in the slope of the southern unit, immediately above the road grade that is adjacent to Lodge Creek. During the site evaluation in late June and early July of 2016, many of these streams,

Seasonal stream in northern unit (Type N)

seeps and springs were actively flowing. Given the relatively steep slopes on either side of Lodge Creek, these streams do not appear to have the capacity to support fish. However, Lodge Creek is typed as fish-bearing, so forest management and road building or maintenance activities on the slopes above the creek, as well as adjacent to the small non-fish bearing tributaries that feed it, can have an adverse effect on the Creek, in particular sediment delivery.

Wetlands

Aside from the wetland complex surrounding Lodge Creek, no other wetlands have been identified on this property. The wetlands surrounding Lodge Creek play an important role in filtering water that comes off the steep slopes on either side of the creek. It also provides important wildlife habitat for migratory birds, mammals and amphibians.

Management Recommendations

The WA DNR Forest Practices Rules regulate forest management activities, including timber harvesting and road building and maintenance, along all waterways in the State. For eastside forests, riparian management regulations are intended to provide stand conditions that vary over time. They are designed to mimic eastside disturbance regimes within a range that meets functional conditions and maintains general forest health. These desired future conditions are a reference point on the pathway to restoration of riparian functions, not an end point of riparian stand development.

Riparian Management Zones (RMZ's) are required along all typed waters. RMZs on Type F (fish-bearing) waters have three zones. The core zone is nearest to the edge of the bankfull width. The inner zone is the middle zone, and the outer zone is furthest from the water. Permitted forest practices vary by timber habitat type and site class. RMZ's along Type Np (non-fish perennial) and Ns (non-fish seasonal) waters require an equipment limitation zone thirty-feet wide measured horizontally from the outer edge of bankfull width.

The following chart illustrates the management zone widths that are required along Type F streams, and which will apply to timber management areas on the slopes east of Lodge Creek.

Site Class	Total RMZ Width	Core Zone Width	Inner Zone Width	Outer Zone Width
I	130'	30'	45'	55'
II	110'	30'	45'	35'
III	90'	30'	45'	15'
IV	75'	30'	45'	0'
V	75'	30'	45'	0'

Stream Bank Integrity

In the RMZ core zone for Type F Waters and RMZs for Type Np Waters, operations shall:

- Avoid disturbing brush and similar understory vegetation;
- Avoid disturbing stumps and root systems and any logs embedded in the bank;
- Leave high stumps where necessary to prevent felled and bucked timber from entering the water;
- Leave trees which display large root systems embedded in the bank.

Yarding

Ground-based equipment shall not be used in Type F Waters. Yarding across Type F Waters is limited to cable or other aerial logging methods. Ground-based transport of logs across Type Np and Ns Waters shall minimize the potential for damage to public resources. Skidding logs and driving ground-based equipment through defined channels with flowing water is not allowed. Whenever skidding across Type Np or Ns Waters, the direction of log movement between stream banks shall be designed to minimize sediment delivery to the stream. In order to maintain wetland water movement and water quality, and to prevent soil compaction, ground-based logging systems shall not be used in Type A or B wetlands. Where harvest in wetlands is permitted, ground-based logging systems shall be limited to low impact harvest systems. Ground-based logging systems operating in wetlands shall only be allowed during periods of low soil moisture or frozen soil conditions. Locations of temporary stream crossings to Np Waters shall be shown on the base map of the forest practices application. Whenever skidding in or across Type Np or Ns Waters, the direction of log movement between stream banks shall be designed to minimize sediment delivery to the stream.

RESOURCE CATEGORY IV: FOREST INVENTORY/TIMBER/WOOD PRODUCTS

Overview

Typical stocking density of KRMA forest, with larger diameter dominant trees crowded by smaller diameter understory trees.

As with all second and third growth forests across the region, forest cover across the KRMA is a product of past management. The original old growth forest was cut from most of the site from the 1930's through the 1960's, and the site was left to naturally regenerate to a mix of conifer species. Forests that naturally regenerate tend to form dense thickets of trees that gradually self-thin over time. The forests at the KRMA typify this condition in that stand densities often exceed 400 trees per acre (TPA) and less dominant trees in the understory are beginning to succumb to suppression-based mortality. Both the high density, and the increasing volume of dead wood, both standing and on the ground, is creating an increasingly high risk for forest fire.

The vast majority of the forested areas of the KRMA are well-stocked, even excessively stocked. Douglas fir is the dominant species across the entire site. Represented in lower volumes are noble fir, grand fir, western hemlock, mountain hemlock, western red cedar, red alder and big leaf maple. The white firs appear to be succumbing to drought stress on steeper slopes and are dying off in increasing numbers. The western hemlock, in particular on the eastern slopes of Amabilis Ridge, is highly infested with dwarf mistletoe. There are also periodic pockets of laminated root rot amongst the Douglas fir. These drought a disease vectors are increasing the levels of dead wood throughout the forest, and can be viewed as the forest ecosystems response to high stocking densities and a natural process of self-thinning.

Other than the adverse effects of disease and drought, the majority of the forest appears to be in good growth and the relatively highly productive soils are producing high quality timber.

Consistent growth rings in 45 year old Douglas fir in northern unit.

Desired future condition

The long-term desired future condition for the forest across this property is as a

working forest that provides a broad range of valuable forest products and ecosystem functions such as wildlife habitat, clean air, and clean water, as well as recreational opportunities for the homeowners within the KRMA. The forest will be managed using *uneven-aged* silvicultural practices that will eventually lead to the development of a complex forest structure that includes trees of multiple ages and species – both hardwood and conifer. Old-growth stumps throughout the site indicate that the original stocking density of the forest ranged between 70 – 140 tpa. Therefore, this forest will be successively thinned to gradually reduce the stocking of the dominant trees to approximately this level, while stimulating natural regeneration in the understory. Species composition will be shifted to favor the more drought tolerant species (e.g. Douglas fir, mountain hemlock, big leaf maple) on slopes, while retaining drought intolerant species (e.g. grand fir, noble fir, western hemlock, cedar, alder) at the base of slopes and in and along drainages. In the short term, it may be necessary to subsidize the thinning and removal of small diameter (non-merchantable) timber through the revenue generated from harvesting larger trees.

Residual old-growth stumps indicate a historic stocking density of between 70 - 140 tpa.

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 native hardwoods and conifers of multiple age classes that can be expected to tolerate increasingly drier and warmer summers. This may translate to concentrating production of for sensitive species, such as cedar, western hemlock and grand and noble fir in the lower areas of the property, and favoring Douglas-fir and big leaf maple on drier slopes. Timber harvesting will use individual tree selection, group selection, and variable density thinning to achieve a more complex forest structure and to produce high quality forest products.

A fundamental silvicultural philosophy behind this management plan is that managing for ecologically diverse forests also translates to managing for economic diversity by providing the opportunity to harvest and sell a multitude of timber products across a range of species. Diversity also lends towards economic and ecological resiliency, as the landowner does not rely on a single species for income and the forest is less susceptible to major natural disturbances such as wind, ice and pest and disease epidemics.

Annual allowable harvest

Of a total of 223 acres of commonly held land in the KRMA forest, approximately 140 acres are accessible for sustained timber production. The remaining 83 acres are comprised of either set-asides that protect sensitive ecosystems (e.g. riparian areas along Lodge Creek, old-growth habitat at the top of Amabilis Ridge), or unproductive sites such as the slide area in the NW corner of the northern unit, or the savannah-type forest on the knob in the northern tip of the southern unit.

The NRCS soil productivity rates listed earlier in this document estimate that the majority of the soils across the timber-producing areas of this forest are capable of producing approximately 200 board feet of timber per acre per year. These estimates are based on an unmanaged stand that is 50 years old or older. Therefore, active management and better stocking and species composition should result in higher productivity rates over time. Based on the conservative NRCS soil productivity rate, the 140 acres of merchantable timber on this property should be capable growing at least 28 thousand board feet (mbf) of timber per year. Therefore, assuming a maximum sustained yield of 90 percent of annual growth (25 mbf/year), this forest should be capable of producing at least 250 mbf of timber every 10 years in perpetuity. At an average delivered price of $500/mbf, this translates to a minimum gross revenue of approximately $125,000 every 10 years. A wide range of expenses will need to be extracted from this gross revenue in order to arrive at a final net return to the landowner, such as: logging, timber sale administration, road building and maintenance, replanting, slash abatement, pruning, etc.

The first two commercial thinning entries scheduled in this plan are intended to reduce stocking density and return this forest to optimum growth. Given the extremely high tree densities in most areas of the forest, these initial timber harvests may exceed the annual allowable harvest levels stated above. Once the forest has been restored to a moderate stocking, all future timber harvests should comply with the allowable harvest levels.

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. Ground-based logging will be used on slopes up to 45%. Slopes greater than 45% will need to be evaluated for cable thinning. New forest access or skid roads may need to be constructed in order to gain access to timber on steeper slopes. Logging and heavy equipment use will be avoided during the wettest seasons of the year in order to minimize compaction and disturbance to the shallow and fragile soils.

The following harvest methods will be used across the property:

Pre-commercial thinning

Pre-commercial thinning is recommended for stands that exceed 350 tpa. Forest stands that exceed this density will typically enter the stem exclusion phase between the ages of 15 – 25 years depending largely on soil productivity. This phase is characterized by a dense canopy with sufficient shade to kill lower branches, suppress understory vegetation, and lead to suppression-based mortality of non-dominant trees. Live crowns gradually begin receding, and once they diminish below 35 percent, the growth of the tree shifts from girth production to height production as trees compete for sunlight. In order to keep these stands in optimum growth, and to minimize the risk for natural disturbance, they should be pre-commercially thinned.

The object of pre-commercial thinning is not to maintain an even spacing amongst all trees, but rather to favor healthy trees, both hardwood and conifer, that have dominant crowns and good log quality - a technique referred to as "best tree selection". Stands exceeding 350 tpa should be thinned to 250 – 300 tpa. The first thinning of a stand typically occurs "from below", selecting the smaller diameter, suppressed and poorest quality trees first. 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. It is crucial that the best trees within a given area be left, 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 help ensure stability against wind disturbances. 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, etc.). The resulting slash can be piled into habitat piles measuring a minimum of 10 ft across and 6 ft high and/or downed logs measuring a minimum of 20 ft long and 12 inches in diameter, cut into firewood and removed, piled and burned, chipped, or any combination thereof. Thinning should be avoided during the prime bird nesting season between March 15th-June 30th.

Thinning from below

Thinning from below is a technique typically used during the first commercial thinning entry in a stand. Approximately one-third of the overall trees are removed, typically from the suppressed and intermediate canopy classes, in order to promote the growth of the co-dominant and dominant trees. Best Tree Selection methods are used similar to pre-commercial thinning. This means that co-dominant or dominant trees may be removed if they have defect or will release

more desirable species in the understory. Thinning is *across the species*, retaining the best quality tree of each species, both hardwood and conifer. If pre-thinning stand density is approximately 300 - 350 tpa, then stands will be thinned to approximately 200 – 250 tpa.

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 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 (a) resistance to disturbance, (b) ability to recover after disturbance, and (c) 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 200 – 250 tpa, then the 2nd entry will reduce the density to 120 – 160 tpa. During the third entry thinning, stand density will be reduced further to approximately 90 – 105 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 25 – 75 dominant trees per acre. These leave trees will be retained as permanent biological legacies, whether standing or downed. VRH objectives include providing habitat for wildlife and retaining 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.

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

See Forest Management Plan map in Appendix IV for full-scale map.

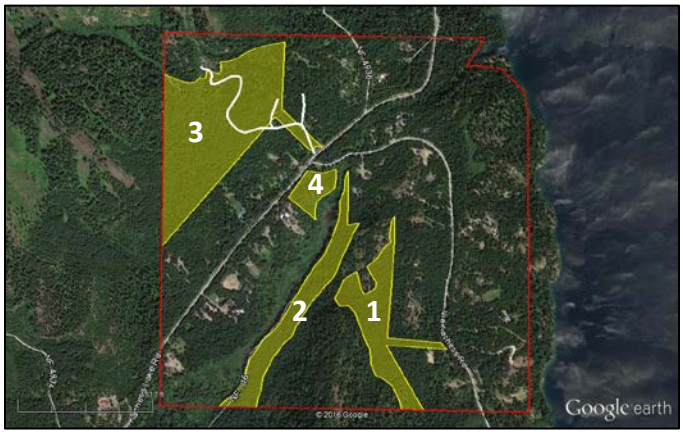
The KRMA forest has been delineated into several discrete forest management units. These units are broadly defined as follows:

1. FMU 1: Forests occurring on slopes <45%. These units encompass the most productive timber areas.
2. FMU 2: Forests occurring on slopes >50%. These units encompass steep slopes that will require tower or other cable logging systems. These steeper slopes are less productive, due to shallower soils and lower available moisture.
3. FMU 3: Conservation set-asides. These units encompass ecologically sensitive areas, such as the old growth at the top of Amabilis Ridge, the open savannah forest type at the northern tip of the southern unit, the steep slopes along the northern property line of the northern unit, and the riparian area along Lodge Creek. These areas will be managed exclusively as reserves for biological diversity, wildlife habitat and recreation.

FMU 1

Total acres	Age	Dominant spp.	Trees per acre	Average DBH	Avg. height	Avg. crown ratio
114.25	45 - 65	Douglas-fir	360 - 580	10” - 12”	90’	35% - 40%

FMU 1 is comprised of four distinct stands that span slopes less than 45% and encompass the most productive timber growing sites across the KRMA forest. Although there is a high degree of variability in stocking and species composition across these stands, they share similar enough characteristics to warrant a common management strategy, and therefore are combined under a single forest management unit. This unit include the following stands:



FMU 1 is comprised of four distinct stands.

1. Stand 1: 23 acres along the eastern slopes of Amabilis Ridge in the southern unit.
2. Stand 2: 20 acres along the western slopes of Amabilis Ridge in the southern unit.
3. Stand 3: 65 acres along the eastern slopes in the northern unit.
4. Stand 4: 5.75 acres located in the valley between Kachess Road and Lodge Creek in the southern unit.

The forests across this management unit range from 45 – 65 years old and naturally regenerated following clearcut timber harvesting. Naturally regenerated forests tend to grow back at a high stocking density and with a wide range of species. Douglas fir is the dominant species across this unit, with noble fir occurring in second abundance. The noble fir occasionally occurs in solid stands, but otherwise is common throughout the forest, as are the other species. Western hemlock, mountain hemlock, grand fir and western red cedar also are common, and red alder occurs in small gaps, mostly in proximity to wetter sites.

The stocking density across most areas of this unit is extremely high. Averages range between 360 – 580 trees per acre (tpa), but some areas are quite sparse, with less than 200 tpa and some areas are extremely dense, with more than 800 tpa. Diameter distribution is highly stratified between the dominant canopy, which includes trees between 10" – 16" dbh that often comprise a third of the total stocking density, and the sub-dominant canopy, which includes trees less than 10" dbh that often comprise 2/3 of the total stocking. Dominant trees are typically 80' – 100' tall, whereas sub-dominant trees are often less than 70' tall. In areas of higher stocking densities, there is an increasing rate of suppression

Typical stocking density (580 tpa) on the eastern slopes of Amabilis Ridge. Dominant trees scattered amongst a thicket of smaller diameter sub-dominant trees, many of which are blowing over.

Extremely dense stand on west side of Amabilis Ridge with over 620 tpa. There is a high degree of suppression mortality and standing dead trees throughout this stand.

Lower stocked stand (200 tpa) with brush-filled gaps in NE corner of northern unit.

mortality amongst the sub-dominant trees caused by the dense shade of the heavy dominant canopy. These suppressed trees either die and remain standing in place, or fall and are contributing to increasing levels of woody biomass along the ground.

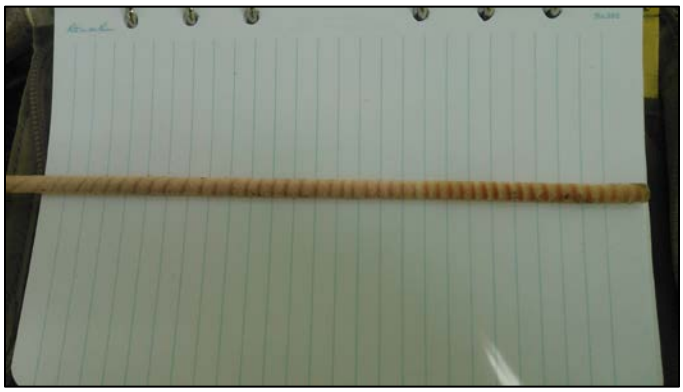
Shade from the dense canopy is causing the live crowns of the trees to recede. The dominant trees still retain as much as 40% - 50% live crown, but the suppressed understory trees in many cases have less than 35% live crown. As crowns recede, the overall growth rate of the forest precipitously declines as trees shift from adding diameter growth to focusing on height growth. Overtime this growth pattern leads to stands of trees that are increasingly tall and skinny, and much more susceptible to falling or breaking during wind storms. Dense canopy shade is also having a suppressive effect on continued natural regeneration of conifers in the understory. Western hemlock, and to a lesser degree western cedar, is periodically regenerating throughout this unit, but tends to only occur in areas of lower stocking density or on wetter sites. Understory shrub diversity and abundance also follows light patterns, with more shrubs occurring in areas of lower stocking density, and nearly barren forest floors in areas of high canopy density.

Increased understory shrub diversity and natural conifer regeneration in lower stocked area in northern unit.

Across many of the steeper slopes in this unit, and on the driest sites, grand fir and noble fir are dying off at a significant rate. These species tend to be more susceptible to prolonged periods of drought, and are less competitive than Douglas fir. The true firs are either dying and standing in place, or falling over and contributing more woody biomass to the forest floor. In some cases, large patches (~1/2 acre) of true firs have fallen over or broken off during previous wind storms. Dwarf mistletoe is also common in the western hemlock, in particular along the western slopes of Amabilis Ridge, and root rot pockets occur periodically throughout the Douglas fir.

Large patch of blown down grand fir along eastern flank of Amabilis Ridge.

Management Recommendations



Consistent 1/8" growth rings in 50 year old Douglas fir in Northern unit.

The primary short-term objective across this unit is to reduce stocking density and excess wood in the forest in order to mitigate fire risk and improve growth rates of residual trees. With dominant trees (>10" dbh) averaging 220+ trees per acre, there is ample merchantable volume across this unit to conduct at least two commercial thinnings over the next 20 years. The challenge will be to reduce the stocking density of the smaller diameter understory trees throughout the unit, as this material is of lower value and represents the majority of the timber volume that needs to be removed. This plan proposes to remove approximately 2/3 of the dominant trees over two successive commercial harvests spaced approximately 8-10 years apart, and to remove approximately 2/3 of the understory trees during the first commercial thinning. For instance, if the total stocking density is 640 tpa, of which 220 is comprised of dominant trees, then the dominant canopy will be initially thinned to 140 tpa, and the understory will be thinned to 200 tpa. Thinning in the dominant canopy will be *across the diameters*, removing trees of varying sizes, and will target the white fir for removal in favor of retaining the Douglas fir and mountain hemlock. Hemlock infested with mistletoe, and root rot pockets in Douglas fir will also be targeted for removal. During the first two commercial thinnings, no trees over 20" dbh will be removed, unless they have obvious signs of defect or disease, as these trees will be retained for their genetic diversity into the next generation of forest. When the understory trees are thinned, only the most vigorous trees of each species will be retained, as well as those that still retain more than 35% of their live crowns. These trees will be spaced to approximately 15' - 20' apart in order to minimize competition. To the extent that pulp/utility markets will support the removal of small diameter logs, the material will be removed and sold from the forest. However, this low quality timber can also be processed in the woods and stacked to create constructed wildlife habitat logs that average 20" in diameter and 20' long that are distributed at least 50' apart. Branches and tops can be processed and left to decay in the woods, as long as slash mats do not exceed 12" deep.

1. 2016 – 2021: Rebuild forest access roads.
   Certain former forest access roads will need to be reopened and/or reconstructed prior to commencing logging activities. In some areas, reopening former roads and trails will yield

a significant volume of timber. Stream crossing structures may be necessary to cross stream channels through the western extent of the northern unit. These roads include:

a. Along western edge of Lodge Creek. Given the extensive wet areas along this road, proper drainage structures (e.g. ditches, cross drains, etc.) will be essential to its long-term viability. Seek and mark former skid trails through remainder of forest for future reopening or use during logging activities.
b. Access to Stand 1 from Kachess Road.
c. Access to Stand 3 from Kachess Road.
d. Access across southern and north-eastern portions of northern unit.

2. 2016 – 2021: Commercially thin from below.
   Remove 1/3 of the dominant trees and 2/3 of the understory trees, bringing stocking densities of both cohorts to approximately 140 and 200 respectively. Harvest should yield 5 - 8 mbf/acre of merchantable timber (not including pulp). Thin across the diameters to promote a more structurally diverse stand. Target white firs for removal on drier sites and steeper slopes, as well as hemlock infested with mistletoe and root rot pockets in Douglas fir. Do not cut any tree over 20" dbh unless it has obvious defect or disease. Retain only the most vigorous understory trees of each species, and those that still retain >35% live crown. Pulp logs can be processed into wildlife habitat logs and left in the forest by stacking together enough poles to create a minimum 20" diameter by 20' long constructed log. Slash should be lopped and scattered throughout the site to the extent that it does not produce a mat greater than 12" thick. All excess slash and woody biomass should be removed from the forest.

   Commercial thinning in Stand 4 in the valley between Kachess Road and Lodge Creek should be conducted with an eye towards managing this site as much for recreation and public access as long-term timber production. This unit is an ideal place for community members to hike, picnic and observe a working forest. Skid trails can double as walking trails in between timber harvests. This is an ideal site for the more drought intolerant species, such as cedar, western hemlock, grand fir, and red alder.
3. 2016 – 2021: Develop fire breaks along forest edges adjoining private parcels.
   During logging operations, all understory trees less than 10" dbh should be removed within 100' of the property lines in order to interrupt the fuel ladder from understory to forest canopy. Limbs on remaining trees should be pruned to a minimum of 20'. All resulting slash should be removed from the site.
4. 2026 – 2031: Commercial variable density thin.
   Removing another 1/3 of the dominant trees, bring the stocking density of the canopy down to approximately 90 tpa. Harvest should yield at least 5 - 8 mbf/acre. Target dominant tree removal on white firs, hemlock infected with mistletoe and diseased or

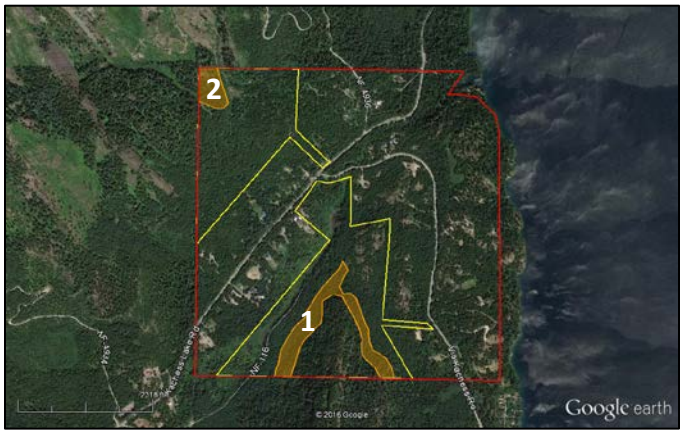
defective Douglas fir, as well as where vigorous understory trees will be released. Minimize damage to the understory cohort to the extent possible. During commercial logging, pre-commercially thin the understory to remove any defective trees, or to reduce competition in favor of Douglas fir and mountain hemlock on the drier sites.

5. 2036 – 2041: Conduct variable retention harvest.
   Conduct a final harvest across the dominant trees by reducing their stocking density to 25 – 70 tpa. Select the best quality trees for retention as permanent biological and genetic legacies into future generations of the forest. Retained trees can be clumped and/or dispersed throughout the unit. Dominant trees should be removed where they will release vigorous understory trees. Understory trees that have come of commercial size can be thinned to reduce stocking density, however, the most dominant and vigorous trees should be retained. Favor Douglas fir and western hemlock on drier sites, and the white firs and cedar at lower elevations. By this time, significant natural regeneration will have occurred throughout the understory. If stocking densities exceed 240 tpa, pre-commercially thin to at least this density. Favor Douglas fir and western hemlock on drier sites.
6. 2046 – 2051: Commercial variable density harvest
   By now the second cohort of trees will be of sufficient commercial size to warrant thinning. Thinning should be conducted across the diameters and species, removing any defective or diseased trees and targeting dominant trees only where they will release vigorous understory trees. Overall stocking density across all cohorts of trees, including overstory, understory and natural regeneration, should be maintained at less than 360 tpa.

FMU 2

Total acres	Age	Dominant spp.	Trees per acre	Average DBH	Avg. height	Avg. crown ratio
26.5	50	Douglas fir	520	10”	90’	45%

This management unit is comprised of two stands that occur on slopes greater than 45% where ground-based logging will likely not be feasible. Both stands share a very similar forest composition to FMU 1, with Douglas fir as the dominant species and western hemlock and noble fir playing a competitive role in the canopy. This unit is extremely dense also, with in excess of 300 tpa in the overstory and 300 tpa in the understory. Western hemlock and western red cedar are naturally regenerating more prolifically throughout this unit than FMU 1. There are old Douglas fir stumps scattered throughout the two stands at approximately 140 tpa, which gives obvious clues to historic species and stocking densities. There were pistol butted trees and other signs of unstable slopes in areas of Stand 2 that may exclude future commercial timber management.



FMU 2 is comprised of two distinct stands.


Typical composition in Stand 2, with trees of varying diameters and cedar regeneration in the understory.


Smaller diameter cedar and hemlock in the understory of Stand 1.

Despite the high stocking density, live crowns across the dominant trees in this unit still exceed 40%. The stocking density of Stand 1 is higher than Stand 2 (640 tpa vs 420 tpa), and resultantly diameters in Stand 1 tend to be smaller than Stand 2, averaging only 9” dbh. The understory cohort in Stand 1, comprised largely of cedar and hemlock, is also much denser

than trees in the understory of Stand 2. This high density is reducing growth rates across the entire unit, and leading to an increasingly level of suppression-based mortality throughout the understory.

Rapidly diminishing annual growth rings in 45 year old 11" dia. Douglas fir in Stand 1.

Management Recommendations

Access to Stand 2 in the NW corner of the northern unit may be obtained from the adjacent landowner to the north, as there appears to be a forest access road leading to the NW corner of the KRMA. However, access through the narrow band of Stand 2 that wraps around Amabilis Ridge will be more problematic. Although there is some evidence of a limited skid trail network across this stand, it is unlikely these trails are suitable for access by a tower, and future ground-based skidding on these steep slopes is doubtful. Stand 1 will need further evaluation for logging feasibility.

Regardless of whether either stand is deemed suitable for future commercial timber harvesting, there will be both an ecological and economic benefit to pre-commercially thinning them in order to promote the growth of larger and higher quality timber, as well as to reduce fire risk. Since it will not be feasible to remove woody material from this site, it may require two successive thinning entries to gradually reduce the stocking density so as not to overload the understory with excessive fuels.

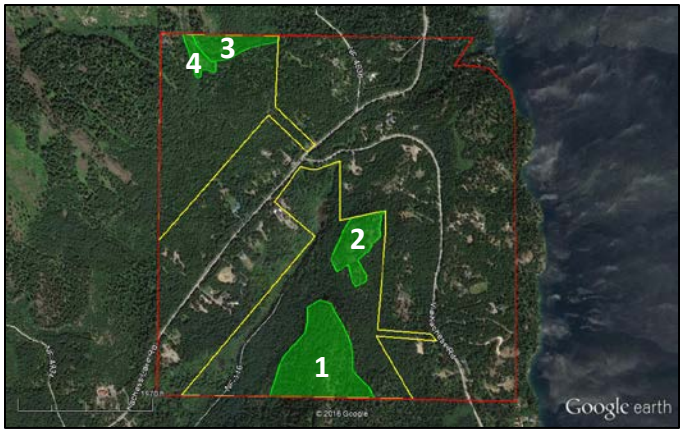
1. 2016 – 2021: Pre-commercially thin by removing no more than 30 – 50 percent of the understory trees.
   Target the white woods and cedar for removal (except in low spots), and space cedar apart by at least 15'. Retain the most dominant, largest diameter and/or highest quality trees. Slash should be lopped and scattered, poles piled into constructed habitat logs, and piled into discrete piles in openings in the forest away from trees. Slash mat should not exceed 12" deep. Cost per acre for PCT will be in the $600 - $1,000 range.
2. 2026 – 2031: 2nd pre-commercial thinning.
   If the slash from the previous thinning has softened sufficiently to no longer present a fire threat, these stands can be pre-commercially thinned a second time by removing an additional 30 – 50 percent of the understory trees as per above. Total stand density should be reduced to approximately 240 tpa.
3. 2036 – 2041: Commercially thin

Evaluate both stands for commercial cable logging. If access can be achieved, stands can be thinned by removing up to 50 percent of the merchantable timber and bringing total stand density down to approximately 120 tpa. For cable logging to be financially feasible, a higher proportion of dominant trees will need to be removed. From this point forward, this unit should be thinned on approximately a 20 year cycle. Depending on how thick naturally regenerating conifers come into the understory, they may require periodic pre-commercial thinning to keep their densities below 200 tpa and well-spaced to about 15' apart.

FMU 3

Total acres	Age	Dominant spp.	Trees per acre	Average DBH	Avg. height	Avg. crown ratio
48.6	Varying	Varying	NA	NA	NA	NA

FMU 3 is comprised of four distinct stands that, for the following reasons, will be set aside as either restricted management or non-management areas.



FMU 3 is comprised of four stands.


Complex canopy structure and low stocking density of old-growth along eastern flank of Amabilis Ridge.

1. Stand 1: This stand comprises 28 acres of rare old-growth mountain hemlock that was spared from logging when the original old growth forests were cut from this area. The stand occupies both extremely steep slopes (>70%) on either side of Amabilis Ridge, as well as the ridgeline. The composition of this stand provides a useful template to the species and stocking densities of the former forests on this site. Stocking averages 70 tpa, with diameters averaging 25" dbh and heights up to 104'. A core from a 25" diameter hemlock indicated the stand was at least 195 years old. As is common with old growth, in particular that which occurs on ridgelines, the hemlock across this stand has been battered by the wind and weather and exhibits both broken tops, freeze crack

and other signs of defect that diminishes its timber value. However, the high defect increases the value of these trees for wildlife, as both a wide range of birds and mammals occupy the cavities and complex crowns of each tree.

Given the high ecological value of this rare old-growth community, plus the lack of access to the ridge top, this Stand should be conserved as a biological reserve. The rough topography of the ridge and the rocky outcrops along the steep slopes make the logistics of cable logging highly complex and expensive. Given the high cost and complexity of building a road to the ridge, plus the impacts to shallow soils, combined with the low value of the timber on the site, any future logging of this unit is not deemed economically feasible. Instead, this stand should be used as a destination for hiking and other related recreational purposes, as well as the ongoing study of the unique plant communities found in old-growth forests.

2. Stand 2: this stand comprises an open savannah-type forest that is perched across a nearly bald knob in the NE corner of the southern unit. This rock uplift has extremely thin soils that have only produced a small community of trees since the area was logged over 60 years ago. A wide range of native grasses, forbes and flowers proliferate in the open gaps across this site, and the stand has all the appearances of good bear habitat. Small groups of mature Douglas fir cling to the limited microsites where soils are deeper.

Given the unique quality of this site, it should be conserved as a destination for hiking and other recreational values, including hunting. Individual tree selection could be used on the site to extract merchantable timber, but utmost care must be taken to not disrupt the thin and extremely fragile soils across this knob.

3. Stand 3: this stand occupies steep slopes along the northern property line and has no road access. Given its inaccessibility, it appears to have been spared by logging during previous timber harvests, and currently is stocked with a mix of mature conifers, including Douglas fir, cedar, hemlock and white fir. The southern boundary of this stand is a steep seasonal stream ravine, which also limits access to the site from the south, and further underscores the value of conserving this stand in order to minimize impacts to the stream.

4. Stand 4: this stand is comprised of an area that has witnessed recent disturbance from landslides. Freshly deposited gravel covers most of the site, and a young thicket of alder and cottonwood is beginning to colonize the exposed soils. Currently the site is the destination for hikers, mountain bikers and off road vehicles, and should continue to be used as such given the good views to the south and east. If desirable, the site could be replanted back to Douglas fir, and the alder thickets pre-commercially thinned. Given how droughty the site is, it is unlikely that alder will develop into a merchantable tree, but it does have a high short-term value in its ability to build soil and create a more conducive environment for longer-lived conifers that will eventually succeed it.

Exposed gravel and newly regenerating alder and cottonwood across Stand 4.

RESOURCE CATEGORY V: PROPERTY ACCESS/ ROADS AND TRAILS

See Forest Management Plan map in Appendix IV for roads and trails.

Forest access road leading up into Northern unit.

The KRMA forest has an extensive network of old skid trails and forest access roads that were constructed when the original old growth forest was logged. Although not all, many of these roads were fairly well located to provide optimal access across the steep ground. From main haul roads, multiple skid trails branch out, most along cross-slope to minimize grade. In that era, however, very few, if any, culverts were installed where roads or trails crossed seasonal streams and road drainage was rarely considered. Given that there has been little to no forest management across the KRMA forest for nearly 50 years, most of the roads and trails have become overgrown and are currently impassable to vehicles of any type, if not barely discernable to the eye. Therefore, depending on future use, seasonal use, and equipment, most areas of the KRMA's road system will need maintenance, upgrading or relocating before they can be fully utilized.

Many former skid trails were discovered during the site evaluation in July 2016, but many more remain to be found. A more thorough evaluation of the full extent of the road and trail system may yield additional opportunities for reaching hard to get areas, in particular on steeper slopes. Although there is an extensive network of trails within the property, access from the main road (Kachess Lake) may still be problematic. The KRMA owns a finger of land extending SE from both the northern and southern units to Kachess Lake Road and Kachess Road respectively. Former access roads should be available to these parcels that will allow access up into either management unit.

The majority of the northern unit is accessible by a road network that stems back to Kachess Lake Road. The steep slopes across most of the unit will likely limit log truck access to the bottom portions. A main trail leads from Kachess Lake Road on a circuitous path towards the NW corner of the property before passing on to U.S. Forest Service land. Given the limited access from the North, most of this area will likely remain a low priority for timber management.

The southern unit has significant access issues. Although the SE corner is easily accessible via a USFS road, the roadbed quickly becomes swampy for most of its length along the base of the

slope. At the break in slope, seeps and springs are frequent, and their constant inundation has rendered most of the roadbed inaccessible to all but the most capable of offroad vehicles. Much of the road also occurs within the riparian management zone of Lodge Creek, creating a potential risk for sediment delivery and other impacts to water quality, should this road system be reopened. There are indications of former skid trails that run diagonally up the slopes, but these trails were not investigated or mapped for this plan. An overgrown access road leads up through the finger of land extending to Kachess Road, but its direction and extent into the KRMA remains to be known. A small road segment was recently constructed across a portion of the KRMA forest in the NE corner, which could provide limited access to this area as well. Presumably there are additional skid trails that will provide access to more areas of this unit.

Mucky road along base of slope above Lodge Creek.

Management recommendations

Since a road system already exists, and impacts to soils have already occurred in specific places, it is sensible to gradually reopen most roads in order to provide optimal access both for forest management equipment and emergency vehicles. Cleared forest roads also serve as limited fuel breaks should a forest fire enter the property. Roads that are improperly placed, or appear to be providing irreparable damage to steep slopes or waterways will be left abandoned after any necessary correction actions have been taken. Reopening the forest road network will yield a significant volume of timber, given that many roads have been growing trees for more than 50 years. It is possible that revenue generated from harvesting timber on the road beds, landings and road margins could cover most of the cost of reopening the road system.

1. Resolve forest access issues from Kachess Lake Road and Kachess Road and reopen roads into both units. Negotiating temporary access across private parcels will provide more optimal access to the forest while minimizing impacts to a single route.
2. Evaluate access road along Lodge Creek. In consultation with the WA DNR, develop a road restoration plan. This may require abandoning portions of the road and realigning to higher ground, installing extensive drainage systems, or other strategies.
3. Reopen remaining road system to allow seasonal access to all parts of the property. This can be done in conjunction with commercial logging while equipment and contractors are on site.
4. Identify locations log landings for commercial harvesting operations. Skidding distances should be limited to no more than 1,000’ from a landing in order to optimize efficiency

of logging operation and to reduce impacts to soils from yarding logs long distances. Multiple small landings along road margins may be preferable to fewer large log landings.

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

RESOURCE CATEGORY VI: WILDLIFE

Overview

The highly variable topography and vegetative cover across the KRMA provides nearly optimal habitat for most wildlife species endemic to the area. From the rare old growth mountain hemlock at the top of Amabilis Ridge, with its large trees and open forest structure, to the wetlands along Lodge Creek that provides surface water and habitat for birds and amphibians, to the dense forest stands that provide thermal cover for nesting and denning, to the open conifer stands with heavy berry and nut producing shrubs interspersed throughout, there are a multitude of habitat types for birds, mammals and amphibians alike. Tree fungal diseases, such as laminated root rot, are killing larger trees that provide snag habitat for cavity dependent species. Although there are some large downed logs throughout the property, most are in advanced stages of decay and any new wood is primarily small diameter and coming from suppressed trees in the lower canopy.

Present conditions

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants. Many areas on the uplands are covered by extensive stands of Douglas-fir, western hemlock, and grand and silver fir, and the wet soils and riparian corridors support big leaf maple, alder and cottonwood. These woodland areas have a diverse understory of salal, Oregon-grape, and huckleberry. The areas provide habitat for woodland wildlife, such as black-tailed deer, elk, cougar, black bear, fox, coyote, woodpeckers, ruffed grouse, and mountain beaver.

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

1. Retaining old growth trees and managing for older forest conditions,
2. Planting and/or conserving a diversity of conifers and hardwoods,
3. Creating and maintaining horizontal heterogeneity (e.g. both open gaps and areas of higher stand density)
4. Conserving and/or recruiting larger diameter snags and downed coarse woody debris,
5. Planting and/or conserving mast (seed, berry and nut) producing shrubs,
6. 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. Natural recruitment 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 16 inches dbh. 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-fir and hemlock (typically with multiple dead tops) are good examples of this. They are rarer but also very important due to their long expected life span. The most important management decision regarding the wildlife habitat will be the retention of the snags, large down logs, and old growth conifers.

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

Downed logs: more than five logs per acre that are a minimum of 20" in diameter and 20' long

Snags: more than 4 snags per acre 20" in diameter and 60' tall

Wildlife Habitat Piles & Logs

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 constructed by stacking poles on bottom and piling fine branches on top.

Old habitat log constructed by piling small diameter poles together.

Management Recommendations

1. Retain all snags and minimize disturbance of large downed logs during forest management and timber harvesting activities. Over time, manage for the recruitment of at least 3-5 snags/acre >20" dbh and at least 3-5 downed logs >20" dia. and 20' long. Distribute non-merchantable log sections back out into the woods during logging.
2. Avoid significant forest management activities during the prime bird nesting season between March 15th – June 15th. This time also corresponds with the period of greatest bark vulnerability during the spring as sap begins rising in trees.
3. Landings and skid trails can be broadcast to a browse mix following logging activities to provide forage for deer and elk.
4. Retain hardwoods and manage for broader distribution across forest.
5. Habitat logs can be created in a managed stand by either leaving un-merchantable sections of logs after commercial harvest, or by using smaller logs obtained during pre-commercial thinning activities and stacking them parallel to each other. The latter can quickly be achieved when using a processor, and is an alternative to shipping low value pulp grade logs off the site. 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.

APPENDIX II. MANAGEMENT PLAN IMPLEMENTATION TIMETABLE (30 YEARS)

Year	Activity	FMU	Acres	Comments
2016 - 2021	Evaluate former road system and begin reopening key roads	NA	NA	This can be done in conjunction with commercial timber harvesting while equipment and contractors are on site. In some areas, reopening former roads and trails will yield a significant volume of timber. Stream crossing structures may be necessary to cross stream channels.
2016 - 2021	Commercially thin from below	1	114	FMU 1 can be thinned in phases over successive years. Remove 1/3 of the dominant trees and 2/3 of the understory trees, bringing stocking densities of both cohorts to approximately 140 and 200 respectively. Harvest should yield 5 - 8 mbf/acre of merchantable timber (not including pulp). Thin across the diameters to promote a more structurally diverse stand. Target white firs for removal on drier sites and steeper slopes, as well as hemlock infested with mistletoe and root rot pockets in Douglas fir. Do not cut any tree over 20" dbh unless it has obvious defect or disease. Retain only the most vigorous understory trees of each species, and those that still retain >35% live crown. Pulp logs can be processed into wildlife habitat logs and left in the forest by stacking together enough poles to create a minimum 20" diameter by 20' long constructed log. Slash should be lopped and scattered throughout the site to the extent that it does not produce a mat greater than 12" thick. All excess slash and woody biomass should be removed from the forest.
2016 - 2021	Develop fire breaks along forest edges adjoining private parcels.	1	NA	During logging operations, all understory trees less than 10" dbh should be removed within 100' of the property lines in order to interrupt the fuel ladder from understory to forest canopy. Limbs on remaining trees should be pruned to a minimum of 20'. All resulting slash should be removed from the site.
2016-2021	Pre-commercially thin by removing no more than 30 – 50 percent of the understory trees.	2	26.5	Target the white woods and cedar for removal (except in low spots), and space cedar apart by at least 15'. Retain the most dominant, largest diameter and/or highest quality trees. Slash should be lopped and scattered, poles piled into constructed habitat logs, and piled into discrete piles in openings in the forest away from trees. Slash mat should not exceed 12" deep. Cost per acre for PCT will be in the $600 - $1,000 range.
2026 - 2031	2nd pre-commercial thin.	2	26.5	If the slash from the previous thinning has softened sufficiently to no longer present a fire threat, these stands can be pre-commercially thinned a second time by removing an additional 30 – 50 percent of the understory trees as per above. Total stand density should be reduced to approximately 240 tpa.
2026-2031	Commercial variable density thin	1	114	Removing another 1/3 of the dominant trees, bring the stocking density of the canopy down to approximately 90 tpa. Harvest should yield at least 5 - 8 mbf/acre. Target dominant tree

				removal on white firs, hemlock infected with mistletoe and diseased or defective Douglas fir, as well as where vigorous understory trees will be released. Minimize damage to the understory cohort to the extent possible. During commercial logging, pre-commercially thin the understory to remove any defective trees, or to reduce competition in favor of Douglas fir and mountain hemlock on the drier sites.
2036 - 2041	Commercial variable retention harvest	1	114	Conduct a final harvest across the dominant trees by reducing their stocking density to 25 – 70 tpa. Select the best quality trees for retention as permanent biological and genetic legacies into future generations of the forest. Retained trees can be clumped and/or dispersed throughout the unit. Dominant trees should be removed where they will release vigorous understory trees. Understory trees that have come of commercial size can be thinned to reduce stocking density, however, the most dominant and vigorous trees should be retained. Favor Douglas fir and western hemlock on drier sites, and the white firs and cedar at lower elevations. By this time, significant natural regeneration will have occurred throughout the understory. If stocking densities exceed 240 tpa, pre-commercially thin to at least this density. Favor Douglas fir and western hemlock on drier sites.
2036-2041	Commercially thin (cable)	2	26.5	Evaluate both stands for commercial cable logging. If access can be achieved, stands can be thinned by removing up to 50 percent of the merchantable timber and bringing total stand density down to approximately 120 tpa. For cable logging to be financially feasible, a higher proportion of dominant trees will need to be removed. From this point forward, this unit should be thinned on approximately a 20 year cycle. Depending on how thick naturally regenerating conifers come into the understory, they may require periodic pre-commercial thinning to keep their densities below 200 tpa and well-spaced to about 15’ apart.
2046-2051	Commercial variable density thin	1	114	By now the second cohort of trees will be of sufficient commercial size to warrant thinning. Thinning should be conducted across the diameters and species, removing any defective or diseased trees and targeting dominant trees only where they will release vigorous understory trees. Overall stocking density across all cohorts of trees, including overstory, understory and natural regeneration, should be maintained at less than 360 tpa.

APPENDIX III. 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

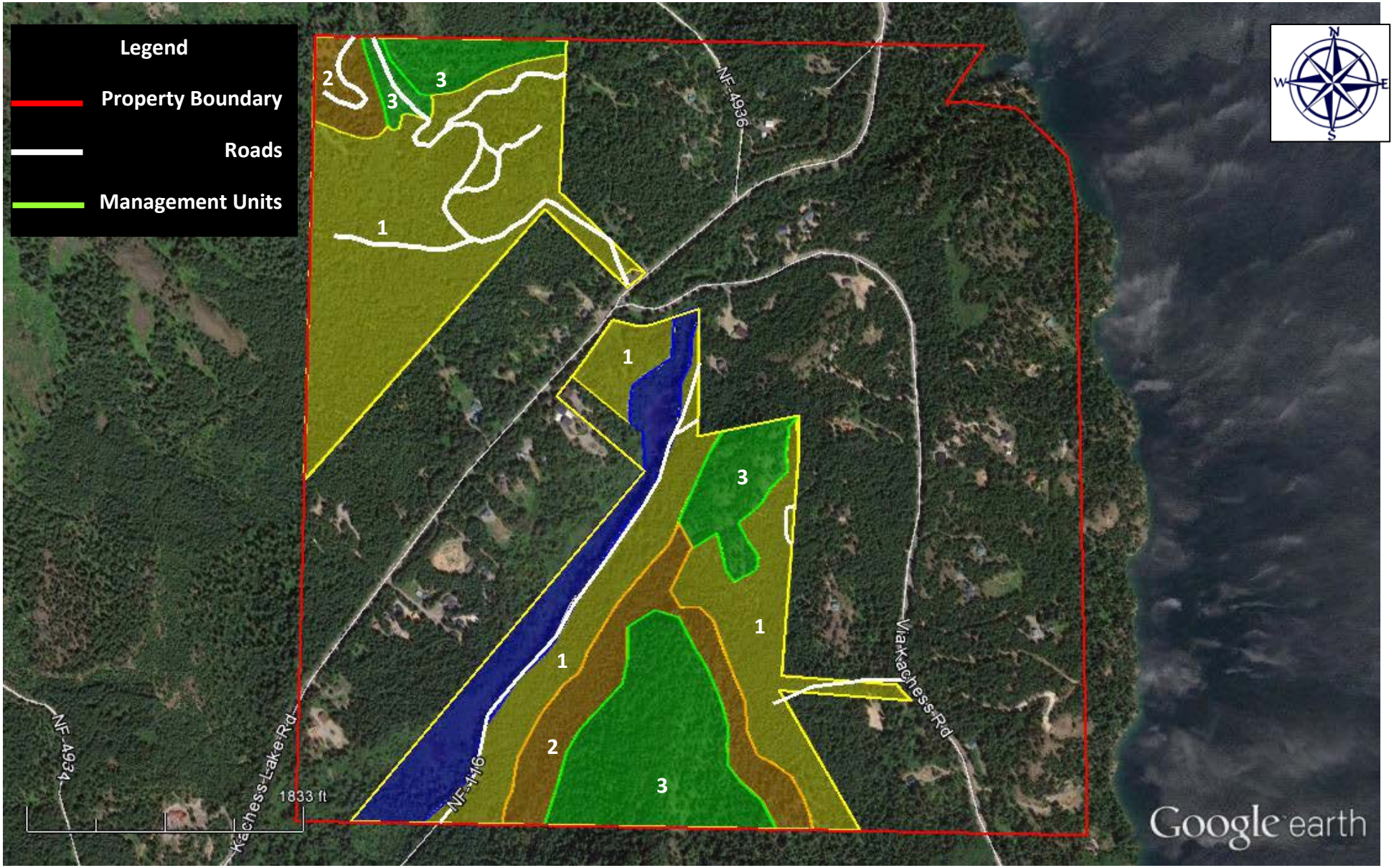
Monitoring record

Date	Observation	Note taker

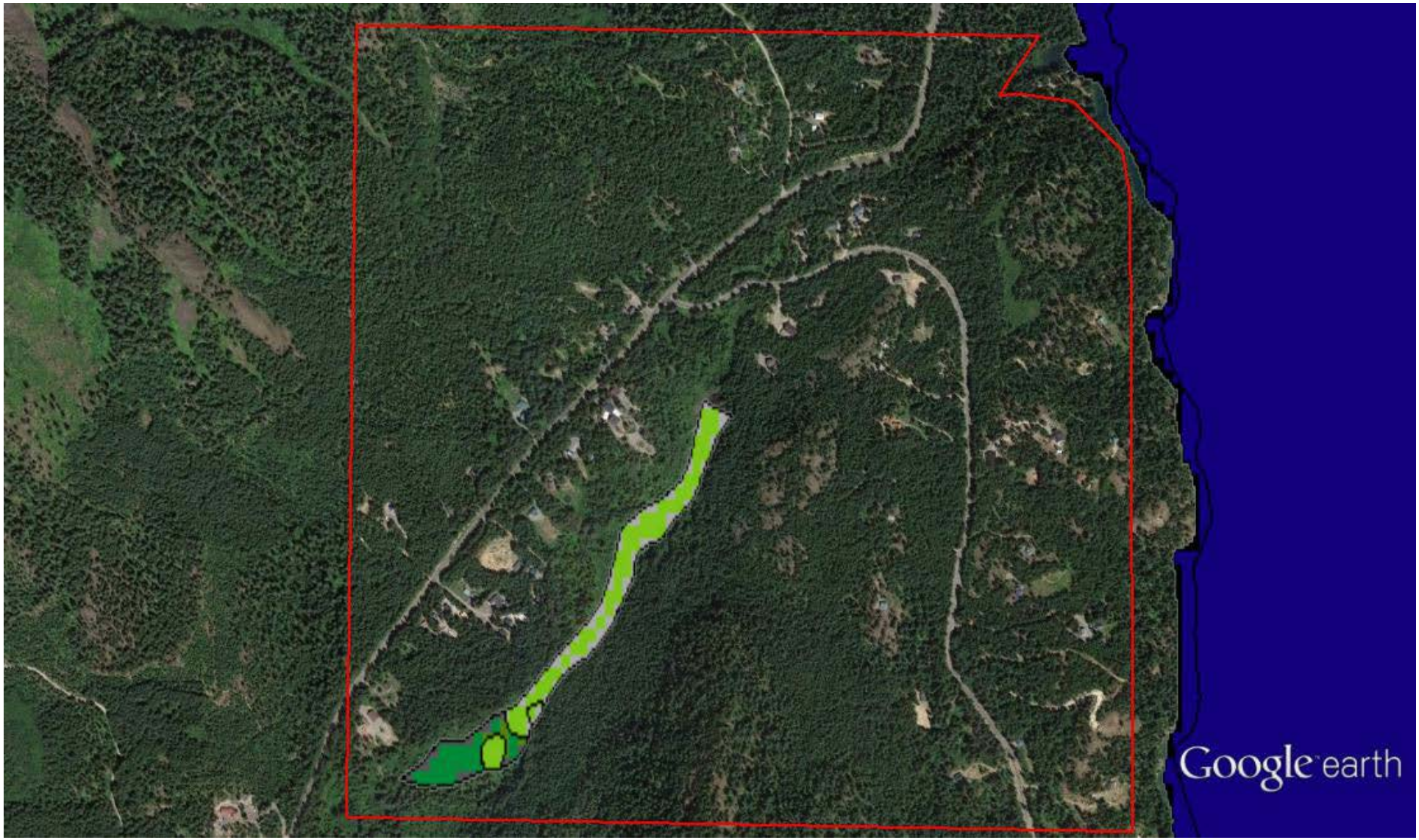
APPENDIX IV. AERIAL PHOTO(S)/PROPERTY MAP(S)

Aerial/Parcel Photo

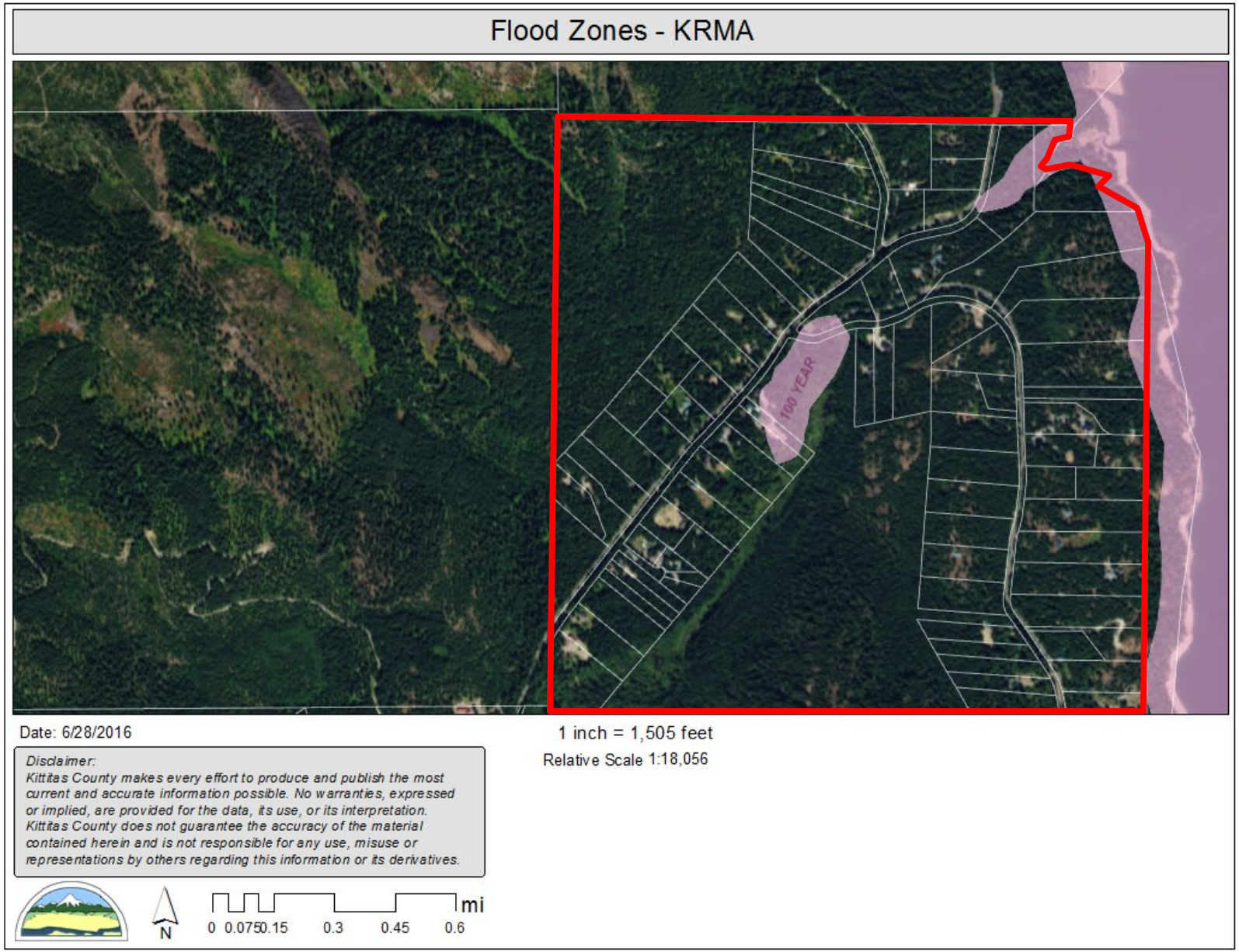
Plan Map


Legend
Property Boundary
Roads
Management Units
N
W
E
S
NF-4936
NF-4934
Kachess Lake Rd
NF-4116
Via Kachess Rd
1833 ft
Google earth

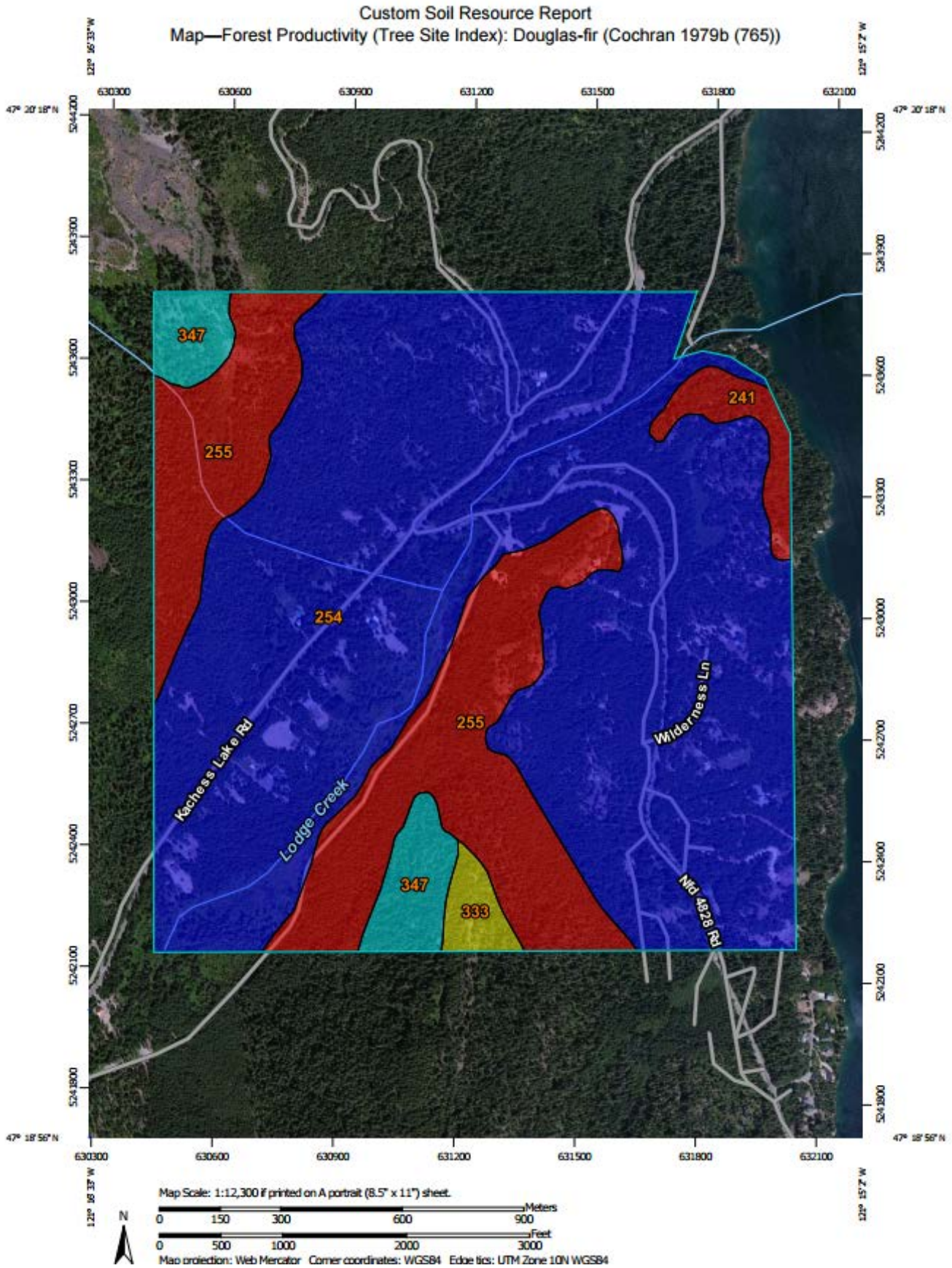
Wetlands Map – US Fish and Wildlife Service



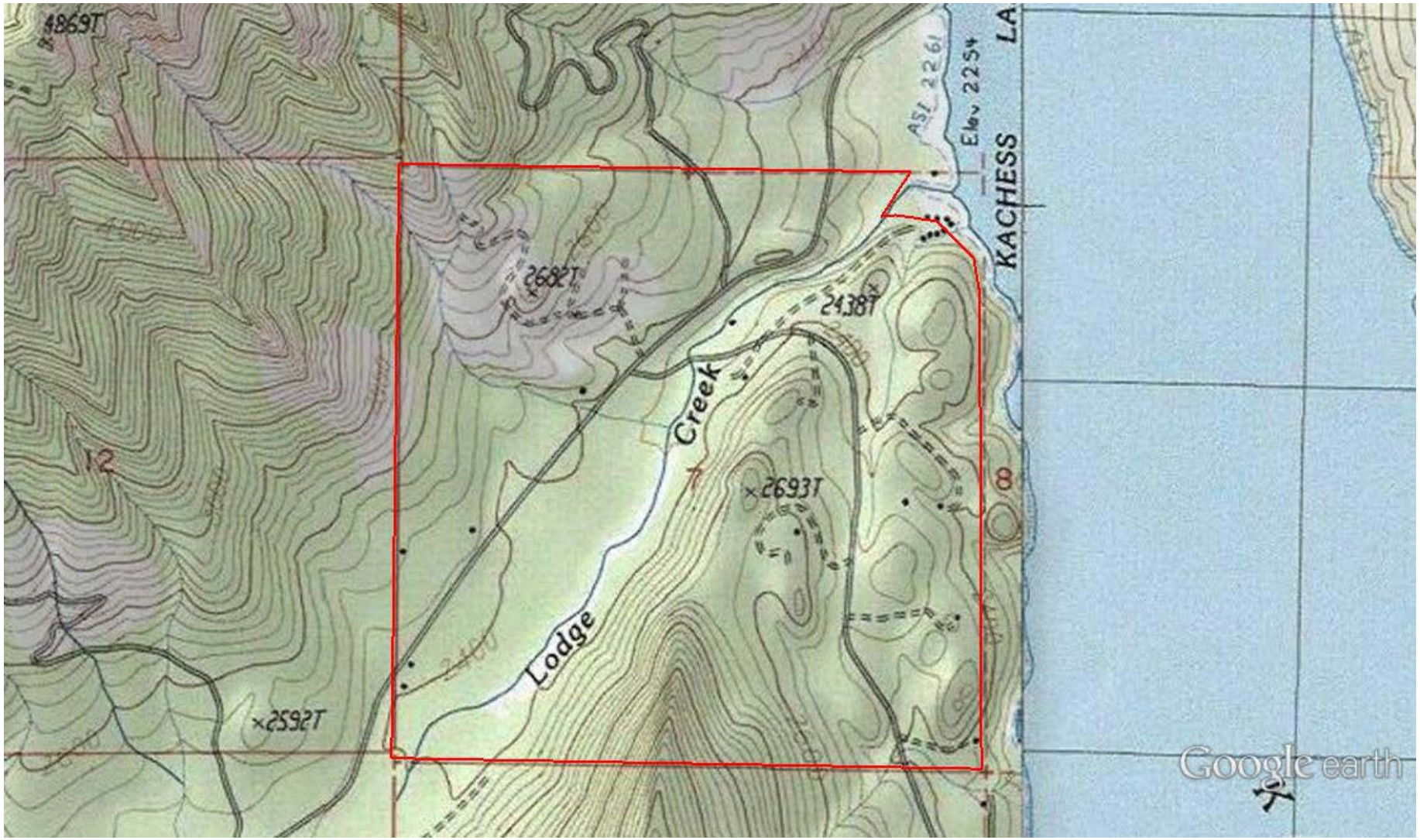
Flood Zones


Flood Zones - KRMA
100 YEAR
Date: 6/28/2016
1 inch = 1,505 feet
Relative Scale 1:18,056
Disclaimer:
Kittitas County makes every effort to produce and publish the most current and accurate information possible. No warranties, expressed or implied, are provided for the data, its use, or its interpretation. Kittitas County does not guarantee the accuracy of the material contained herein and is not responsible for any use, misuse or representations by others regarding this information or its derivatives.
N
0 0.075 0.15 0.3 0.45 0.6
mi

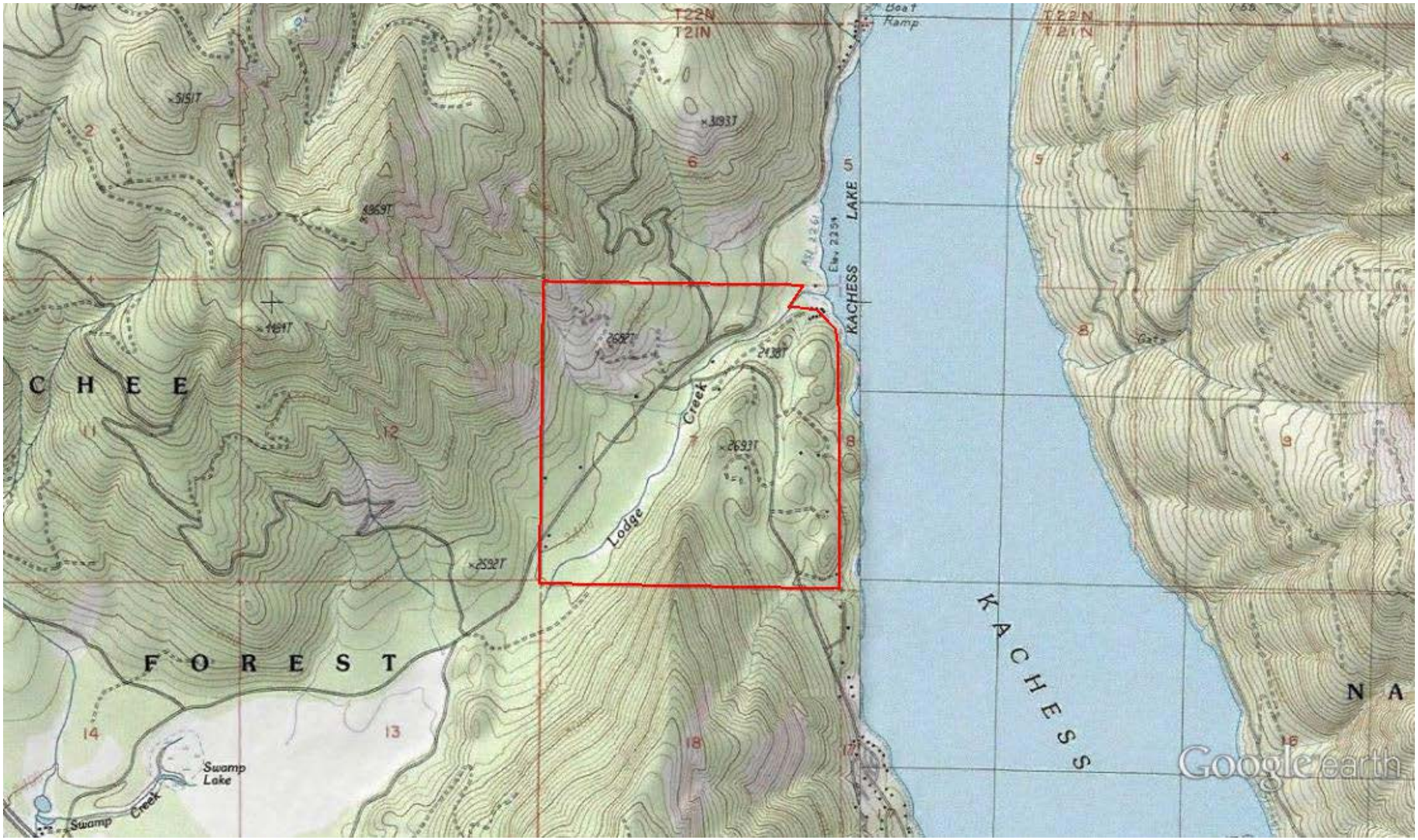
Soils & Forest Productivity Map



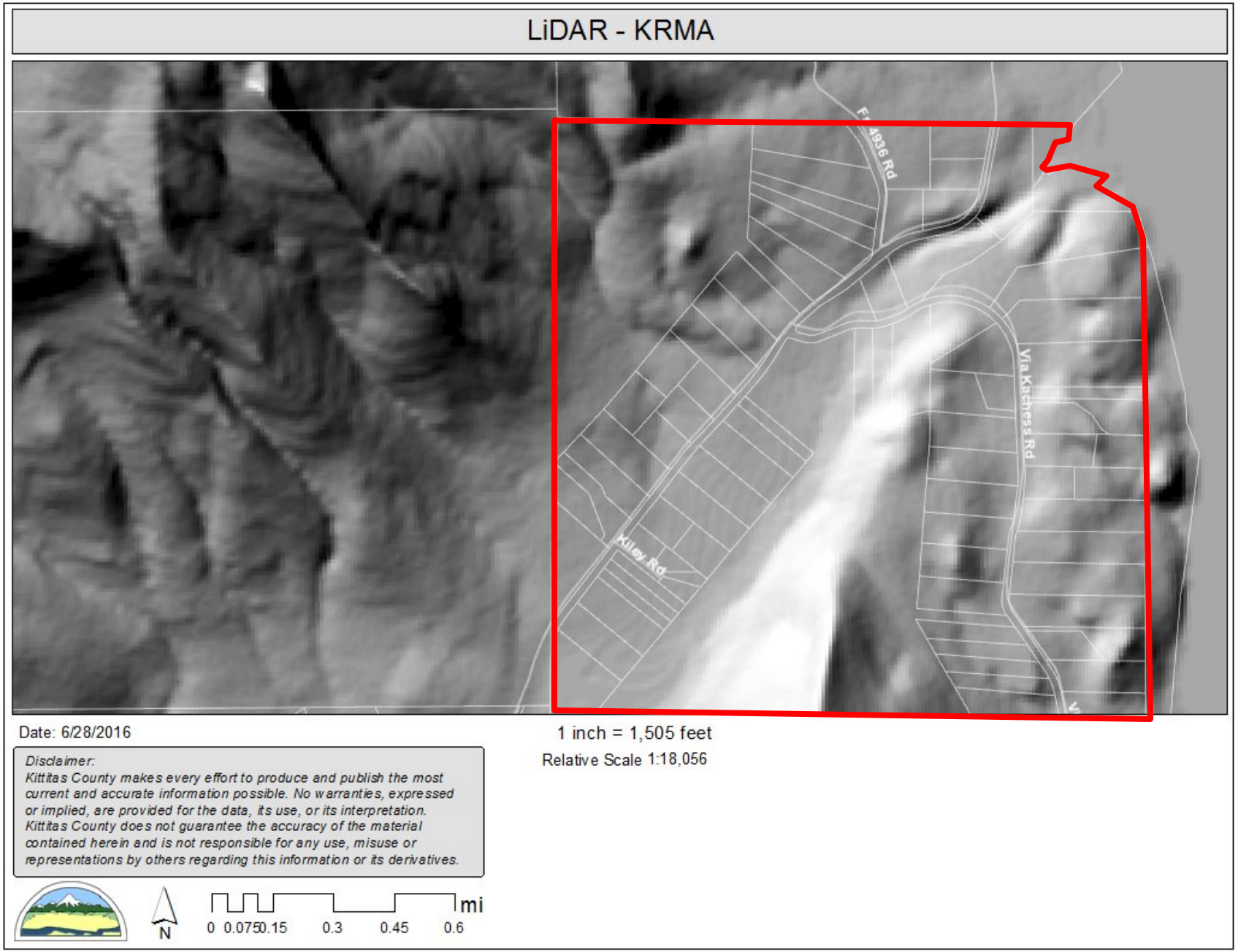
Topographic Map – Property



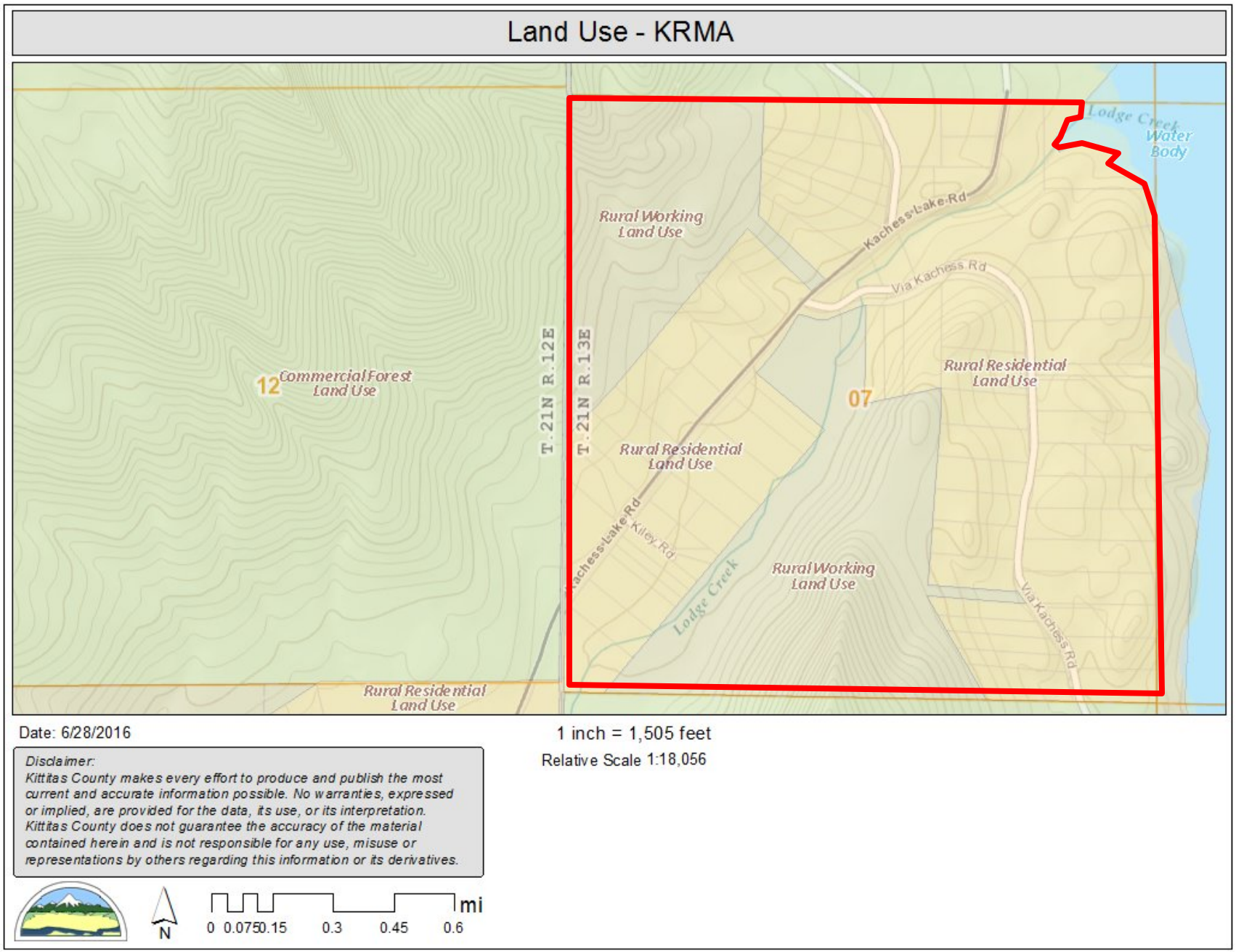
Topographic Map – Surrounding Area



LiDAR – Surrounding Area



Land Use


Land Use - KRMA
Lodge Creek Water Body
Rural Working Land Use
Kachess Lake Rd
Via Kachess Rd
12
Commercial Forest Land Use
T. 21N R. 12E
T. 21N R. 13E
07
Rural Residential Land Use
Rural Residential Land Use
Kachess Lake Rd
Kiley Rd
Lodge Creek
Rural Working Land Use
Via Kachess Rd
Rural Residential Land Use
Date: 6/28/2016
1 inch = 1,505 feet
Relative Scale 1:18,056
Disclaimer:
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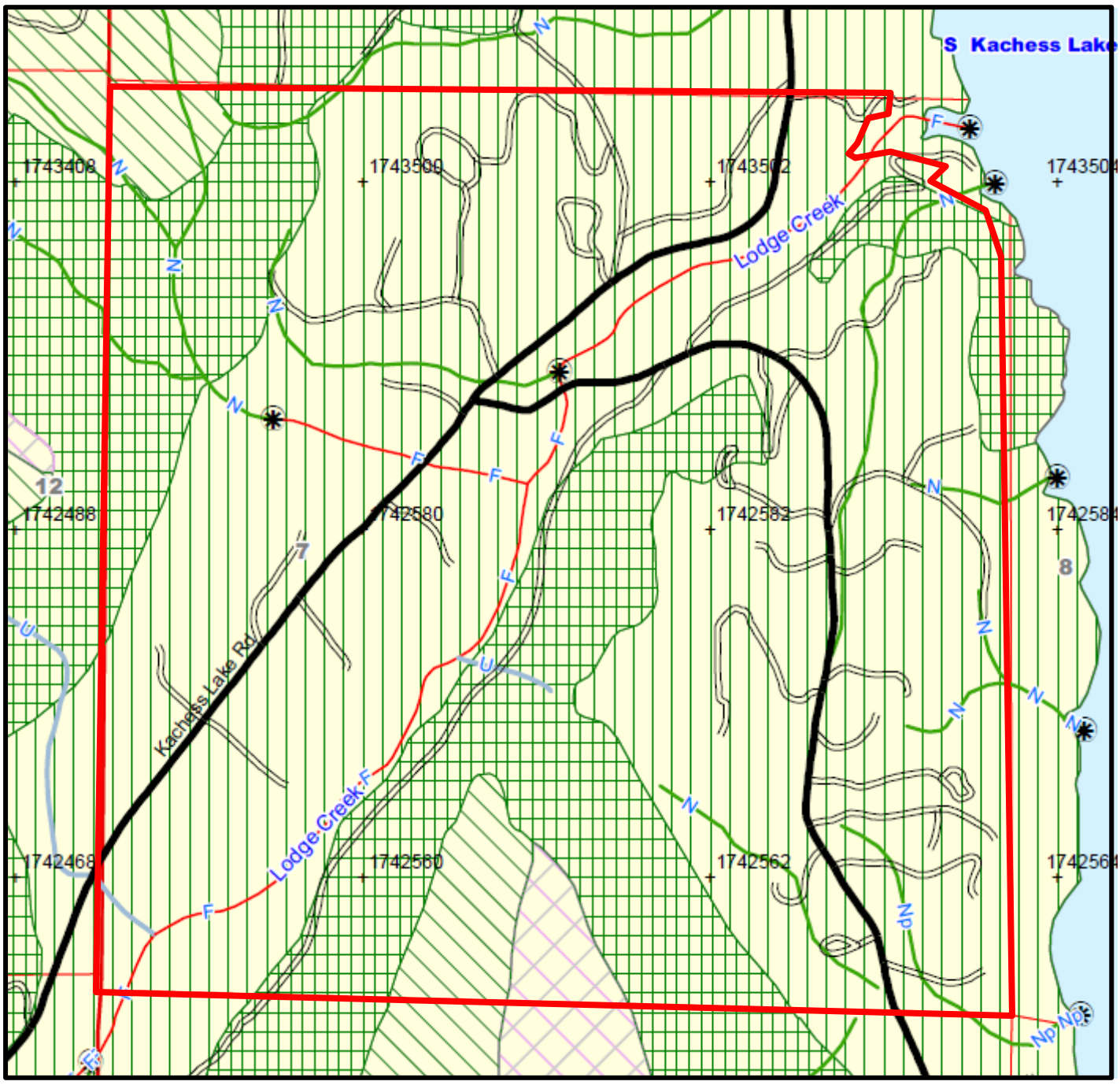
N
0 0.075 0.15 0.3 0.45 0.6
mi

Soil Site Class Map



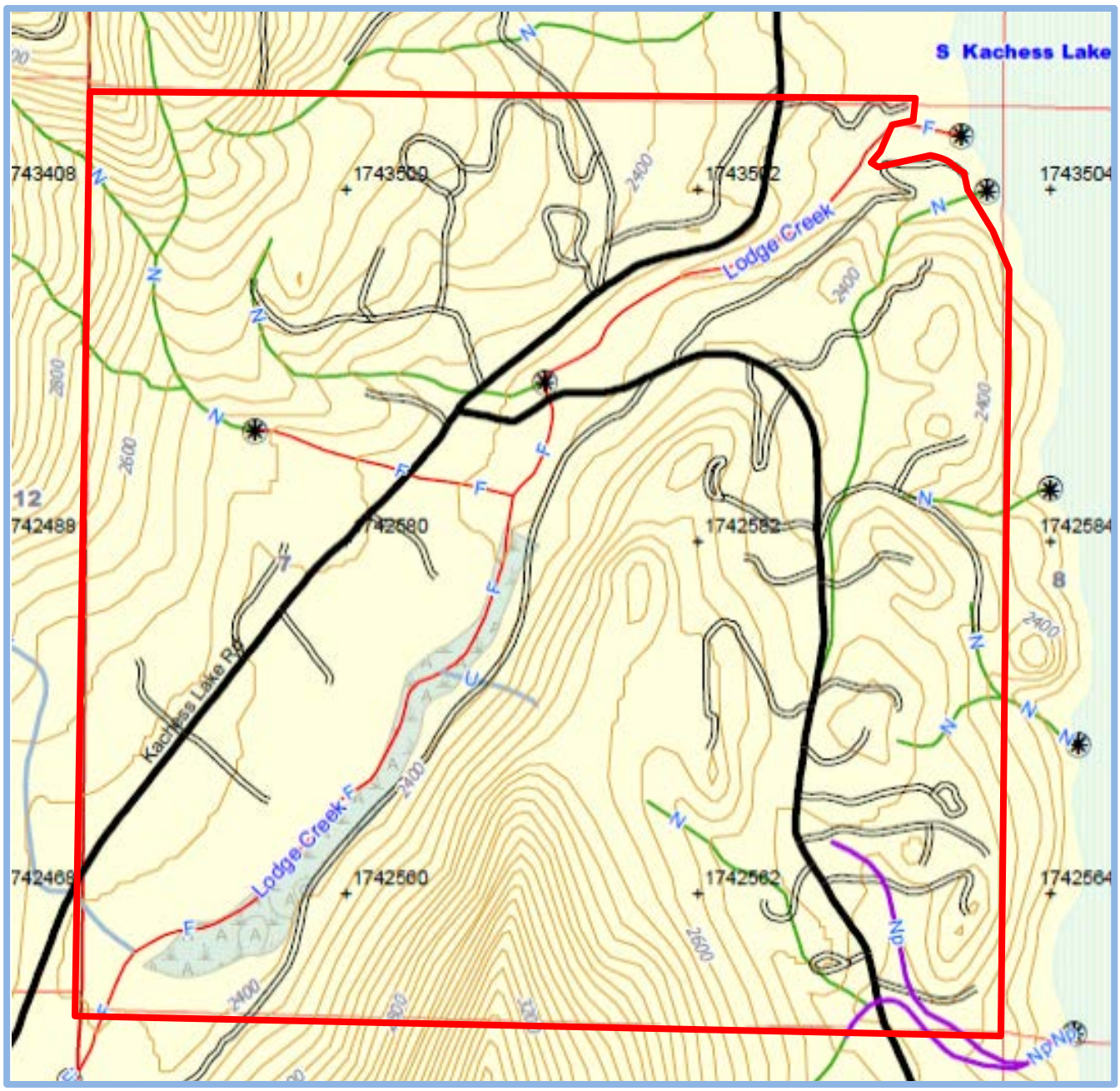
SITE CLASS – On Site Class Map only

- Site Class I
- Site Class II
- Site Class III
- Site Class IV
- Site Class V

SITE INDEX – On Site Class Map only

- Non-Commercial or Marginally Commercial
- No Data
- Red Alder

Water Type Map



STREAMS

- Stream Water Type S, F, N
- U, unknown
- X, non-typed per WAC 222-16
- Water Type Change

WETLANDS – Resource& Water Type Maps only

- Type A
- Type B
- Forested
- other