Roslyn Forest Land Stewardship Plan

July 3, 2008

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Roslyn Forest Land Stewardship Plan (LSP)
Executive Summary

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The Roslyn Forest (RF) is approximately 300 acres located in the north half of section 17, Township 20, Range 15, Kittitas County, Washington. It lies to the north and east of the developed footprint of the city of Roslyn.

Mature mid- to late-succession Ponderosa pine and Douglas-fir forests were characteristic of this fire-disturbed area in the eastern slopes of the Cascades prior to European settlement. These forests were historically adapted to "high frequency/low intensity" fires that maintained an open structure and were beneficial to the ecosystem. Due to past management practices, fires have been far less frequent, causing the RF to become overstocked with trees and other forest fuels making it more susceptible to high intensity/stand replacement fires and outbreaks of epidemic insect infestations. The aim is to return the modern landscape to historic conditions: a mosaic of open Ponderosa Pine grand fir forest, with varying degrees of tree densities and canopy closures, low volumes of hazardous fuel and adequate habitat opportunity for many species.

This Land Stewardship Plan was developed to make concrete steps for managing the RF for habitat and recreation. To do this, 15 areas were delineated for management purposes; each is described in terms of current conditions and is prescribed with a set of management treatments in this plan. Recommended treatments were designed based on plant associations and other site-specific characteristics (such as soils and water). The objectives of the LSP are to: (1) maintain and enhance a healthy native forest ecosystem, (2) provide for a quality non-motorized recreation experience, (3) manage forest fuels, (4) provide watershed protection, and (5) preserve, maintain, and enhance historical and cultural elements and sites.

In order to achieve the objectives, a Citizen Advisory Committee will be established. The Citizen Advisory Committee, appointed by the Mayor and confirmed by the Roslyn City Council, shall provide specific management recommendations to the City of Roslyn. Elements that are to be incorporated into an action plan have been outlined with the purpose of successfully implementing LSP strategies and recommendations within the next 5 years. It is critical to identify and prioritize specific recommendations in this plan and to develop detailed annual and seasonal plans of action. These action plans will be developed with input from the Advisory Committee and acted upon by the City of Roslyn, and should also involve public input and participation. The duties of the Citizen Advisory Committee shall be to make recommendations to the City of Roslyn on: (1) forest practices, (2) trail maintenance, (3) future forest product uses and sales, (4) modifications and revisions to the LSP, and (5) other specific management actions identified in the LSP.

The Roslyn Forest Land Stewardship Plan will: (1) provide habitat for a wide range of wildlife species, (2) help provide landscape permeability for wildlife moving through and into adjacent areas of open space, (3) reduce the risk of catastrophic fires, and (4) result in a visually attractive landscape. The RF will also serve as refuge for native wildlife species that are negatively impacted by the human population growth and development occurring in Upper Kittitas County.

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Introduction

The Roslyn Forest (RF) encompasses approximately 300 acres on the eastern slopes of the Cascade Mountains of Washington State was deeded to the City of Roslyn pursuant to paragraph 1.12.1 of the Second Amendment of the Settlement Agreement Regarding MountainStar Master Planned Resort, Cle Elum Urban Growth Area and Supporting Infrastructure and Services, by and between MountainStar Resort Development, LLC., and RIDGE. The RF lies to the north and east of the developed footprint of the city of Roslyn, which spans the southern boundary of the RF. This large expanse of open space serves as habitat for a variety of plant and animal species, and provides recreational opportunities for the citizens of Roslyn and its visitors. As part of the consideration for the conveyance of the RF to the City of Roslyn, the City agreed to the following: 1) no development of residential or commercial uses on the property, 2) the abandonment of any existing Forest Practice Permits; and 3) the adoption of a Land Stewardship Plan (LSP) that addresses use and any subsequent logging on the property.

Upper Kittitas Valley is experiencing increasing human encroachment on the landscape, including both development and recreational use. These, in turn, impact wildlife occurrence, abundance, behaviors, and wildlife/plant mortality in different ways. There is also concern regarding genetic separation of many species north and south of Interstate 90. Only through a more holistic approach to land use planning and resource management can we help mitigate these impacts. This involves collaboration with all interested parties in land use planning. Sustainable resource management must provide the quality of life desired by citizens, while also addressing the needs of a healthy environment. A holistic approach to land and resource management will help produce the best long-term results for a fully functioning ecosystem landscape.

The effectiveness of the RF as a corridor for wildlife in the face of these increasing pressures will largely depend on its relative landscape permeability and connectivity to different areas of source habitat (see Appendix C for a full explanation of these concepts). Overall landscape permeability in the future will be greatly dependent upon broad scale development and land management actions and patterns, such as the increased housing and road densities of suburban/urban character within the Suncadia resort and further development of the Roslyn Ridge. The fate of resident wildlife species which have large home ranges, such as the pileated woodpecker and Cooper's hawk, will ultimately depend on future development actions and patterns with similar impacts.

Due to timber management and fire suppression practices during the more than 100 years since European settlement, the RF is extremely dense with fuels from both trees and shrubs. Higher densities of trees tend to exploit water and nutrients, making tree stands more vulnerable to epidemic insect infestations, diseases, and catastrophic fires.

The forest's location fulfils an important function, serving as an undeveloped habitat connection between the Yakima River, Easton Ridge, Cle Elum River, and West Fork Teanaway River areas. There is currently development occurring on the lands adjacent to the west and north. (See Appendix F, Figure 2 for perimeter zoning.) The potential of

the RF as a wildlife corridor will be determined by future development of these surrounding areas.

The desired future condition of the RF will help provide landscape permeability and connectivity for wildlife moving through the mosaic of conservation easements and open space in the Roslyn/Cle Elum vicinity. Greenway and corridor design is a growing field within land-use planning. However, relatively few plans to date have had much consideration for ecological functions (Smith and Hellmund 1993). The main goals of the Roslyn Forest (RF) are thus to protect and enhance wildlife habitat and to provide a quality non-motorized recreational experience that minimizes impacts to wildlife and wildlife habitat.

To attain these RF goals over the long term, a detailed study and the development of a Land Stewardship Plan (LSP) was commissioned. The study assessed the RF in its current condition and compared it to an ideal healthy and functioning forest ecosystem. Two primary threats to the integrity of this forest ecosystem were identified: heavy fuel loads requiring fire management, and development on the surrounding private lands.

This Roslyn Forest Land Stewardship Plan (RF LSP) proposes management strategies to ameliorate any potential negative impacts as well as to enhance and maintain a healthy forest ecosystem that is visually attractive and safe for humans. The LSP recommends strategies to address landscape structure, with separate strategies for dry sites and wet/ moister sites. Improving and protecting forest health is discussed through techniques to reduce the risk of fire, insects, disease, exotic species and noxious weeds. Finally, approaches are recommended for roads, trails, and passive recreation.

The LSP covers the following topics:

1. Detailed management goals and objectives;
2. Descriptions of existing current conditions;
3. Desired future conditions, in keeping with the identified management goals and objectives (both general and specific to certain identified vegetation types and locations);
4. Practices and procedures that will foster these desired future conditions;
5. A monitoring plan to document and track conditions and outcomes of management practices in the future;
6. A 5-year action plan for LSP implementation; and
7. Procedures for updating this LSP in the future.

Roslyn Forest Area Description

The RF contains moderately varied terrain and habitat types, from dry open areas to moist forest. Factors which drive this varied landscape include: the steady decrease of rainfall east of the Cascade crest, aspect, slope, soil types, and natural disturbances such as fires and floods.

Historic Overview

Human impacts have played a role in creating this landscape. Native Americans historically "managed" the landscape for many purposes, such as to increase game and vegetation productivity. However, the degree of influence on the RF is not well understood. Human activities, such as development, logging, fire suppression, agricultural practices, mining, damming, and recreation have altered and will continue to alter the landscape in many ways.

Historically, conditions for forests at this elevation with south and west aspects were more open, characterized by large, widely spaced Ponderosa pine and Douglas-fir with a modest shrub layer. While no records of the initial harvesting of this section have been located, a timber survey completed in 1956 by Kittitas County states: "Area adjacent to Roslyn fully stocked with good quality yellow pine (Ponderosa) and fir (Douglas) reproduction 40 to 60 years old. Was logged of merchantable timber many years ago" (Appendix E, Figures 1 and 2). It is most likely that the timber taken at that time was used for building the City of Roslyn and structures related to mining activities.

The RF is an important post-settlement historic area. There are ten sites within the RF that are listed on the Roslyn Register of Historic Places (see Appendix F, Figures 9 and 10). These sites are: Original Roslyn Reservoir Site, Roslyn Electric Star/Cross, Sliding Rock, Chimney Rock, Picnic Rock, Roslyn No. 8 Mine Incline, Roslyn No. 6 Incline, Ronald/Roslyn Power Pole Line, Mine Slag Piles, and the Cedar Gulch Trail. Three trails are listed on the City of Roslyn Register of Historic Places: the Cedar Gulch Trail, the Roslyn #6 Rail Incline, and the Roslyn #8 Rail Incline.

Soil

Soil is the basic resource upon which all plant growth is dependent. Since plant roots (including trees) need air to breathe and water to grow, soil texture and structure which delineate this are very important. More than half of the "feeder roots" of trees and other plants are in the top 6 to 8 inches of the soil where the bulk of the organic matter and nutrients are. Soil compaction and other site disturbances reduce soil pore space for air and water, resulting in lower site productivity.

Forest soils are made up of four main ingredients: (1) mineral particles, (2) organic matter, (3) water, and (4) air. Soil "texture" refers to the makeup of the mineral particle size. Soils that have a larger proportion of clay and silt are finely textured. A higher proportion of sand results in a coarse textured soil. A soil made of roughly equal amounts of sand, silt, and clay is referred to as a loam. Loams tend to be more fertile, and to have good water holding capacity. Organic matter (decaying vegetation woody

material) is an important component of a forest soil. Soils with high organic matter have better "structure," which leads to greater fertility and greater water holding capacity.

The dominant soil type found in the RF is known as "Roslyn Sandy Loam." This is a deep, well drained soil formed from glacial drift or old alluvium (deposited by moving water) with a layer of volcanic ash and loess (deposited by wind). This soil drains quickly, is less susceptible to "compaction," and is less easily eroded than fine soil types. Organic matter content in this area is moderate since dry sites are associated with slower decay.

Water

There are six intermittent stream channels that flow primarily from spring snow melt from the adjacent private lands on the Roslyn Ridge above (see Appendix, B Figure 8). These channels dry up by mid-summer, but evidence suggests ground flow movement persists throughout the year based on flows in wetlands located below the RF. There is one spring located adjacent to an opening in the southwest corner of the RF.

Vegetation

The RF is within the Douglas-fir vegetation zone, which is considered to be a dry forest type. It transitions to the moister grand fir zone to the west and the drier Ponderosa pine zone to the east. The majority of the RF faces south and west (see Appendix F, Figure 3), which suggests drier conditions except in a few small north facing pockets and riparian zones (areas along water bodies). These micro-climates can result in moister conditions.

Forests are distinguished by plant species growing together. The RF predominately consists of the Douglas-fir/common snowberry/pinegrass and the Douglas-fir/shiny-leaf spirea/pinegrass plant associations, which represent the driest sites (plant association descriptions in Appendix C). These areas are generally characterized by large trees that are widely spaced with low to tall undergrowth of shrubs and grasses. The riparian areas are represented by the grand fir/vine maple, grand fir/common snowberry/pinegrass, grand fir/Cascade Oregon grape, and Douglas-fir/common snowberry plant associations.

Wildlife Habitat Conditions

The RF currently supports a diverse array of wildlife species, some of which are integral to a fully functioning ecosystem. The amount and type of habitat required differs from species to species, depending on what each requires throughout the stages of its life. Some animals and plants require a very small area, while others need up to 300 square miles of available habitat. Certain species even require diverse habitat types throughout the course of the year. A fully intact ecosystem includes habitat potential for this wide range of species' needs. The RF helps provide critical connectivity for species moving within and between the Yakima River, Easton Ridge, Cle Elum River and West Fork of the Teanaway River (see Appendix D and Appendix F, Figures 1 and 2).

Medium to large mammal species common in the RF include deer, elk, black bears, mountain lions, bobcats, and coyotes. Douglas squirrels, Townsend's chipmunks, and yellow pine chipmunks can also be found throughout the RF, as well as a variety of mice, moles, voles, shrews, and one species of gopher. The nocturnal northern flying squirrel, an important component to ecosystem integrity, dens in snags and mistletoe brooms found in the RF (Lehmkuhl *et al* 2006b).

The forest also provides an array of nesting habitats for many resident birds, as well as foraging areas and potential nest sites for birds with large home ranges: these include pileated woodpecker, Williamson's sapsucker, red-naped sapsucker, Cooper's hawk, and sharp-shinned hawk (all of which currently nest in the Roslyn vicinity). Owls, such as the great-horned and saw-whet owls, commonly nest in this area.

Some animals have more specific habitat needs. Riparian zones provide habitat for amphibians and mollusks, while reptiles such as the western fence and alligator lizards can be found on drier sites. The bushy-tailed woodrat prefers cooler and moister areas, particularly riparian, which have rocks large enough to provide crevices for dens (Lehmkuhl *et al* 2006a). The golden mantled ground squirrel seems to prefer drier areas with abundant downed wood.

The RF is also important in seasonal migration patterns. For example, the northern goshawk is likely to use the RF to prey on species such as ruffed grouse and snowshoe hare. Many species of neotropical migrant bird species (most migrating songbirds) can be spotted in this area.

Existing Recreation Opportunities

The RF serves as a regional recreational amenity because of its proximity to the City of Roslyn, an outdoor tourism destination. There over 5 miles of identified trails/roads in the RF that are widely used for many different recreational purposes (see Appendix F Figure 9). Most of these trails follow road beds used originally for timber harvest and mining purposes. Another widely used trail follows a modern fiber optic line up a steep grade. Additionally, there are approximately 1.6 miles of recently constructed user-built trails throughout the RF primarily used by local mountain bikers.

Recreation activities in the RF shall be in accordance with this LSP.

Roslyn Forest Land Stewardship Plan

The City of Roslyn shall administer the lands covered by this LSP pursuant to the terms contained herein and in accordance with and subject to the restrictions contained in the conveyance of the land to the City in the Assignment of Purchaser's Interest in Purchase and Sale Agreement for Roslyn Ridge as well as the recorded Declaration of Covenant Restricting Use of Roslyn Ridge, executed by the City on September 24, 2004 and recorded with the Kittitas County Auditor as Record No. 200409300069 ("Declaration of Covenant"). The City will stay true to the recorded Declaration of Covenant and the LSP when considering any future amendments to the LSP or in the implementation and administration of the LSP and shall do so in accordance with the terms of this LSP.

It is understood that the following Main Goals and Priorities of the Roslyn Forest (RF) are to:

1. Maintain and enhance a healthy forest ecosystem;
2. Provide habitat and habitat connectivity/permeability for a wide range of wildlife species;
3. Provide a quality non-motorized recreational experience;
4. Manage forest fuels to reduce the risk of catastrophic fires;
5. Provide watershed protection;
6. Preserve and maintain historical and cultural elements and sites;
7. Preserve and maintain the landscape such that it is visually attractive and safe for people;
8. Provide non-motorized access to and across the RF and adjoining properties to create access from the City of Roslyn to Cle Elum Ridge and beyond to the Teanaway Valley, with the exception of possible snowmobile access as set forth in Section (E) of the "Overview of Management Strategies" of this LSP; and
9. Balancing recreation with protection of wildlife and habitat.

The above Main Goals and Priorities may not be amended in the future except in accordance with the provisions set out in this LSP. The LSP supports these Main Goals and Priorities. More specific Goals and Objectives of the LSP that include and support the above Main Goals and Priorities are set out below and throughout the LSP, and should be read to bolster the Main Goals and Priorities. These Goals and Priorities shall guide the City's administration of the RF and LSP.

Goals and Objectives of the Land Stewardship Plan

1. Maintain and enhance a healthy native forest ecosystem.
    a. Implement dry forest management (i.e. Ponderosa pine and Douglas fir).
    b. Implement riparian and moist site (mesic) management.
    c. Prevent and control the presence of exotic and invasive plants and animals.
    d. Minimize impacts of insects and disease.
    e. Maintain and protect wildlife habitat connectivity/permeability.
    f. Protect and enhance the forested viewshed from the City of Roslyn.

2. Provide for a quality non-motorized recreation experience.
    a. Develop looping trail systems within the RF.
    b. Create incentives for a "ridge-wide" trail system.
    c. Provide for the safety of trail users.
3. Manage forest fuels.
    a. Reduce the risk of catastrophic stand replacement fires.
    b. Maintain a "firesafe" perimeter around the City of Roslyn.
    c. Maintain an appropriate amount of downed wood (coarse woody debris or CWD) and snags (dead trees) for wildlife habitat.
4. Implement watershed protection.
    a. Identify and address storm water and surface water runoff issues that exist between adjacent private lands, the City of Roslyn, and the RF.
    b. Control erosion and sediment flowing into downstream water systems.
5. Preserve, maintain, and enhance historic and cultural elements of the RF.

Holistic Management Approach

The ongoing management described in this LSP promotes and demonstrates a holistic approach to land use planning and development in Upper Kittitas County in order to help produce the best long term results for the objectives and goals stated above. The LSP approach involves collaborating with all interested parties in developing objectives and goals for land use planning and resource management that provide for the quality of life desired by citizens while also addressing what is needed for sustainable natural resources and a healthy environment.

Other local examples of holistic management plans are seen in the measures that have been taken to create and protect the RF, the Stream "C" Corridor (West Fork Teanaway River), the Cle Elum River Corridor, and the additional open space within the City of Roslyn and within Suncadia. These areas have helped to retain and can help to foster future landscape connectivity for wildlife that range between the Yakima River and the West Fork Teanaway River, via the Cle Elum River Valley and Roslyn Ridge.

LSP Citizen Advisory Committee

In order to achieve the desired future conditions and management objectives of this plan, an LSP Citizen Advisory Committee will be established in conjunction with the adoption of this LSP or if not concurrently, then within sixty (60) days after the adoption of the LSP.

The Citizen Advisory Committee shall be appointed by the Mayor and confirmed by the City Council and shall consist of Citizens of Roslyn representing local interest groups as well as other interested citizens. The City will also request that a representative from the Washington State Department of Fish and Wildlife participate with the Citizen Advisory Committee as well as any other representative of the State that is interested in participating. The Citizen Advisory Committee shall meet quarterly at a minimum with more frequent meetings initially. The Citizens Advisory Committee shall adopt rules and

bylaws and shall comply with the Washington Open Public Meetings Act (Chapter 42.30 RCW). All reports, minutes, and communications by the Citizen Advisory Committee shall be copied to the Roslyn City Council and at least annually a report shall be made to the City Council. The duties of the Citizen Advisory Committee shall be to make recommendations to the City of Roslyn on specific:

1. Forest practices,
2. Trail work,
3. Modifications and revisions to the LSP,
4. Future forest product uses and sales, and
5. Other specific management actions identified in this LSP.

Another purpose of the Citizen Advisory Committee is to provide an ongoing review of all aspects of the LSP and to provide updates and recommendations to the City Council when needed and to provide official comment on any action that involves review under SEPA or the City's Critical Areas Ordinance. The Citizen Advisory Committee shall also provide specific written comment within the timeframe set out by this LSP for any proposed amendments to the LSP.

5-Year Action Plan

An Initial Action Plan shall be developed by the Citizens Advisory Committee and approved by the City Council within sixty (60) days of the adoption of the LSP. The Initial Action Plan shall include specific treatments to be implemented during 2008 that shall address the most critical issues set out in this LSP or portions thereof, including but not necessarily limited to, forest fuel management, fire fighting access, and access restrictions. The plan should also involve public input and participation.

A Five-Year Action Plan shall be developed by the Citizens Advisory Committee and approved by the City Council by December 31, 2008, for the period from January 1, 2009 through December 31, 2013. The Five-Year Action Plan shall identify and prioritize specific recommendations and develop detailed annual and seasonal plans of action towards the successful implementation of the strategies and recommendations outlined within it. The Five-Year Action Plan shall be updated annually by December 31 of each year to maintain a five-year timeframe. These plans should involve public input and participation.

The list below outlines elements of the LSP that need to be addressed in the 5 year action plan.

1. Prioritize, schedule, and implement site-specific treatments;
2. Develop, prioritize, schedule, and implement management demonstration sites for public education and comment;
3. Develop and present specific requests for adjacent landowners to foster holistic land use management and to protect and enhance the natural and recreational assets of the RF (i.e. using "firewise" techniques on adjacent private forests, storm water runoff mitigation, possible trail system expansion);

4. Develop, prioritize, schedule, and implement volunteer work groups.
5. Prioritize, schedule, and implement forest/habitat projects for future funding and volunteer work;
6. Prioritize, schedule, and implement a monitoring program (See "Monitoring" below and Appendices F and G);
7. Prioritize, schedule, and implement a recreation management program;
8. Develop and enact an annual work plan;
9. Develop and implement a process for project approval; and
10. Develop immediate and long-term funding plans (including grant writing).

Costs Associated with Implementation and Future Activities

The limiting factor for LSP implementation will be funding. Funding sources could be, but are not necessarily limited to: (1) city tax dollars, (2) grants, (3) harvesting of merchantable timber and the sale of other forest products, and (4) fund-raising events and/or campaigns.

Future LSP Monitoring

Ongoing monitoring of field conditions and plan success in reaching goals and objectives is an integral part of adaptive, holistic management. At the discretion of the City Council this work may be done through contracted services, a position created within a Land Trust, a state agency, educational institution and/or by volunteer groups and interested individuals.

The ongoing design of the RF monitoring plan should be considered an adaptive and fluid process. It will need to incorporate new information and issues as they surface, while still adhering to the identified management goals and objectives of this LSP. The Citizen Advisory Committee shall conduct, at a minimum, an annual meeting to oversee the monitoring of LSP implementation and effectiveness. The continued use, recruitment, and expansion of volunteer groups and the constructive use of public input should also be high priorities of the monitoring process. The Citizen Advisory Committee shall provide a report to the City Council that summarizes the findings of the review and provides all recommendations, if any, regarding changes or alterations to the monitoring program.

Administration of LSP

The City of Roslyn as the owner of the RF shall be responsible for the day to day operation of the RF and the LSP, subject to any specific procedures or restrictions set out in this LSP. It is the intent of the City to closely follow the recommendations in the LSP but it is understood by all of the parties that the City must have discretion and flexibility in order to best implement the LSP and its related action plans and effectively manage the RF. It is also understood that the City shall exercise its discretion in accordance with the Main Goals and Policies of the RF and LSP and will not exercise its flexibility or discretion in a way that is in opposition to these Main Goals and Policies unless said Goals and Policies are first amended in accordance the with the process set forth in the

following provision titled "Amendments to LSP." It is further understood that nothing in this agreement should be construed to limit the City's inherent powers to address emergency situations and it is understood that the City will take actions necessary to address the emergency in order to protect the RF.

Amendments to LSP

In the event the City of Roslyn finds it necessary to amend the Main Goals and Priorities, or make amendments that impact the intent of the LSP or its recommendations, it shall obtain the written consent of RIDGE and Suncadia LLC, or their successors and assigns, subject to the procedure set out below. RIDGE and Suncadia LLC shall each receive written copies of the proposed amendments and shall have sixty (60) days following the receipt to object in writing to the proposed amendments. If either party fails to respond during the sixty (60) day time period it shall be presumed that party agrees to the amendment and the same shall be noted on the record at the time the City Council adopts the amendments and noticed public meeting. The Advisory Committee shall have sixty (60) days to consider any proposed amendments to the Goals and Priorities of the RF and LSP that are not suggested by the Committee and shall make recommendations in writing to the City Council prior to the Council adopting any such amendments. The City Council shall also hold a noticed public hearing on any proposed amendments to the Goals and Priorities of the RF and LSP and any amendment thereto shall not become effective until after such public hearing is conducted.

Management Recommendations

The desired future conditions are described in this section. Techniques are then laid out to achieve those objectives, followed by site-specific prescriptions for each stand within the RF. Wherever applicable, more specific objectives are given on a specific site-by-site basis. These strategies are designed to most quickly and effectively reach the desired future conditions, and are similar to those recommended for adjacent, regional managed landscapes, particularly the shaded fuel break descriptions found in the Cle Elum River Corridor LSP (Hess 2004) and Stream "C" Corridor LSP (Begley 2006).

All management actions will be field verified prior to any on-the-ground activity. All management treatments shall only occur if deemed necessary for overall forest health. Additionally, any management treatments in riparian areas will need to be in accordance with the city's Critical Area Ordinance (CAO) and will need to be approved by the City of Roslyn in accordance with existing regulations, ordinances and permits. Prior to a decision on any CAO action, the City shall review all written comments and recommendations and/or justifications submitted by the Advisory Committee to the City.

Desired Future Conditions

These desired future conditions described are designed to mimic the historic mature forests typical of this area (large widely spaced Ponderosa pine and Douglas-fir). More moist sites dominated by grand fir should move toward late successional conditions. These were characteristic of the fire disturbance regime in the eastern slopes of the Cascades prior to European settlement. The site specific management prescriptions are designed to achieve these desired future conditions by restoring areas towards their historic structure based on plant associations and other site specific characteristics (i.e. soils and hydrology). Treatments are based on current and historic conditions, site potential toward achieving the goals for the forest, site context within the broader landscape, and expert opinion.

A- Landscape Structure

The general landscape of the RF should be patchy configuration with varying degrees of tree densities and crown closures mimicking a landscape in continual change, as it would be in natural disturbance cycles, such as fire. There is an emphasis on open forest. This will best ensure its effectiveness as a wildlife corridor and provide habitat for the widest range of wildlife and plant species; the RF could even serve as refuge for native wildlife species that are negatively impacted by the human population growth and development occurring in Upper Kittitas County. Detailed conditions of this patchy configuration are given in Appendix G.

B- Riparian Zones

The moist area and riparian objective is to create and protect continuous and diverse vegetation for dense cover critical to many species; this is done through encouragement of late successional, or climax conditions, at the pace that their particular site and micro-climate allows.

C- Forest Health (Fire, Insects, and Disease)

The desired structure mimics historic conditions on eastern Cascade slopes described earlier as "open forest, characterized by large, widely spaced Ponderosa pine and Douglas-fir with a modest shrub layer." This structure will help provide an overall healthier forest that is more resistant to disease, insects, and fire. Though disease, insects, and fire are integral parts of the natural ecosystem, each can create significant negative impacts in an unhealthy forest, including safety hazards to humans, particularly the risk of catastrophic wildfire.

D- Noxious Weeds and Exotic Species

Noxious weeds compete strongly with native species and often eradicate natural biodiversity. Noxious weeds spread by various means, including wind, animals, and humans. Introduced species, such as European starlings, house sparrows and other animals, can also upset the natural balance by out-competing their native wildlife counterparts for resources, and by their aggressive predatory behaviors. Therefore, noxious weeds and exotic species should be controlled. This will be a challenge due to the lack of same management techniques on all landscapes surrounding the RF, and the fact that some species currently established are very hard or impossible to remove.

E- Roads, Trails, and Non-Motorized Recreation

Recreational use of the RF will be designed to allow for a quality experience within a living forest that minimizes impacts to wildlife and wildlife habitat. Recreation will only include non-motorized recreation such as hiking, biking, jogging, snowshoeing, and cross country skiing. A coordinated "ridge-wide" trail system that would provide slow-speed egress and ingress from the City of Roslyn to the Cle Elum Ridge may be incorporated at a later date. The desired future condition includes an established trail system with well designed trailhead(s) that receives annual maintenance.

Overview of Management Strategies

A - Dry Site Strategy

These types of treatments should only occur in areas dominated by the Douglas-fir/ pinegrass, Douglas-fir/common snowberry/pinegrass, and the Douglas-fir/shiny-leaf spirea/pinegrass plant associations. Areas represented by these three plant associations, the great majority of the RF, should generally be widely spaced (~60-80 trees per acre), and around 75 to 100 of basal area per acre[1]. Grand fir, which is fire and shade tolerant, should be removed from these areas.

To create these conditions, treatments call for the reduction of much of the smaller wood in the forest. Removal of some smaller diameter trees (1-15 inches) is prescribed. This helps larger, dominant trees to grow faster and to reach mid- to late-succession conditions sooner. Treatment also includes a general reduction of the shrub layer and abundant

[1] Basal area is the amount of tree mass at breast height (4.5' above ground). A tree with a 14" diameter at breast height has approximately 1 square foot of basal area.

downed wood, leaving some on site and creating random piles for wildlife habitat. The reduction of the shrub layer, especially dense thickets of oceanspray, will create a more open understory. Tree limbs up to approximately 10 feet above ground are known as "ladder fuels" for their notoriety of bringing low ground fires up into the tree crowns, and should be pruned on many trees. Snags are dead standing trees; they offer unique nesting habitat for birds. Snag densities in the treated area should be a minimum of 6 snags per acre and ideally 10-20 snags per acre. Topping trees is prescribed for areas that have less than 6 snags per acre. Debris from treatment activity should be burned on site in piles, and/or chipped. If chipping is used, piles should be hauled off site using the existing road beds to help reduce the risk of hazardous fuels.

Prescribed low intensity burning should be considered in these sites after these treatments. The drier plant associations are well adapted to fire, and some plant species may require it to fulfill their actual life history requirements, which is why low level managed burns are recommended. Managed burns will also help to lower the amount of woody debris which can create catastrophic wildfire, and will result in a visually attractive landscape. In areas where this strategy is recommended, small random patches (~1/4 acre) of touched areas should remain.

This prescription should be initiated as soon as this LSP is adopted and should be maintained every 5-7 years. A rotation schedule can be established by dividing up the parcels into 5-7 annual groups. This occasional (every 5-7 years) understory/shrub reduction, lower limb pruning, and low intensity thinning will help mimic the role of the historic high frequency (~ every 15 years), low intensity fires that burned primarily through the understory, killing relatively few trees.

This strategy helps to reduce competition between trees for the limited amount of available water and nutrients, thereby promoting a forest that is more resilient to disease and insect infestation. The creation of snags will mimic the low mortality of trees associated with these historic types of fires, and will provide habitat for a variety of wildlife species. Ladder fuel pruning is used to help prevent catastrophic wildfires that result in high tree mortality and human safety hazards.

B – Riparian and Moist (Mesic) Site Strategy

The moister sites are mainly found in riparian zones and a few small north facing pockets. They tend to be dominated by the grand fir/ vine maple and grand fir/ Cascade Oregon grape plant associations.

Riparian zone conditions are dictated by requirement of the City of Roslyn Critical Areas Ordinance (CAO) (Ordinance 1002, Roslyn City Code Subchapter 12.13). This ordinance requires all channels within the RF to have a 300 foot riparian protection buffer (See Appendix F, Figure 8). In this buffer, no disturbance activity is generally permitted. Management treatments shall therefore be very limited in these areas. The main technique is preservation, leaving these areas "as is," to develop to climax conditions at the pace that their particular site and micro-climates allow. If the LSP Citizen Advisory Committee finds that there is some site-specific portion of these buffers that may be

better managed to meet the goals and objectives of this LSP, the Committee will approach the City of Roslyn with its written recommendations and rationale. When improvements are recommended by this LSP, they are listed in site-specific prescriptions.

The objective is to create continuous and diverse vegetation in riparian zones. In the areas identified for enhancement, the low intensity treatment consists of planting native vegetation according to the existing plant association and other factors specific to the site. The plants used for these enhancement activities must be transplanted or purchased by a native plant provider.

C – Insects and Disease Strategy

Prescriptions such as hazardous fuels reduction and firewise treatments are recommended to reduce risks to forest health from insects and disease, as well as to minimize safety hazards to humans, particularly the risk of catastrophic wildfire.

Insect infestations are endemic elements of the ecosystem and will (and should) always persist in the landscape. Tree mortality associated with disease and insects are natural generators of snags and downed wood. Openings, usually called pockets, created by root rot and bark beetles create structural diversity across the landscape. Recently killed or dying trees can be topped to help create snags. However, dense dry forests that are altered from their historic structure can encourage epidemic proportions of infestation, causing excessive change to the landscape, such as the mountain pine beetle epidemic of 1990.

Treatments in areas where insects or disease have already had a dramatic toll, such as dense pockets of beetle kill, could include felling highly decayed snags and piling downed wood. Piles should be either burned or chipped. These types of treatments in turn will reduce hazardous forest fuels that promote catastrophic fires.

Specific stands with insect and disease concerns are identified as applicable, with site-specific prescriptions.

D - Exotic and Noxious Weed Strategy

The primary noxious weed in the RF is knapweed. Knapweed and other noxious weeds tend to be located on or adjacent to pre-existing roadbeds and other disturbed sites. Volunteer groups can control noxious weeds by hand pulling and bagging them annually in the spring before they become strongly established or go to seed. If weed populations become too much to control by hand pulling, biological control agents, such as the knapweed root weevil, could be considered. Herbicides use should only be considered in exceptional and limited situations.

Hand pulling does not require prior field verification or review by the RF Citizen Advisory Committee.

E - Roads, trails, and Passive Recreation Strategy

The existing trails will provide only non-motorized looping trails within the RF. Recreational uses will only include passive recreation such as hiking, biking, jogging, horseback riding, snowshoeing, and cross country skiing, subject to any necessary restrictions to protect the trails. The established trail system with well designed trailhead(s) will receive annual or biannual maintenance.

Existing roads will be closed to all motorized vehicles (including snowmobiles and dirt bikes), except for management and emergency purposes. Existing roads may also be minimized and/or removed. Snowmobiles will not have ingress/egress access through the RF to access the Cle Elum Ridge from the City of Roslyn unless a coordinated "ridge-wide" trail system is created working in conjunction with adjacent property owners. Such a trail system would provide perpetual recreational, non-motorized access from the City of Roslyn to the Cle Elum Ridge and beyond into the Teanaway Valley. In the event that such a trail system is possible, and to the extent that its creation is dependent on snowmobile ingress/egress through the RF, then a corridor for slow-speed snowmobile travel across the RF will be considered as part of the LSP. Any such plan shall be reviewed by the Advisory Committee and must be approved by the Roslyn City Council with input from the Kittitas County Recreation District #1 adjacent landowners, and Citizens of Roslyn. Until such a system is developed, if ever, the trails will provide only non-motorized looping trails within the RF.

A recreation management section shall be incorporated in the 5-year action plan which includes:

1. Trail identification, maintenance, closures, and re-routing planning;
2. Trailhead placement and design;
3. Rules of conduct establishment (i.e.dogs, off-trail travel, direction of travel, smoking, music, gathering plant or other natural materials);
4. Trail signage;
5. Mixing and/or segregating trail uses (i.e. hiking, biking, horseback riding, skiing, snowshoeing);
6. ADA (disability) access;
7. Adjacent private access and usage;
8. Public education;
9. Volunteer coordination; and
10. Prioritization of recreational needs for future funding.

Site-Specific Recommended Prescriptions and Treatments

The RF was broken up into 15 regions, called "stands," for study and treatment purposes, as seen in the map references of stand descriptions in Appendix F, Figures 1-10. Stand description conditions were surveyed and analyzed in order to apply appropriate prescriptions specific to the landscape. Factors of consideration were those that influence the abundance (or limitations) of wildlife populations and potential for passive recreation.

Plant associations, number and crown cover of trees, amount of living downed wood in the understory layer, insect and disease infestations, noxious weed establishment, trails, and historic sites were therefore the considered variables. For a full description of each stand, see Appendix H.

Where the dominant landscape of the stand is dry, the prescription uses a dry site strategy. Where there is wet area, riparian treatments are prescribed. If there is a problem with heavy fuel loading, insects, disease, or noxious weeds, these are addressed. Historic site management will be noted where appropriate.

Stand A

Apply the dry site strategy throughout this stand.

Stand B

B1 – Small Diameter Tree Removal

The dense pockets dominated by Ponderosa pine 6-10 inches diameter at breast height (dbh) and about 25-40 feet tall should be thinned. Remove the smallest diameter trees around larger more dominant trees, with the goal of achieving 100-150 trees per acre with a basal area of 75 to 125 square feet per acre, dominated by Ponderosa pine. All shade tolerant grand fir should be removed. The remaining trees will grow faster, reach late succession conditions sooner, and be more resistant to insects and disease by reducing competition for the limited amount of available water.

B2 - Meadow Creation/Restoration

The openings in the north portion of the stand could be restored to resemble a more natural grassland/meadow. The beginning phase should control noxious weeds by hand pulling and bagging annually in spring and early summer. It is impractical to try to remove the non-native grasses. Wildflower species such as lupines and paintbrush should be added through transplanting attempts; seed or starts should be purchased if available. Ongoing annual maintenance should occur for this restoration effort to be continuously successful, including selective removal of encroaching trees.

B3 – Periodic Stand Maintenance (5–7 years)

Apply the dry site strategy throughout this stand.

Stand C

Apply the dry site strategy throughout this stand.

Stand D

Apply the dry site strategy throughout this stand.

Stand E

Apply riparian and mesic site strategy throughout this stand.

Stand F

Although the stand is almost entirely within the 300 foot riparian buffer, the dry site strategy should be applied to this stand.

Stand G

G1 – Riparian and Mesic Site Strategy

The riparian and mesic site strategy should be applied throughout all of the eastern exposures and any areas represented by the grand fir/ vine maple plant association.

G2 – Dry Site Strategy

The dry site strategy should be considered in the drier west and south facing areas, though consideration must be made due to this site being within the 300 foot riparian buffer.

Stand H

H1 – Dry Site Strategy

Apply dry site strategy in the center of this stand. The area located within the 300 foot riparian buffer has a high amount of western pine beetle infestation and would benefit by dry site treatment.

H2 - Meadow Creation/Restoration

The openings in the north portion of the stand could be restored to resemble a more natural grassland/meadow. The beginning phase should control noxious weeds by hand pulling and bagging annually in spring and early summer. It is impractical to try to remove the non-native grasses. Wildflower species such as lupines and paintbrush should be added through transplanting attempts; seed or starts should be purchased if available. Ongoing annual maintenance should occur for this restoration effort to be continuously successful, including selective removal of encroaching trees.

Stand I

Apply dry site strategy throughout this stand. The area within the 300 foot riparian buffer has a high amount of western pine beetle infestation and dry site treatment should be considered.

Stand J

J1 –Riparian and Mesic Site Strategy

The riparian and mesic site strategy should be applied in any areas represented by the grand fir/ common snowberry/ pinegrass plant association and areas within the 300 foot riparian buffer.

J2 – Dry Site Strategy

Apply dry site strategy in the drier west and south facing areas.

Stand K

Being entirely within the 300 foot riparian buffer zone, apply the riparian and mesic site strategy throughout the stand.

Stand L

L1- Historic Preservation
Preservation and restoration of historical places and features should be a priority in this stand.

L2 - Noxious Weed Control
Apply knapweed and Dalmatian toadflax control near the slag piles, Number 6 Line, and other historic structures. This should be done by hand pulling and bagging, and should take place each spring and early summer.

L3 - Riparian and Mesic Site Strategy
Being entirely within the 300 foot riparian buffer zone, the mesic site and riparian strategy should be applied.

Stand M

M1- Riparian and Mesic Site Strategy
Due to steep slopes, and being within the 300 foot riparian buffer zone, it is recommended to leave this stand "as is."

Stand N

N1- Riparian and Mesic Site Strategy
Due to steep slopes, and being within the 300 foot riparian buffer zone, it is recommended to leave this stand "as is."

Stand O

This area needs further assessment. An initial prescription is proposed below.

O1- Riparian and Mesic Site Strategy
It is recommended to leave this stand "as is."

O2 – Historical Feature Preservation and Restoration
The remains of historical buildings on this site should be preserved and potentially restored.

APPENDICES

Appendix A: Definitions

Basal Area: The amount of square feet of trees at breast height (4.5 feet). A 14 inch diameter at breast height (dbh) tree has approximately 1 square foot of basal area.

Conifer Release: A prescription to "release" established coniferous trees from a situation in which they have been suppressed by thinning out undesirable trees and shrubs which have overtopped them. This is carried out to improve the growth of the coniferous trees.

Fire/Disturbance Regime: An apparently stable vegetative community whose distinctiveness depends on being burned at rather regular intervals. Fire will effectively prevent the vegetative community from reaching its true climax potential.

Habitat: (a) The type of a place where an animal usually lives or, more specifically, the collection of resources and conditions necessary for its occupancy. Habitat is organism/species specific (e.g. pileated woodpecker habitat). (b) A set of specific environmental features that, for terrestrial animals, is often equated to a plant community, vegetation association, or cover type.

Habitat Connectivity: Refers to the homogeneity of habitat across the landscape.

Habitat Fragmentation: Disruptions to habitat connectivity due to either natural disturbances (e.g. fire), barriers (e.g. large water bodies), or human influenced disturbances (e.g. development).

Landscape Permeability: Refers to the relative ease that an animal can move across a particular landscape. Factors such as vegetation types, road and housing density, and slope can influence landscape permeability.

Palustrine: Non-tidal wetlands that are dominated by trees, scrubs, emergents, mosses and lichens.

Seral Stages: Ecological communities (sere) that succeed one another in the biological development of an area (e.g. early, mid, late).

Sere: A sere is a stage in a sequence of events by which the vegetation of an area develops and becomes more complex, usually referred to by its dominant tree species, which may be the largest or most common.

Shaded Fuel Break: A prescription for forest stands to modify ground fuels and ladder fuels to help prevent a ground fire from becoming a crown fire.

Succession: Process in which communities of plant and animal species in a particular area are replaced over time by a series of different and usually more complex communities (seres).

Riparian Zones: Strips and patches of land and vegetation that border streams.

Wetland: An area that is regularly saturated by surface water or groundwater and is characterized by a prevalence of vegetation that is adapted for life in saturated (hydric) soil conditions (e.g. swamps, bogs, fens, marshes, and estuaries).

Appendix B: List of Acronyms

ABGR/ACCI – Grand fir/ vine maple plant association

ABGR/BENE – Grand fir/ Cascade Oregon grape plant association

CERC – Cle Elum River Corridor

CWD – Coarse woody debris (downed wood)

DBH – Diameter at breast height

DEIS – Draft Environmental Impact Statement

GIS – Geographic Information System

GPS – Global Positioning System

LSP – Land Stewardship Plan

MPR – Master plan resort

PSME/CARU – Douglas-fir/ pinegrass plant association

PRBO – Point Reyes Bird Observatory

PSME/SPBEL/CARU – Douglas-fir/ shiny-leaf spirea/ pinegrass plant association

PSME/SYAL/CARU – Douglas-fir/ common snowberry/ pinegrass plant association

PSME/SYAL – Douglas-fir/ common snowberry plant association

WDOE – Washington Department of Ecology

WDFW – Washington Department of Fish and Wildlife

Appendix C: General Concepts Related to Landscape Management

Landscape

A landscape has been defined as a land area with groups of plant communities or ecosystems forming an ecological unit with distinguishable structure, function, geomorphology, and disturbance regimes such as fire (Gaines et al 1999, Forman and Godron 1986, Noss 1983, Romme and Knight 1982). Landscape diversity refers to the number of distinct ecosystems, or combination of ecosystems, and types of interactions and disturbances present in a particular landscape. The importance of landscape structure, in biodiversity has been well documented and established in scientific literature. Structural diversity and complexity of a forest refers to the size and arrangement of trees and other plant species present.

Biodiversity

A healthy ecosystem is generally represented by a wide variety of species, a phenomenon known as "biodiversity," and by a lack of introduced and invasive species, such as European starlings or knapweed. Gast *et al.* (1991) defined biodiversity as "the variety, distribution, and structure of plant and animal communities, including all vegetative stages, arranged in space over time that support self-sustaining populations of all natural and desirable naturalized plants and wild animals." Also, Wilcox (1984) described biodiversity as the variety of life forms, the ecological roles they perform, and the genetic diversity they contain. A biodiversity hierarchy theory has been developed that consists of the genetic, species-population, community-ecosystem, and landscape or regional levels in order of smallest to larget. The biodiversity hierarchy theory suggests that what happens at higher levels of an ecological system, such as the landscape or ecosystem level, will constrain the lower levels, such as the species or genetic levels (Allen and Star 1982, Noss 1990). Along with these levels, biodiversity can be influenced spatially and temporally.

Habitat

Habitat is commonly known as the area where specific animals, or a set of animals, live. In this LSP, "habitat" is defined as a set of specific environmental features generally equivalent to a particular plant community, vegetative association, or cover type (Garshelis in Boitani and Fuller 2000). Factors of interest in the development of this LSP are conditions that control the abundance and distribution of, or that limit, wildlife populations, (called limiting factors), and potential modifications through future actions and conditions.

In the process of assessing habitat value, a series of steps were taken. First, habitat conditions that impact wildlife goals were identified (listed in Appendix H). Next, the habitat changes that are likely to occur in the future, including modifications from human development, were also identified. Once habitat changes were determined and forecasted, the next step was to determine how the wildlife community will respond to

these changes. Future development and other potential changes will dictate management prescriptions designed to create desirable changes in the habitat variables identified.

This process is imperfect because habitat lost or changed does not necessarily cause proportionate losses in wildlife populations. Some parts of the habitat can be more critical than others, and most actions don't totally remove habitat, but rather cause a change in its functionality for wildlife use. Forecasting the amount of habitat loss is much easier than measuring a reduction in habitat value. As an example, quantifying the terrestrial habitat lost to the construction of a reservoir is much less subjective than evaluating the reduction in habitat value caused by selective logging in a similarly sized area. In many cases, habitat analysts can not clearly show how changes in habitat will translate into loss of ecological functioning serving wildlife goals. This inability to quantify connections between the habitat measures and the wildlife populations is the norm rather than the exception, and will likely continue to hinder the assessment of impacts on wildlife and habitats (Holling 1978, Beanlands and Duinker 1983, Anderson and Gutzwiller 1994).

Corridors

Corridors, or a linear extent of habitat, serve important functions for wildlife. The most important components of a corridor are width, connectivity, and quality (Thorne in Smith and Hellmund 1993). Corridor width determines how much of a corridor will be exposed to physical, human, and biological intrusions, and/or edge effects from the outside. Very narrow corridors (line corridors) are entirely influenced by edge. Wider corridors (strip corridors) are broad enough so that a portion of their area will be free of these effects (Forman and Godron 1986).

According to Thorne (ibid), habitat connectivity is determined by the number and severity of breaks along a given stretch of corridor. Along corridors, breaks are most often caused by roads, but other land uses and natural disturbances to vegetation can create breaks. The degree of connectivity determines the suitability of a given corridor for different uses, especially for movement of wildlife, and to a lesser degree, for movement of people. Some animal species will require a high degree of connectivity, whereas others may adapt to breaks in a corridor. A different way at looking at this is to express connectivity as landscape permeability – how easily an animal can move across the landscape during its life cycle. For example, the ease with which a herd of elk can move across the landscape from winter to summer grounds is a measure of permeability. Reducing connectivity makes it harder for wildlife species to disperse to and from different areas of source habitat.

According to Thorne (ibid), corridor quality also depends on the structure of vegetation within the corridor. A corridor of optimal quality will typically have good vegetation structure that varies in abundance and heights, a variety of plant species, and a minimum presence of exotics. The mere presence of a corridor of adequate dimensions may be insufficient for movement and habitation; poor corridor quality can exclude species and prevent their movement (Henein and Merriam 1990).

The design of a corridor must start with the examination of the context in which it will exist. The pattern of elements in the landscape and trends of the surrounding matrix have to be considered to determine the effectiveness of the corridor. In most cases, corridor planning is constrained by landscape fragmentation and increasing development pressure. Having a good understanding of the consequences from likely future scenarios will help provide a better land stewardship plan.

Vegetation

Vegetation forms a continuum across the landscape. Vegetation units are developed for functional resource management criteria (i.e. timber or range), conservation measures, ecological and botanical classifications, mapping, etc., and are often associated with landscape units, ecological units, or animal habitats. Often, the differences among vegetation types are not strongly defined. Patterns in vegetation are thought of by some as being driven by environmental variation. This variation may be viewed as a spectrum of change, or "gradient," and vegetation changes subtly along these gradients. Where the line is drawn is dependent on the purpose of a vegetation classification scheme.

The Washington Department of Wildlife considers old-growth forests east of the Cascade crest to be highly variable in tree species composition and structural characteristics due to the influence of fire, climate, and soils. In general, these stands will have about 10 trees per acre that are older than 150 years of age and larger than 21 inches diameter at breast height (dbh); it will also have between 6 and 18 snags per acre (1-3 greater than 12 inches dbh). Canopies may be single or multi-layered, and downed logs may vary from abundant to absent.

The Washington Department of Fish and Wildlife defines the riparian zone as

> "the area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other… Riparian habitat encompasses the area beginning at the ordinary high water mark and extends to that portion of the terrestrial landscape that is influenced by, or that directly influences, the aquatic ecosystem. Riparian habitat includes the entire extent of the floodplain and riparian areas of wetlands that are directly connected to stream courses."

In both dry and wet sites, the biological and physical properties of the aquatic ecosystems are influenced by adjacent vegetation, nutrient and sediment loading, terrestrial wildlife, as well as organic and inorganic debris. In riparian systems, the vegetation, water tables, soils, microclimate, and wildlife inhabitants of terrestrial ecosystems are influenced by perennial or intermittent water.

Development Considerations

Development has a well studied impact on habitat, connectivity, and permeability. Roads and highways can have both direct and indirect impact on wildlife presence, abundance,

and movement. Four adverse effects of roads include (1) destruction or alteration of habitat due to construction, (2) disturbance of habitat along roads due to noise, vibrations, car visibility, artificial lighting, etc., (3) physical barriers created by roads that can vary from increased resistance for movement to effective separation of functional areas, and (4) collisions between wildlife and motorized vehicles that result in injury or death (Jaarsma in Jongman and Pungetti 2004). There are many examples in scientific literature that demonstrate how roads directly affect populations of insects, reptiles, amphibians, breeding birds, and mammals. Collisions with wildlife and motorized vehicles are also a human safety risk. High densities of roads and development fragment the landscape, making the area less permeable to wildlife.

Buildings and typical "yard" alteration of the natural landscape also make significant changes on the ecosystem. Scientific literature has shown increases in the diversity of species during the early stages of land development. This is because natural succession is selectively altered, creating a new array of habitat types. However, it has been shown that the diversity of species will ultimately decrease with an accompanied increase of a few dominant species, usually exotics. Other studies have shown that heavily human-influenced areas favor granivores (i.e. rodents), medium-sized omnivores (i.e. raccoon), ground feeders (i.e. American robin), and sedentary species (i.e. dark-eyed junco). There will be fewer cavity nesters (i.e. white-breasted nuthatch), ground nesters (i.e. Nashville warbler), and insectivorous migrants (i.e. swallows), while forest-interior species (i.e. Townsend's warbler) will persist in resultant and isolated patches. It has been shown that species with larger home ranges and specialized predators become extirpated because of habitat fragmentation and restrictions on movements by individuals.

The effectiveness of the RF as a corridor for wildlife in the face of increasing development pressures will largely depend on its relative landscape permeability and connectivity to different areas of source habitat. The desired future condition of the RF will help provide landscape permeability and connectivity for wildlife moving through the mosaic of conservation easements and open space in the Roslyn/Cle Elum vicinity. Overall landscape permeability in the future will be greatly dependent upon broad scale development and land management actions and patterns, such as the increased housing and road densities of suburban/urban character within the Suncadia resort and further development of the Roslyn Ridge. The fate of resident wildlife species which have large home ranges, such as the pileated woodpecker and Cooper's hawk, will ultimately depend on future development actions and patterns with similar impacts.

Appendix D: General Descriptions of Representative Plant Associations
(from Lillybridge et. al. 1995)

Forest types used in stand descriptions are categorized using plant associations based on their climax overstory tree species (series) and indicator species (plant) that are supported by a site or patch. Indicator species are plants that can describe the characteristics of a particular site, such as moist well-drained soils, short growing seasons, and dry site conditions. All questions about a piece of land cannot be answered by a plant association classification, but vegetation, soils, and other characteristics of an area can usefully indicate its future species composition, its productivity potential, and its probable responses to management decisions.

Frequent, low intensity fires that were common prior to European settlement helped maintain a more open forest structure by preventing most sites from reaching their climatic potentials. This phenomenon is known as a cyclic climax. The fire-induced cyclic climax was more common on southerly and westerly exposures, which are relatively hotter and drier, and were well represented by infrequently spaced Ponderosa pine. On the cooler and moister north and east facing slopes, Douglas-fir was the dominant tree species. Areas where fire was more uncommon, due either to moist (mesic) site conditions or to chance, would continue through succession to reach the climatic potential, in many cases represented by grand fir; these areas are known as refugia. Both Ponderosa pine and Douglas-fir are fire tolerant species, while grand fir is considered to be fire intolerant.

The RF is within the Douglas-fir vegetation zone. Within this zone the most widely represented series (climax overstory tree species) are Douglas-fir and Grand fir. Early successional, or "pioneering," tree species are generally represented by the shade intolerant Ponderosa pine and slightly more shade tolerant Douglas-fir. Both Douglas-fir and Ponderosa pine are pioneering seral species. Ponderosa pine is purely pioneering, but some individuals will persist in mature stands as large remnant legacy trees. Climax species are represented by both Douglas-fir and the more shade tolerant grand fir. Associations are listed below in order of their frequency in the RF, from most commonly encountered, to least.

<u>Douglas-fir/common snowberry/pinegrass - PSME/SYAL/CARU</u>

This is a common and widespread habitat type in the RF. It is a moderately mesic type represented by Douglas-fir, occurring at moderately low elevations. Stands in this type seem to vary from even-aged stands of pure Douglas-fir, mixtures of Douglas-fir and Ponderosa pine, to mature stands of Ponderosa pine with young Douglas-fir understories.

The undergrowth of most stands is generally characterized by moderately open, discontinuous shrub layers interspersed by grasses and forbs. Other common shrubs in this type are oceanspray, serviceberry, and Oregon grape. Pinegrass and elk sedge are the most dominant herbs in this type. No forbs seem to be consistent with this type.

Prior to fire suppression in the last 100 years, stands in this type tended to consist of large, widely spaced trees. Prior to European settlement, low intensity underburns were common, and stand replacement fires were rare. Currently, stand replacement fires are more common due to the presence of relatively dense understories of Douglas-fir regeneration.

This habitat type provides good quality winter range for deer and elk.

Douglas-fir/shiny-leaf spirea/pinegrass - PSME/SPBEL/CARU

This is a common and widespread habitat type in the RF, generally found in warm, relatively low elevation sites where soils are stony and well drained. They are characterized by moderately open forests comprised mainly of Douglas-fir and Ponderosa pine with a well developed low to tall undergrowth of shrubs and grasses. Douglas-fir dominates mature stands. Both Douglas-fir and Ponderosa pine are capable of pioneering these habitats. Douglas-fir is the main regenerating species, although small amounts of Ponderosa pine can be found regenerating in larger openings.

Evidence suggests fire was historically frequent in this habitat type, allowing for stands generally less than 200 years old. Evidence also suggests that low intensity underburns were common in this habitat type prior to aggressive fire suppression over the last 100 years. Most of the associated undergrowth species are well adapted to fire.

This habitat type generally provides good winter range for deer and elk, especially on southern aspects. The shrubs provide both thermal/hiding cover and forage. The tall shrubs and abundant regeneration of Douglas-fir provides good nesting habitat for chipping sparrows and dusky flycatchers, and good cover for snowshoe hare and grouse. There is abundant ground cover for dark-eyed junco and Nashville warbler nests. There is also an abundance of stumps and short snags used by mountain chickadees. There are plentiful taller snags good for red-breasted and white-breasted nuthatches, hairy woodpeckers, and flying squirrels. The downed wood, coupled with good cover of shrubs and herbs, provides good habitat for chipmunks, golden-mantled ground squirrels, mice, voles, and shrews.

Douglas-fir/pinegrass - PSME/CARU

This is a common and widespread habitat type in the RF. This association generally represents cool, dry sites. These sites are generally open forests dominated by both Ponderosa pine and Douglas-fir. Ponderosa pine is a seral (pioneering or successional) species, while Douglas-fir tends to be the only reproducing tree in mature stands (climax).

The undergrowth is typically characterized by grasses and sedges. A variety of shrubs may be present, but generally not abundant. Common shrubs include oceanspray,

serviceberry, and shiny-leaf spirea. Common snowberry and bitterbrush are not well represented. Shrubs are integral but are relatively inconspicuous for this type of plant association. If the stand has a more visible and distinctive shrub component it is probably either 1) PSME/SPBEL/CARU or 2) PSME/SYAL/CARU.

Forbs are generally low in cover and include such species as white-flowered hawkweed, heartleaf arnica, and lupines. Elk sedge is also usually present.

Fire was very common in these types, with fires intervals ranging from 10 to 40 years. Prior to the last 100 years of fire suppression these stands were characterized by large Ponderosa pine and Douglas-fir, and stand replacement fires were rare. These stands provide forage and good bedding sites for deer and elk, and nesting habitat for species such as chipping sparrows and white-breasted nuthatches.

Douglas-fir/common snowberry - PSME/SYAL

This is the most mesic plant association in the Douglas-fir series. Riparian sites in this type are generally found on alluvium (floodplain) soils or on glacial terraces. This type is generally associated with partly open to dense canopies of Douglas-fir. Both Douglas-fir and Ponderosa pine are pioneering species, and Ponderosa pine is usually co-dominant in mid-succession stands.

The undergrowth is generally characterized by a moderate to very dense shrub layer dominated by common snowberry. Other common shrubs include serviceberry, pachistima, wild rose, Douglas maple, Scouler willow, and Oregon grape. Herbs and forbs generally have low cover and constancy.

Historically, stands of this type had most likely had higher intensity fires that caused significant crown damage due to heavy fuel loading. Although more mesic sites have the ability to reduce fire frequency, the more continuous fuels available in this type might reduce that ability.

These areas provide good hiding and thermal cover, as well as some winter range for large mammals such as deer and elk.

Grand fir/common snowberry/pinegrass - ABGR/SYAL/CARU

This association is common on mid-slopes with westerly or southerly aspects; it is also rarely found on ridge tops or benches. Ponderosa pine, western larch, and Douglas-fir dominate early successional stands. Grand fir and Douglas-fir dominate late successional stands.

The undergrowth is dominated by a variety of shrubs, including common snowberry, oceanspray, shiny-leaf spirea, and baldhip rose. Common herbs include pinegrass, bigleaf sandwort, elk sedge, few flowered peavine, and silver crown luina.

Fires often grow to crown fires in these stands, and likely fire return intervals are in the 50-200 year range. Parasites and diseases such as dwarf mistletoe, stem cancers, and laminated root rot pockets are common.

These "shrubby" stands provide thermal and hiding cover for wildlife. The multiple tree layers provide habitat for arboreal mammals and birds.

Grand fir/vine maple - ABGR/ACCI

This plant association indicates warm, mesic habitats partially influenced by maritime climatic conditions and well drained soils.

Grand fir is normally a minor component in the overstory in early and mid-successional conditions, until it becomes dominant in late-successional and climax conditions. Douglas-fir tends to be dominant, and Ponderosa pine may co-dominate in some stands. This type often has two layers of crown layers with Douglas-fir, Ponderosa pine, or both as the tallest layer, and shorter grand fir layer below.

Vine maple and the occasional bigleaf maple will either be lower than or at the height of the grand fir layer. Vine maple usually forms a dense crown throughout these stands and is a strong competitor to conifer regeneration and development. Due to high crown closures, other shrubs and herbs are not usually abundant. The climax dominance for the shrub and herb layer is not known for this type. It is assumed that vine maple abundance decreases after stands reach 150 years of age.

Fire was common in this type of plant association. Fire helps maintain the abundance of vine maple; even though vine maple indicates moist sites, it also indicates a warm environment favorable to frequent burns.

Multiple canopies of conifers and vine maple provides a wide range of habitats for birds and arboreal rodents.

Grand fir/Cascade Oregon grape - ABGR/BENE

This association is most common on mid-slopes. It is rarely found in canyon bottoms. Most stands have significant coarse material in the soil surface and effective rooting depth generally seems to exceed 30 inches. The oldest stands in this type have only been found to be about 200 years old, while most stands are between 75 and 125 years old. Douglas-fir generally dominates early successional stands. Grand fir is virtually the only tree species regenerating in closed crown stands.

Typically, a compact layer of low-growing shrubs mixed with herbs characterizes the undergrowth. The density of the undergrowth varies considerably in response to overstory crown conditions. A dense, tall crown of Douglas-fir mixed with grand fir effectively reduces light levels available at the forest floor and consumes much of the available soil moisture. Mistletoe and root rot are common in these stands. This results

in very sparse undergrowth. However, some stands have a nearly continuous layer of vegetation across the forest floor. Cascade Oregon grape, pachistima, baldhip wild rose, shiny-leaf spirea, and prince's pine are common shrubs found in this type.

The herbaceous growth is usually a minor component of the undergrowth. Vanilla leaf, rattlesnake plantain, and bigleaf sandwort and the only species consistently present in most stands, but are never abundant. Other species include white hawkweed, pinegrass, and a number of other species, but none with consistency or abundance.

Fire indicators, such as charred bark and logs, are common. Dense stands of grand fir are especially prone to stand replacement fires. Stands under 100 years old are common, suggesting a history of relatively high fire frequency.

Forage for deer and elk in these stands are generally poor. Multiple tree canopies are common and provide habitat for arboreal mammals (i.e. flying squirrels) and birds such as Townsend's warbler. These stands seem to receive moderate big game use, mainly as travel corridors, with visible signs of minor browsing and foraging.

Figure 1: Cruisers Notes 1956

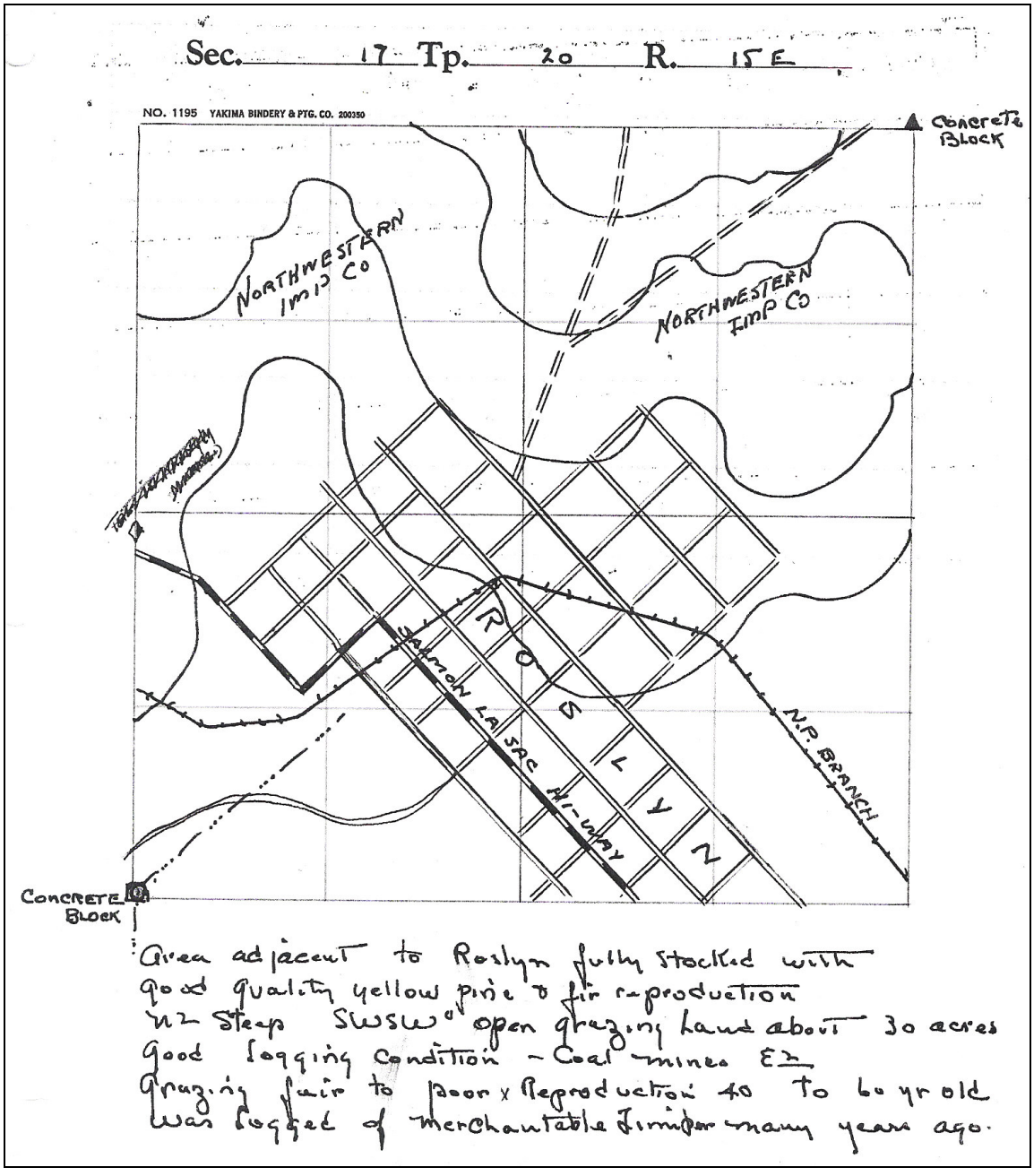
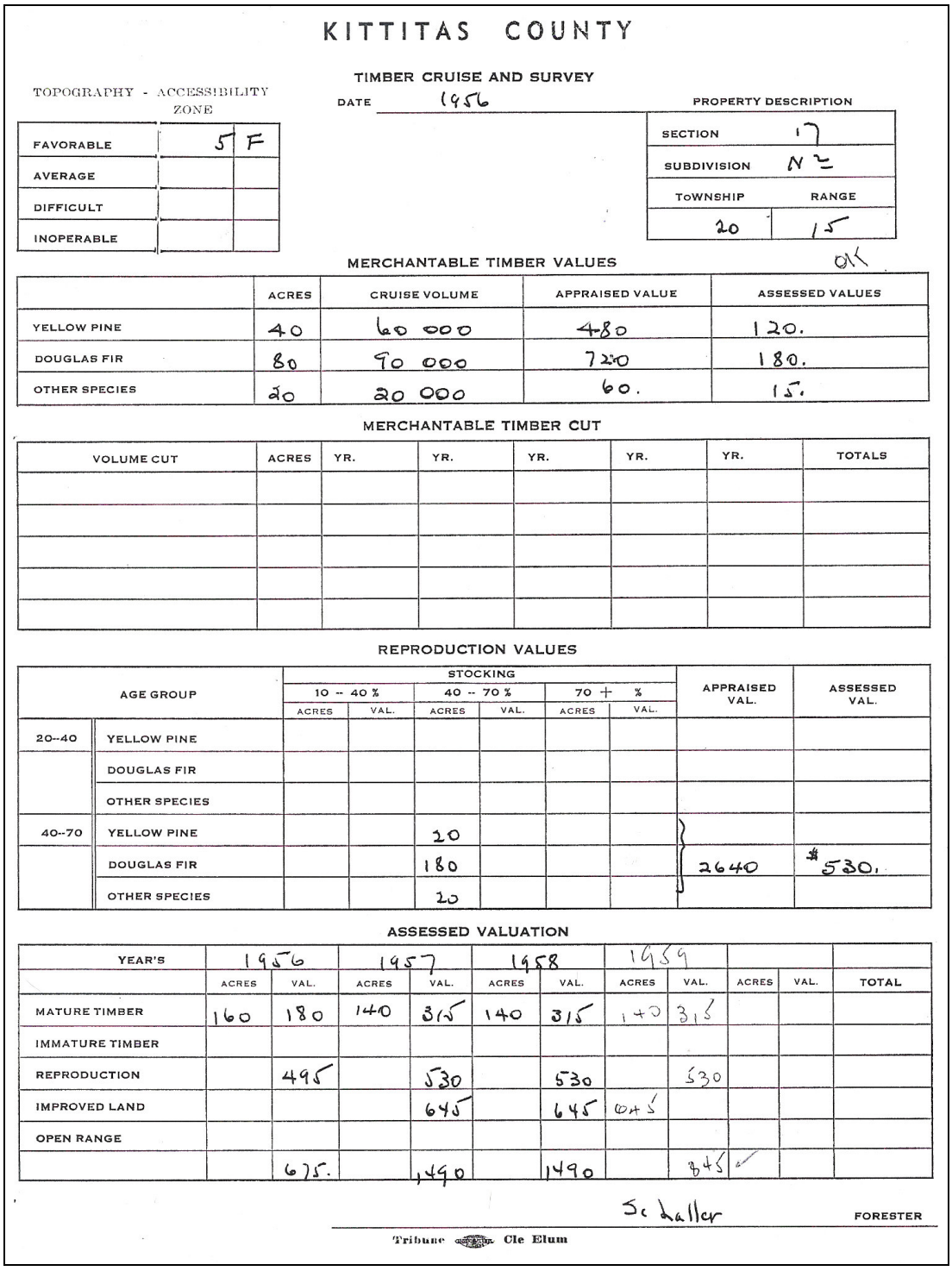


Figure 2: Cruiser Notes 1956



KITTITAS COUNTY

TIMBER CRUISE AND SURVEY

DATE 1956

PROPERTY DESCRIPTION

SECTION	17
SUBDIVISION	N ½
TOWNSHIP	20
RANGE	15

TOPOGRAPHY - ACCESSIBILITY ZONE

FAVORABLE	5	F
AVERAGE		
DIFFICULT		
INOPERABLE		

MERCHANTABLE TIMBER VALUES

OK

	ACRES	CRUISE VOLUME	APPRAISED VALUE	ASSESSED VALUES
YELLOW PINE	40	60 000	480	120.
DOUGLAS FIR	80	90 000	720	180.
OTHER SPECIES	20	20 000	60.	15.

MERCHANTABLE TIMBER CUT

VOLUME CUT	ACRES	YR.	YR.	YR.	YR.	YR.	TOTALS

REPRODUCTION VALUES

AGE GROUP		STOCKING 10 -- 40 % ACRES	10 -- 40 % VAL.	40 -- 70 % ACRES	40 -- 70 % VAL.	70 + % ACRES	70 + % VAL.	APPRAISED VAL.	ASSESSED VAL.
20--40	YELLOW PINE								
	DOUGLAS FIR								
	OTHER SPECIES								
40--70	YELLOW PINE			20					
	DOUGLAS FIR			180				2640	$530.
	OTHER SPECIES			20					

ASSESSED VALUATION

YEAR'S	1956 ACRES	1956 VAL.	1957 ACRES	1957 VAL.	1958 ACRES	1958 VAL.	1959 ACRES	1959 VAL.	ACRES	VAL.	TOTAL
MATURE TIMBER	160	180	140	315	140	315	140	315			
IMMATURE TIMBER											
REPRODUCTION		495		530		530		530			
IMPROVED LAND				645		645	0+5				
OPEN RANGE											
		675.		1490		1490		845			

S. Haller FORESTER

Tribune Cle Elum

Figure 3: Aerial Photo 1942

Figure 4: Aerial Photo 1969

Appendix F: Area Maps

Figure 1: Treatment Stands Maps

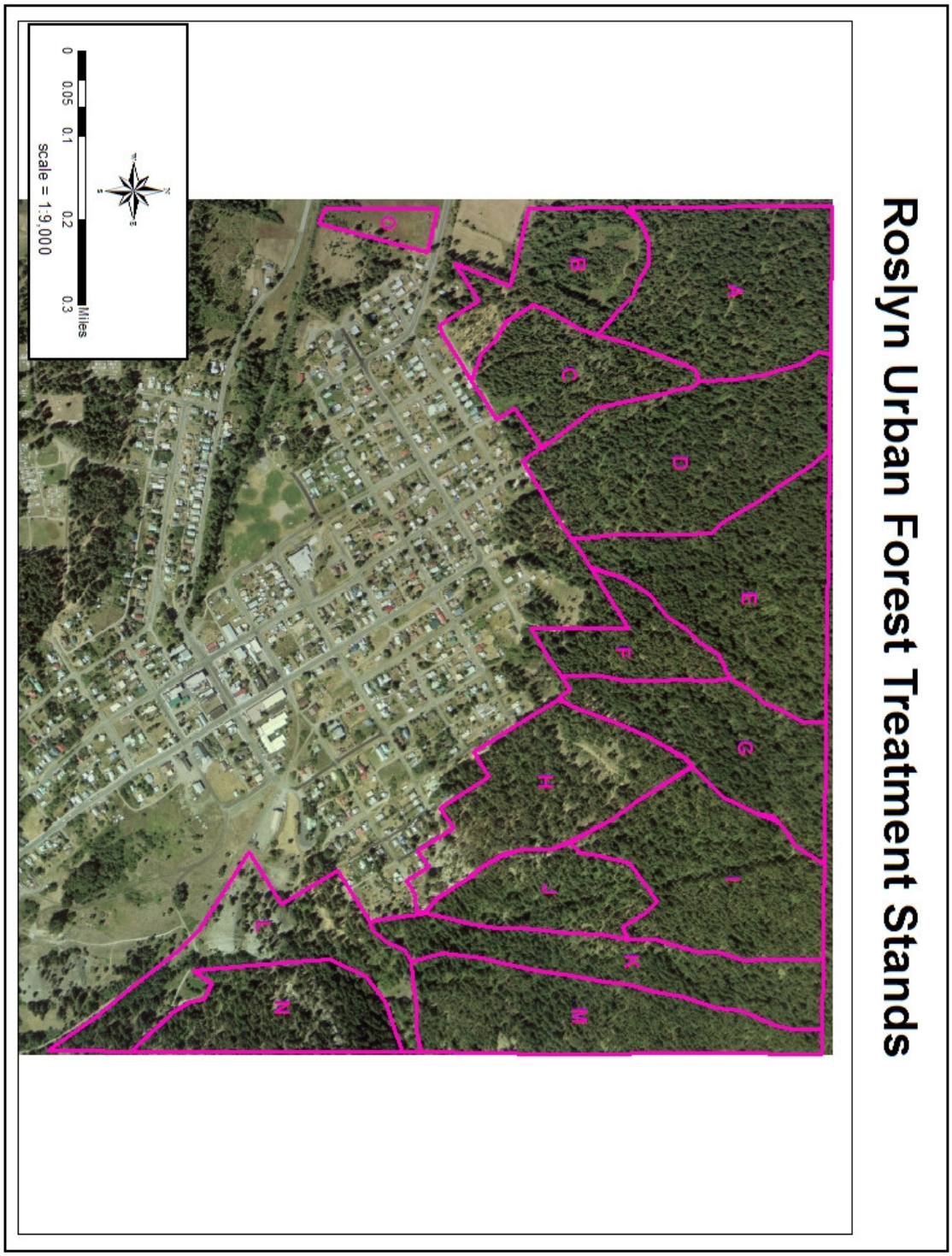


Figure 2: Land Use Zoning

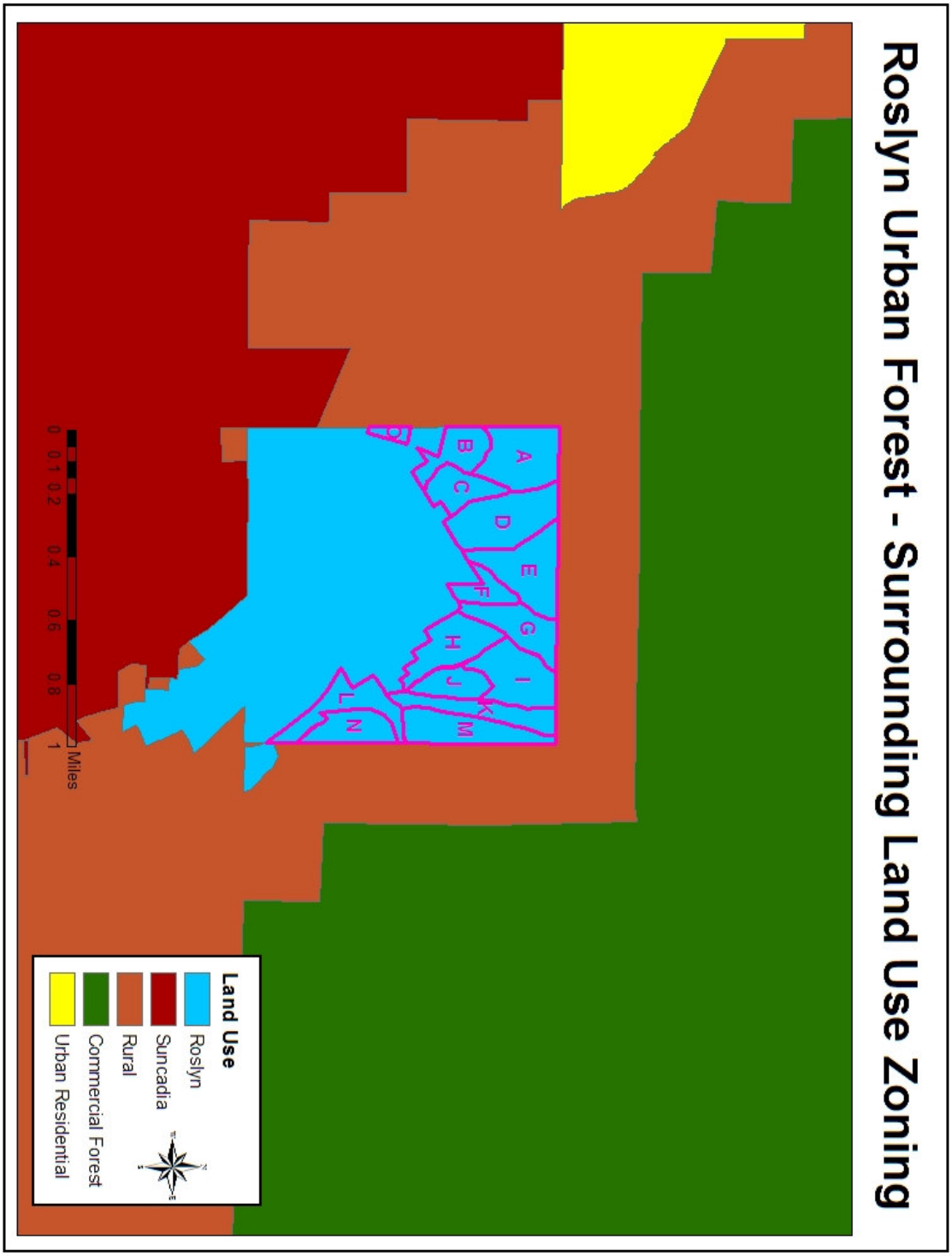


Figure 3: Aspect

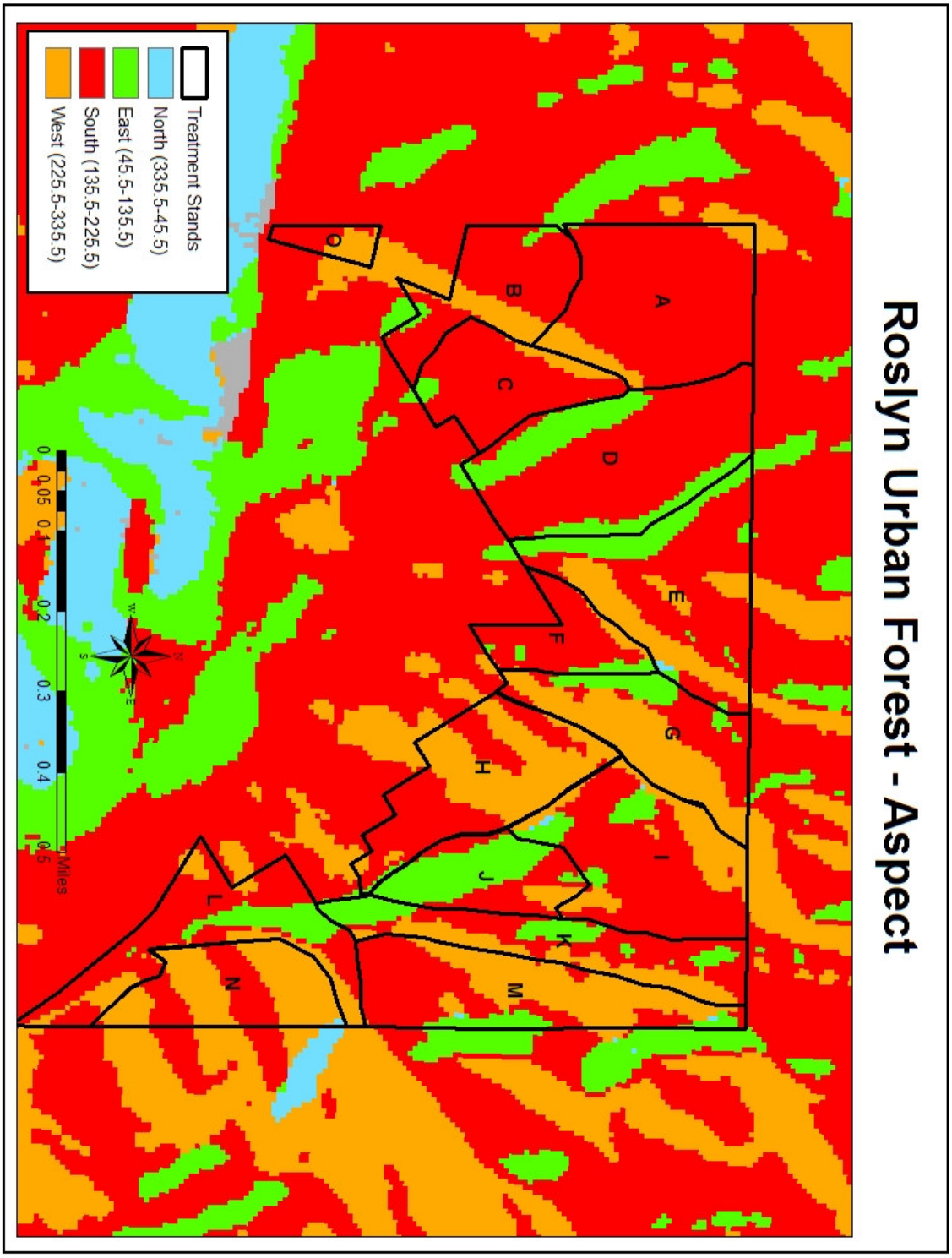


Figure 4: Slope 1

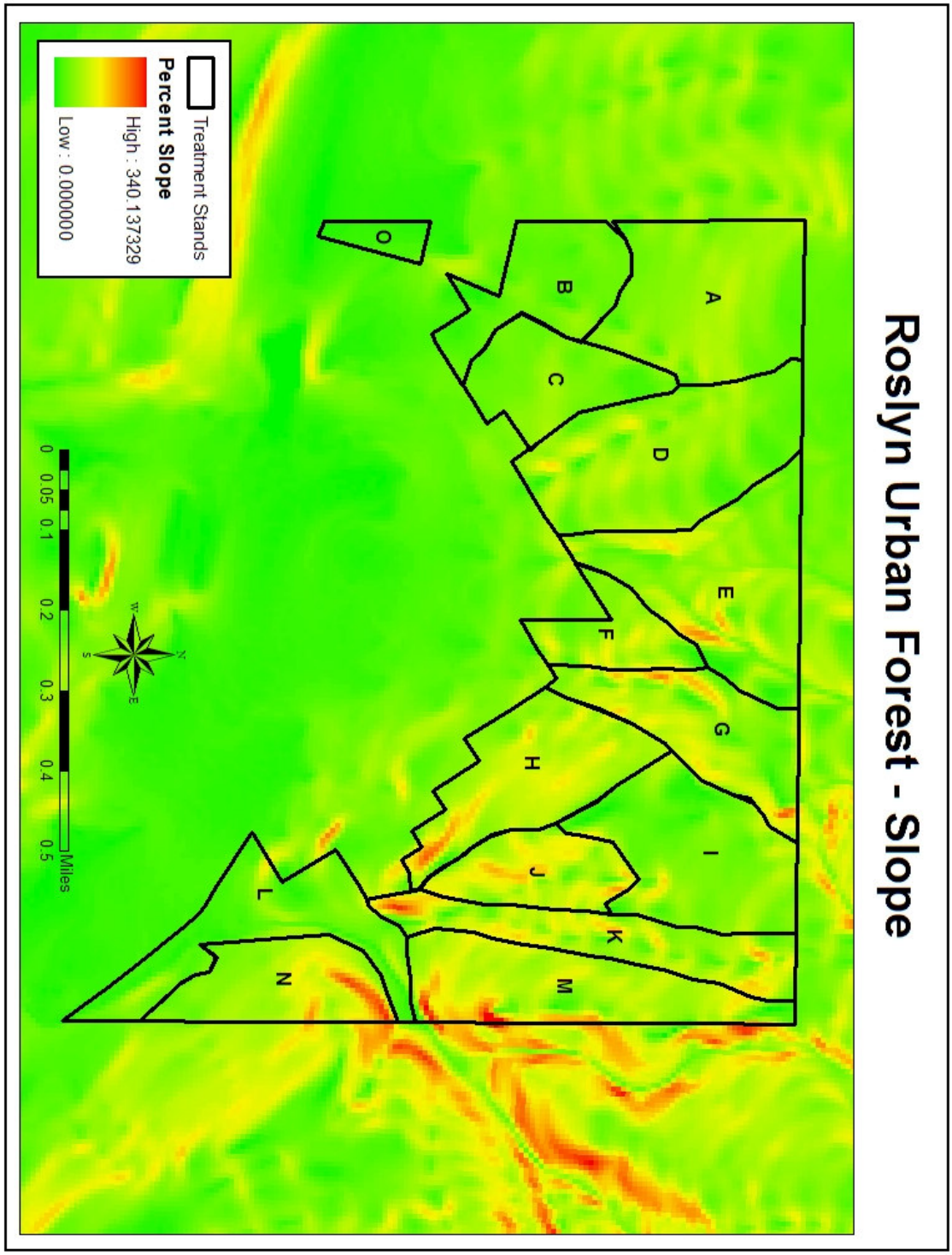


Figure 5: Slope 2

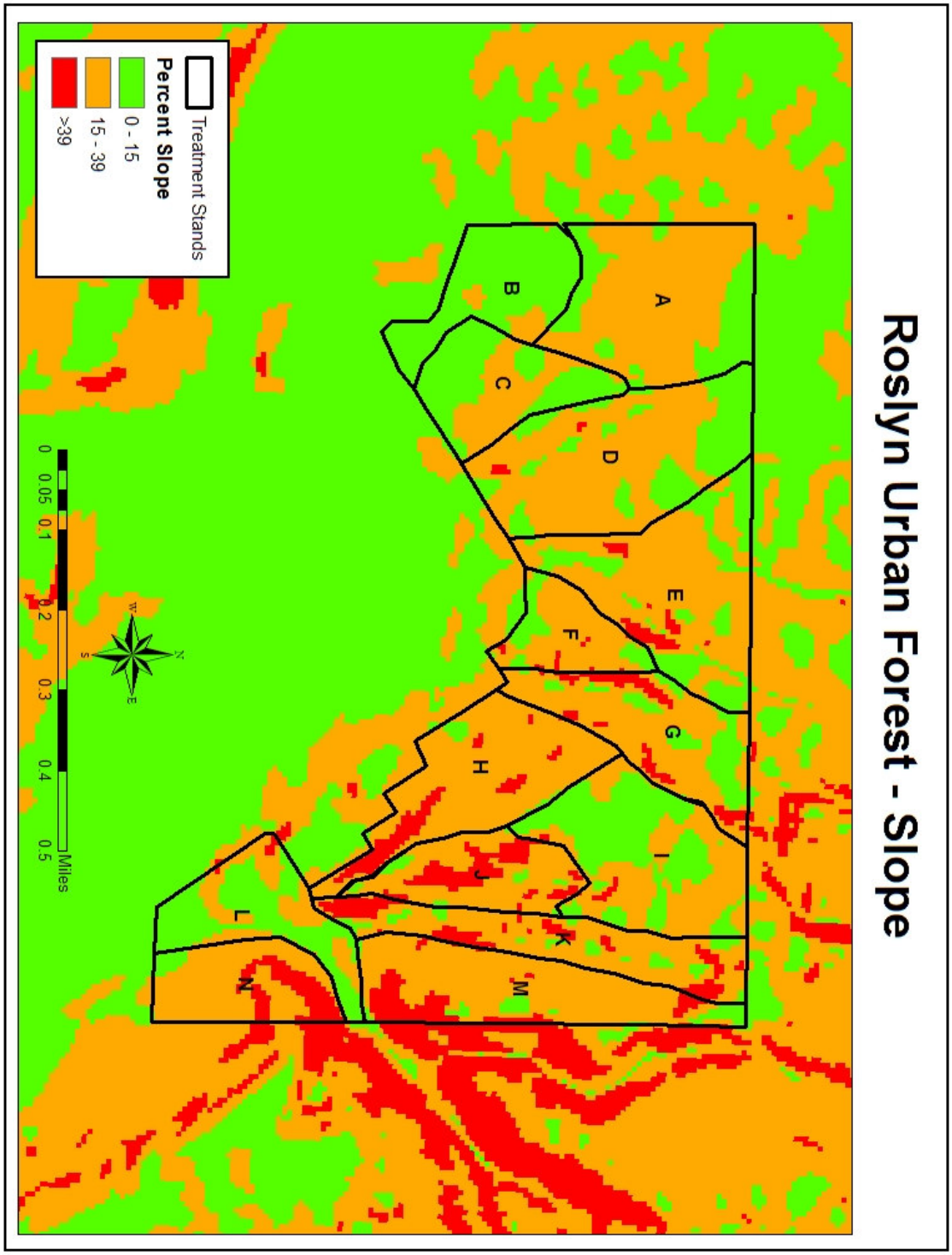


Figure 6: Canopy Closure

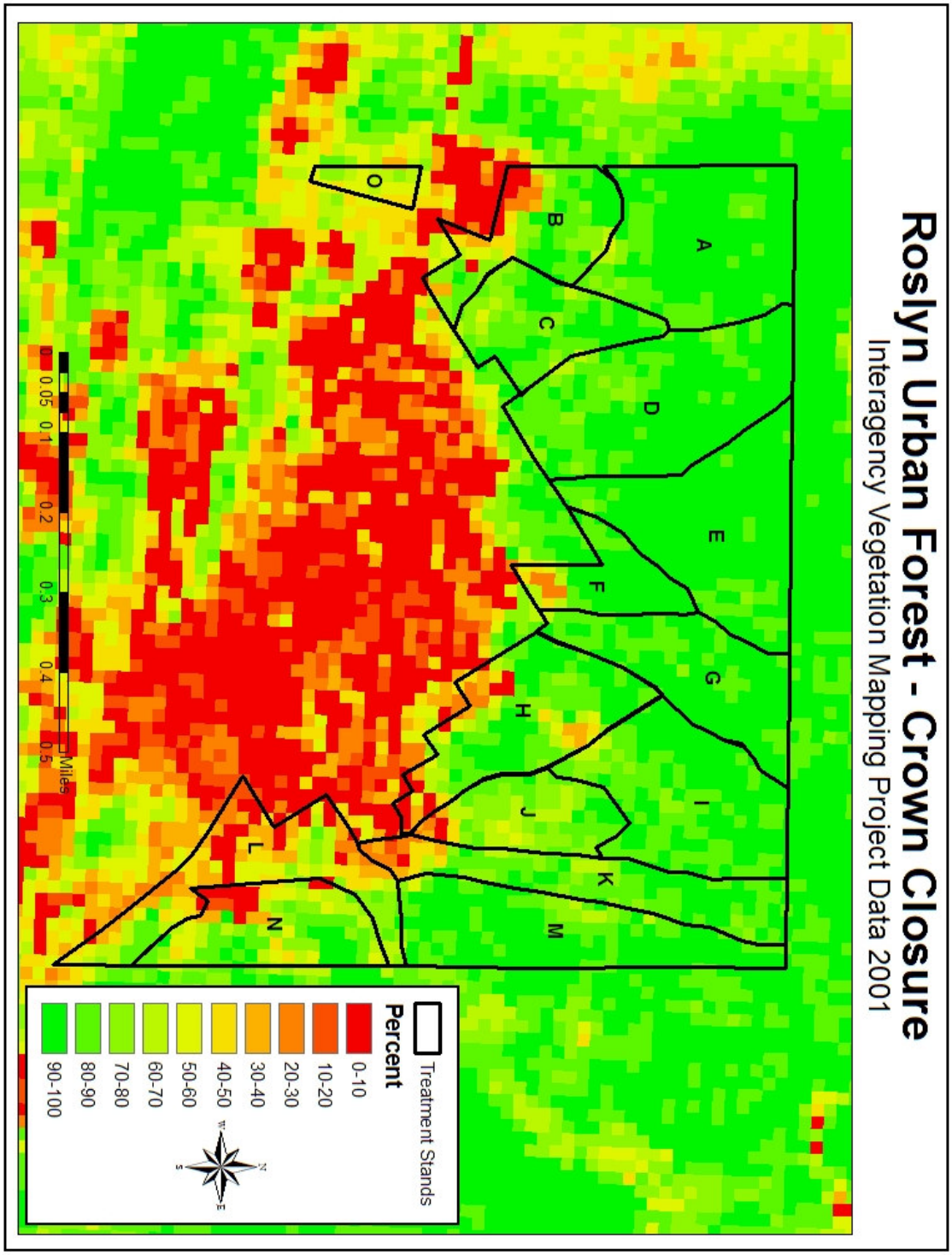


Figure 7: Tree Size

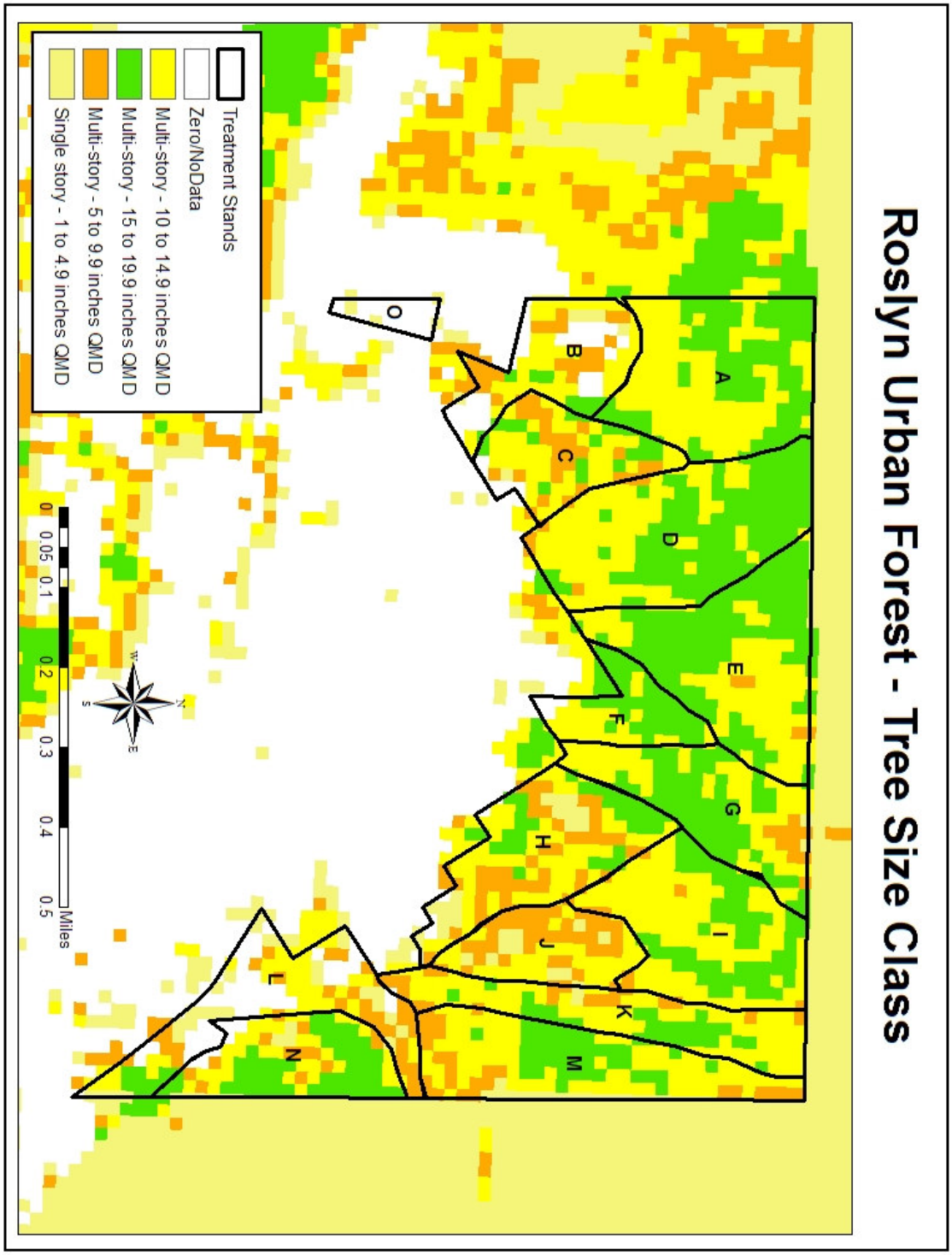


Figure 8: Riparian Buffers

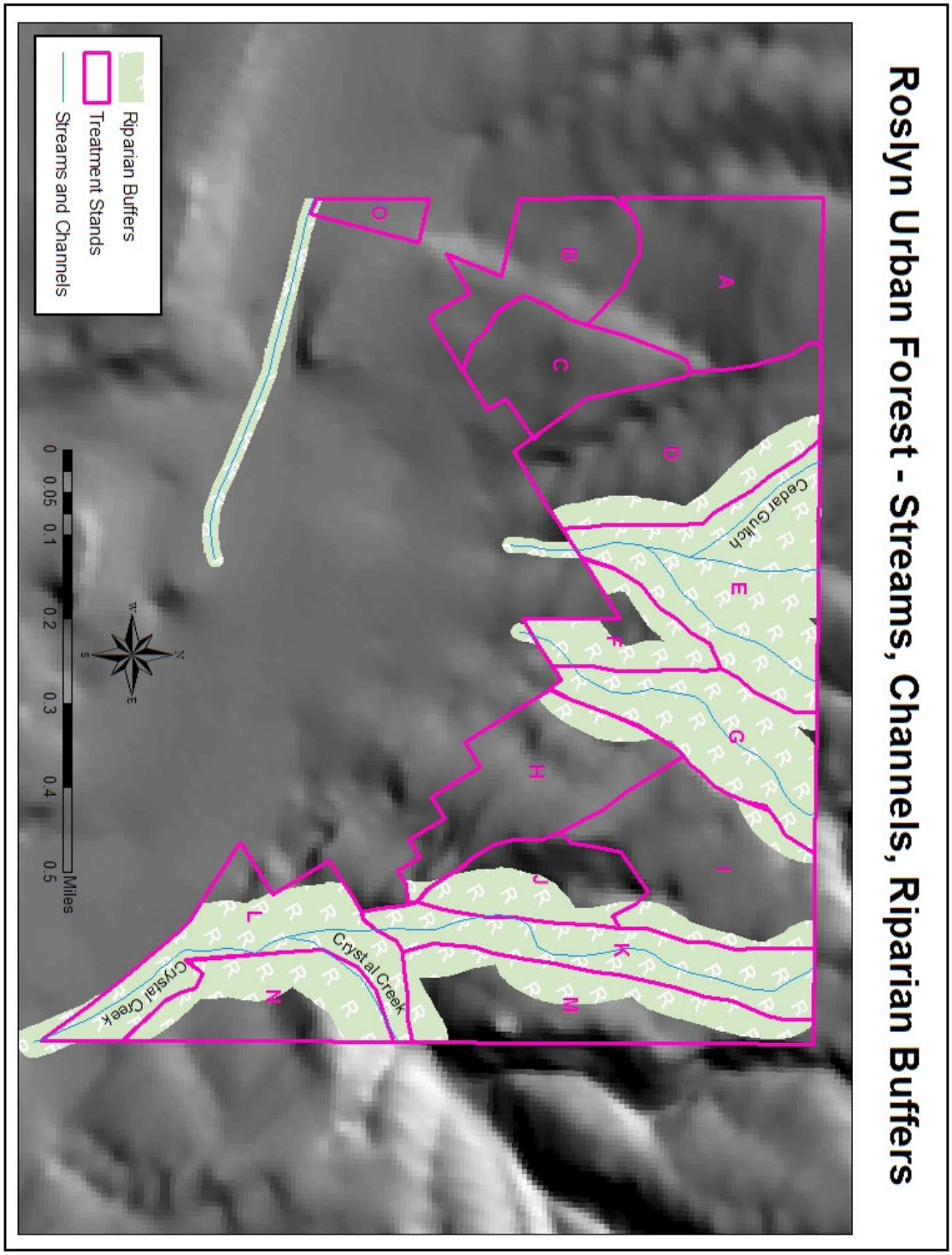


Figure 9: Trails

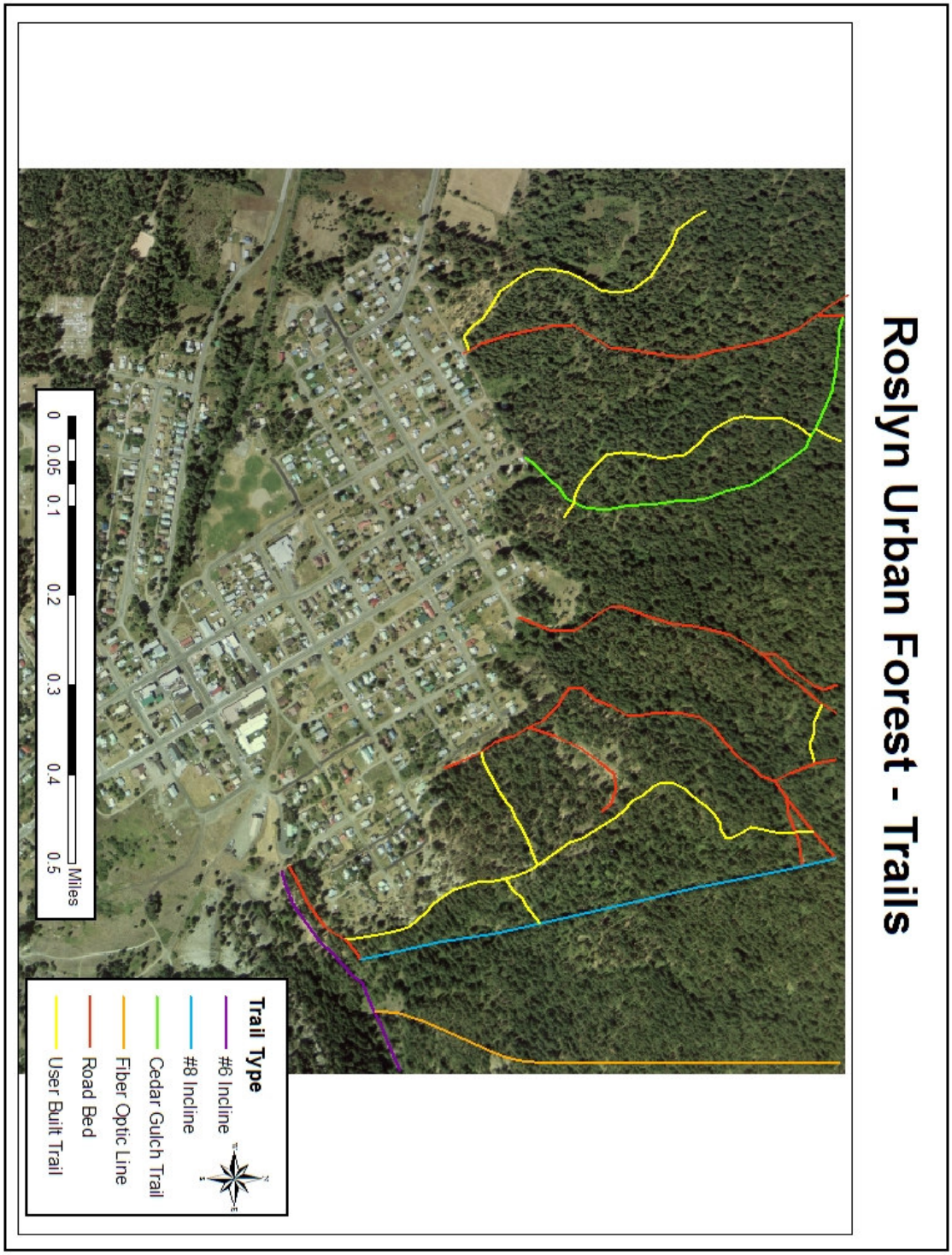
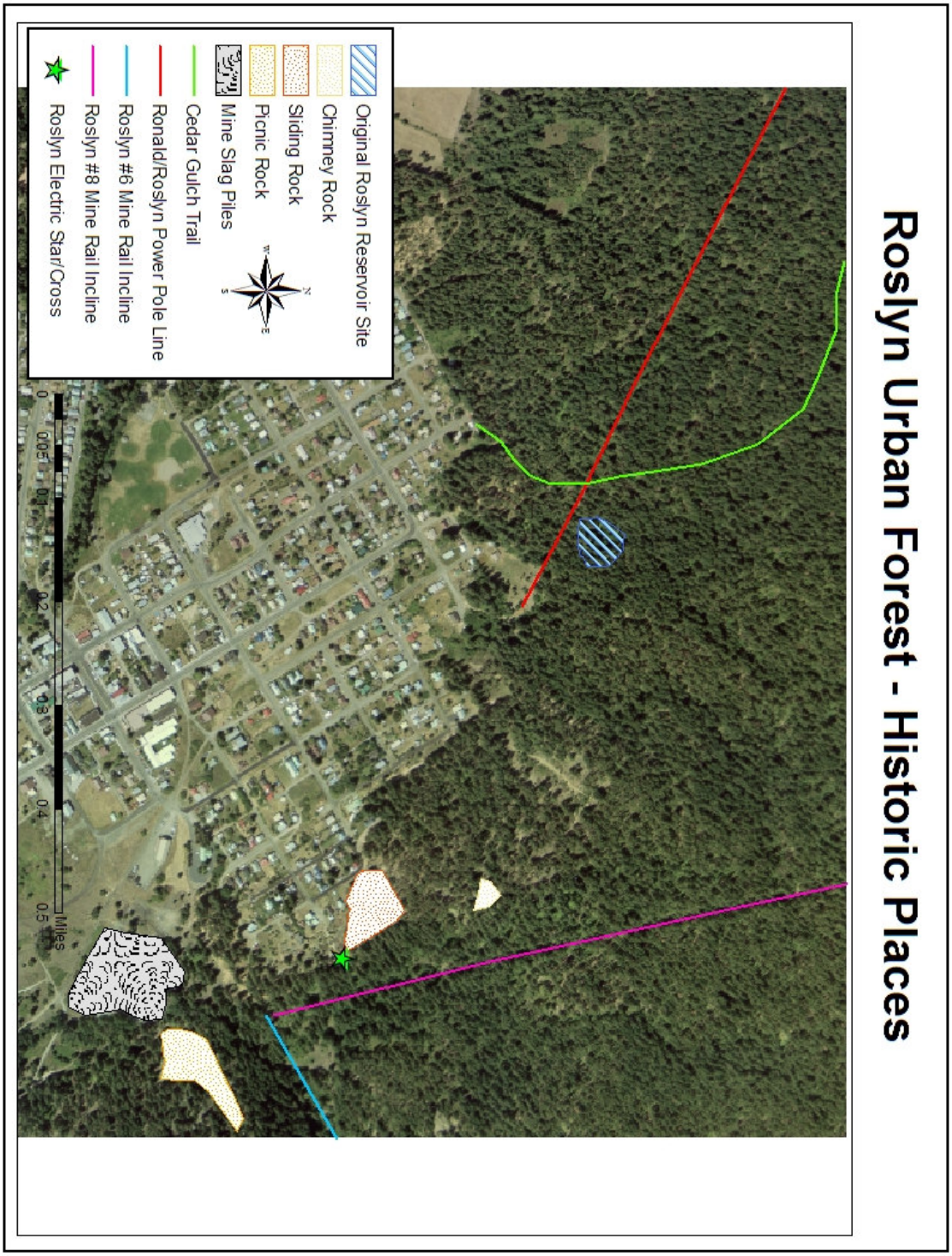


Figure 10: Historic Places



Appendix G: Desired Future Conditions

Desired Future Dry Site Conditions

	Overstory	Mid-Story	Understory
Tree Canopy Structure	75% Ponderosa pine 25% Douglas-fir 0-1% Grand fir	60% Douglas-fir 40% Ponderosa pine 0-1% Grand fir	95% Douglas-fir 1-5% Grand fir 0-1% Ponderosa pine
Crown Closure	Average CC ~40% - 60%		
Tree Stocking	60-80 Trees per Acre ~75-100 ft^2 BA/Acre	SPARSE	SPARSE
Tree Size	25+Average DBH	~12 Average DBH	~2" Average DBH
Dominant Plant Associations	PSME CARU, PSME/SYAL/CARU		
Shrub Layer	Moderate abundance mainly below 3 feet in height with a patchy distribution.		
Herbaceous Layer	Pinegrass and elk sedge are the most dominant native grasses. Common forbs include silky lupine, few-flowered peavine, and white hawkweed.		
Forest Fuels	Low or moderate abundance amount of CWD with a patchy distribution.		
Insect and Disease	Resilient trees with low mortality rates.		
Noxious Weeds	Weeds minimized, and ideally entirely avoided or eradicated.		
Trails	Managed trail system under the control of the Citizen Advisory Committee.		
Historic Places	Add historic places to the City of Rosyln Register of Historic Places as recommended by Citizens Advisory Committee.		

Desired Moist (Mesic) Site Conditions

	Overstory	Mid-Story	Understory
Tree Canopy Structure	50% Douglas fir 40% Grand fir 10% Ponderosa pine	50% Douglas-fir 10% Grand fir 0-1% Ponderosa pine	90% Grand fir 10% Grand fir 0-1% Ponderosa pine
Crown Closure	Average ~85%		
Tree Stocking	~100 Trees/Acre ~120 ft^2 BA/Acre	~60 Trees/Acre ~60 of BA/ACRE	Spare and Patchy

Tree Size	~30 Average DBH	~15 Average DBH	~5” Average DBH
Dominant Plant Associations	ABGR/BENE, PSME/SYAL/CARU, PSME/SPBEL/CARU		
Shrub Layer	Patchy with dense pockets of varying heights dominating the site. Major shrub species include common snowberry, ocean spray, hazelnut, vine maple, Douglas maple, serviceberry, Cascade Oregon grape, shiny-leaf spirea, and little wood rose.		
Herbaceous Layer	Pinegrass and elk sedge are the most dominant native grasses. Common forbs include silky lupine, few-flowered peavine, and prince’s pine.		
Forest Fuels	Moderate abundance of CWD.		
Insect and Disease	Resilient trees with low mortality rate.		
Noxious Weeds	Weeds minimized, and ideally entirely avoided or eradicated.		
Trails	Managed trail system under the control of the Citizen Advisory Committee.		
Historic Places	Add historic places to the City of Rosyln Register of Historic Places as recommended by Citizens Advisory Committee.		

Appendix H: Current Stand Conditions

Stand A

Location and Description	Approximately 28 acres located in the northwest corner of the RF. A majority of the stand is south facing. Slope is primarily 15-39%.		
	Overstory	**Mid-Story**	**Understory**
Tree Canopy Structure	50% Ponderosa pine 50% Douglas-fir 0-1% Grand fir	90% Douglas-fir 10% Ponderosa pine 0-1% Grand fir	95% Douglas-fir 1-5% Grand fir 0-1% Ponderosa pine
Crown Closure	~70% and up to 100% in places		
Tree Stocking	~150 Trees/Acre ~297 ft^2 BA/Acre	~100 Trees/Acre ~52 ft^2 BA/ACRE	~50 Trees/Acre 5 ft^2 BA/ACRE
Tree Size	~10-30" DBH ~19 Average DBH	~5-12" DBH ~9 Average DBH	~1-6" DBH ~5" Average DBH
Dominant Plant Associations	PSME/SYAL/CARU, PSME/SPBEL/CARU		
Shrub Layer	Shrub height can reach up to 20 feet tall. Dominant shrub species include common snowberry, ocean spray, hazelnut, vine maple, Douglas maple, serviceberry, shiny-leaf spirea, and little wood rose.		
Herbaceous Layer	Pinegrass and elk sedge are the most dominant native grasses. Common forbs include silky lupine, few-flowered peavine, and white hawkweed.		
Forest Fuels	The risk of a stand replacement fire is high. CWD and snags of varying heights and conditions are moderately abundant.		
Insect and Disease	Moderately infested during the 1990 mountain pine beetle infestation and may also be susceptible during the next cycle. Current western pine beetle infestation is moderate, but may be susceptible to increasing attack.		
Noxious Weeds	Currently not a problem.		
Trails	There is a trail on an existing road bed that comes south from Stand C and then north near the eastern edge of the stand. This road is currently closed to vehicles and is widely used by local residents for access to the Roslyn Ridge.		
Historic Places	The old Ronald/Roslyn power pole line traverses from southeast to northwest through the center of the stand and is on the Roslyn Register of Historic Places.		

Stand B

Location and Description	Approximately 16 acres located in the northwest corner of section 17, adjacent to Stand A along the north boundary. Primarily south facing. Dense with small diameter trees. Slopes are primarily 0-15%. This stand has small openings (~1.5 acres) in the northern portion. A small spring that flows south down to Stand O is located in the easternmost opening next to a user-built trail along the east and north boundary of the stand.		
	Overstory	**Mid-Story**	**Understory**
Tree Canopy Structure	95% Ponderosa pine 5% Douglas-fir	85% Ponderosa pine 15% Douglas-fir 0-1% Grand fir	95% Douglas-fir 1-5% Grand fir 1-5% Ponderosa pine
Crown Closure	~70% and up to 100% in places		
Tree Stocking	Sparse ~10-20 Trees/Acre ~33 ft^2BA/Acre	~250 ft^2 Trees/Acre ~106 ft^2 BA/Acre	~500 Trees/Acre ~68 ft^2 BA/ACRE
Tree Size	~10-30" DBH ~20 Average DBH	~5-12" DBH ~9 Average DBH	~1-6" DBH ~5" Average DBH
Dominant Plant Association	PSME/SYAL/CARU		
Shrub Layer	Dominant shrub species include common snowberry, ocean spray, hazelnut, vine maple, Douglas maple, scouler willow, serviceberry, shiny-leaf spirea, and little wood rose.		
Herbaceous Layer	Pinegrass and elk sedge are the most dominate native grasses. Common forbs include silky lupine, few-flowered peavine, and white hawkweed. The openings have a wide variety of native and non-native grasses and forbs.		
Forest Fuels	There is a moderate risk of a stand replacement fire. CWD levels are moderate and there is a relatively low abundance of snags in this stand.		
Insect and Disease	Currently not a problem.		
Noxious Weeds	Currently not a problem		
Trails	There is a dead end user built trail that trends southwest to northwest along the east and north boundaries of the stand.		
Historic Places	There are no registered historic places in this stand.		

Stand C

Location and Description	Approximately 15 acres and located in the northwest corner of section 17. Stands A and B are adjacent to the west and Stand D is to the east. A majority of the stand consists of a south facing aspect. Slope is primarily 0-15%, but in the center of the stand slopes are 15-39%.		
	Overstory	**Mid-Story**	**Understory**
Tree Canopy Structure	80% Ponderosa pine 20% Douglas-fir 0-1% Grand fir	75% Douglas-fir 25% Ponderosa pine 0-1% Grand fir	50% Douglas-fir 35% Ponderosa pine 15% Grand fir
Crown Closure	~70% and up to 100% in places		
Tree Stocking	~150 Trees/Acre ~204 ft^2 BA/Acre	~80 Trees/Acre ~45 ft^2 BA/ACRE	~50 Trees/Acre 5 ft^2 BA/ACRE
Tree Size	~10-30" DBH ~16 Average DBH	~4-13" DBH ~10" Average DBH	~1-6" DBH ~5" Average DBH
Dominant Plant Association	PSME/SYAL/CARU		
Shrub Layer	A tall shrub component is abundant and can reach to 20 feet tall. Dominant shrub species include common snowberry, ocean spray, hazelnut, vine maple, Douglas maple, scouler willow, serviceberry, shiny-leaf spirea, and little wood rose.		
Herbaceous Layer	Pinegrass and elk sedge are the most dominant native grasses. Common forbs include silky lupine, few-flowered peavine, and white hawkweed.		
Forest Fuels	The risk of a stand replacement fire is high. CWD and Ponderosa pine snags of varying height and condition are abundant in this stand.		
Insect and Disease	This stand had a relatively high amount of beetle kill during the 1990 mountain pine beetle infestation. Current western pine beetle infestation is moderate, but may be susceptible to increasing attack.		
Noxious Weeds	Currently not a problem		
Trails	There is a trail on an existing road bed that bisects this stand from south to north. This road is currently closed to public vehicles and is widely used by local residents for access to the Roslyn Ridge.		
Historic Places	A small portion of the Ronald/Roslyn Power Pole Line occurs in this stand.		

Stand D

Location and Description	Approximately 32.5 acres located in the northwest corner of section 17. Stands A and C are adjacent to the west and Stand E is to the east. The majority is south facing. Slope is primarily 15-39% with small areas that exceed 39%. There is a concave topography that forms an seasonal stream during spring from snow melt on the Roslyn Ridge above. A small amount on the eastern portion of the stand is included in the 300 foot riparian buffer, running from the channels in Stand E.		
	Overstory	**Mid-Story**	**Understory**
Tree Canopy Structure	75% Ponderosa pine 25% Douglas-fir 0-1% Grand fir	50% Douglas-fir 50% Ponderosa pine 0-1% Grand fir	50% Douglas-fir 45% Grand fir 5% Ponderosa pine
Crown Closure	~80% and up to 100% in places		
Tree Stocking	~165 Trees/Acre ~230 ft^2 BA/Acre	~65 Trees/Acre ~33 ft^2 BA/ACRE	~120 Trees/Acre 4 ft^2 BA/ACRE
Tree Size	~10-30" DBH ~16 Average DBH	~4-13" DBH ~10" Average DBH	~1-6" DBH ~3" Average DBH
Dominant Plant Associations	PSME/SYAL/CARU, PSME/SPBEL/CARU		
Shrub Layer	A tall shrub component is abundant and can reach to 20 feet tall. Dominant shrub species include common snowberry, ocean spray, hazelnut, vine maple, Douglas maple, scouler willow, serviceberry, shiny-leaf spirea, and clustered wild rose.		
Herbaceous Layer	Pinegrass and elk sedge are the dominant native grasses. Common forbs include silky lupine, few-flowered peavine, and white hawkweed.		
Forest Fuels	The risk of a stand replacement fire is high. CWD and Ponderosa pine snags of varying height and condition are abundant in this stand.		
Insect and Disease	This stand had a relatively high amount of beetle kill during the 1990 mountain pine beetle infestation. Current western pine beetle infestation is moderate, but may be susceptible to increasing attack.		
Noxious Weeds	Currently not a problem.		
Trails	There is a trail on an existing roadbed, known as the Cedar Gulch Trail, which bisects the stand from south to north along the eastern edge of the stand. This road is currently closed to vehicles and is widely used by local residents for access to the Roslyn Ridge. There is a user built trail that parallels the Cedar Gulch Trail and the Ronald/Roslyn Power Pole Line traverses from southeast to northwest through the middle of the stand.		
Historic Places	The Cedar Gulch Trail is on the City of Roslyn Register of Historic Places.		

Stand E

Location and Description	Approximately 29 acres located in the center of the north half of section 17. Stand D is adjacent to the west and Stands F and G are to the east. The stand consists of west, south, and east facing aspects. There are three intermittent channels that flow from north to south and converge in the southern 1/3 of the stand. Slope is primarily 15-39% with small areas that exceed 39%, especially along the banks of the easternmost channel. Almost the entire stand is within the 300 foot riparian buffer zone.		
	Overstory	**Mid-Story**	**Understory**
Tree Canopy Structure	70% Ponderosa pine 25% Douglas-fir 1-5% Grand fir	45% Douglas-fir 45% Ponderosa pine 1-5% Grand fir 0-1% Red Cedar	50% Douglas-fir 45% Grand fir 1-5% Ponderosa pine 1-5% Red Cedar
Crown Closure	~80% and up to 100% in places		
Tree Stocking	~165 Trees/Acre ~230 ft^2 BA/Acre	~65 Trees/Acre ~33 ft^2 BA/ACRE	~120 Trees/Acre 4 ft^2 BA/ACRE
Tree Size	~10-30" DBH ~16 Average DBH	~4-13" DBH ~10" Average DBH	~1-6" DBH ~2.5" Average DBH
Dominant Plant Associations	PSME/SYAL/CARU, PSME/SPBEL/CARU, PSME/SYAL, ABGR/ACCI, ABGR/SYAL/CARU		
Shrub Layer	A tall shrub component is abundant and can reach to 20 feet tall. Dominant shrub species include common snowberry, ocean spray, hazelnut, vine maple, Douglas maple, scouler willow, serviceberry, shiny-leaf spirea, Cascade Oregon grape, and little wood rose.		
Herbaceous Layer	Pinegrass and elk sedge are the dominant native grasses. Common forbs include silky lupine, few-flowered peavine, and white hawkweed.		
Forest Fuels	The risk of a stand replacement fire is high. CWD and Ponderosa pine snags of varying of heights and condition classes are abundant in this stand.		
Insect and Disease	This stand had a relatively high amount of beetle kill during the 1990 mountain pine beetle infestation. Current western pine beetle infestation is moderate, but may be susceptible to increasing attack.		
Noxious Weeds	Currently not a problem.		
Trails	There is a trail on an existing roadbed near the eastern edge of the stand. This road is currently closed to vehicles and is widely used by local residents for access to the Roslyn Ridge.		
Historic Places	The Original Roslyn Reservoir and a small portion of the Ronald/Roslyn Power Pole Line are in this stand.		

Stand F

Location and Description	Approximately 9.5 acres located in the center of the north half of section 17. Stand E is adjacent to the northwest and Stands G is to the east. It is primarily south facing. This stand is a moderately steep ridge that separates the channels in stands E and G. Slope is primarily 15-39%. Almost the entire stand is within the 300 foot riparian buffer zone.		
	Overstory	**Mid-Story**	**Understory**
Tree Canopy Structure	90% Ponderosa pine 10% Douglas-fir 0-1% Grand fir	75% Douglas-fir 20% Ponderosa pine 5% Grand fir	50% Douglas-fir 45% Grand fir 0-1% Ponderosa pine
Crown Closure	~80% and up to 100% in places		
Tree Stocking	~140 Trees/Acre ~196 ft^2 BA/Acre	~40 Trees/Acre ~11 ft^2 BA/Acre	~40 Trees/Acre ~3 ft^2 BA/Acre
Tree Size	~10-30" DBH ~16 Average DBH	~4-13" DBH ~7" Average DBH	~1-6" DBH ~3" Average DBH
Dominant Plant Association	PSME/SYAL/CARU		
Shrub Layer	A tall shrub component is abundant and can reach to 20 feet tall. Dominant shrub species include common snowberry, ocean spray, hazelnut, vine maple, Douglas maple, scouler willow, serviceberry, shiny-leaf spirea, and clustered wild rose.		
Herbaceous Layer	Pinegrass and elk sedge are the most dominant native grasses. Common forbs include silky lupine, few-flowered peavine, and white hawkweed.		
Forest Fuels	The risk of a stand replacement fire is high. CWD and Ponderosa pine snags of varying height and condition are abundant in this stand.		
Insect and Disease	This stand had a relatively high amount of beetle kill during the 1990 mountain pine beetle infestation. Current western pine beetle infestation is moderate, but may be susceptible to increasing attack.		
Noxious Weeds	Currently not a problem		
Trails	There is a trail on an existing roadbed that trends from south to north. This road is currently closed to public vehicles and is widely used by local residents for access to the Roslyn Ridge.		
Historic Places	A small portion of the Original Roslyn Reservoir may occur in this stand.		

Stand G

Location and Description	Approximately 20 acres located in the center of the north half of section 17. Stands E and F are adjacent to the west and Stands H and I are to the southeast. This stand is primarily the riparian corridor of a small intermittent stream. It is primarily west facing, with some south and east exposures. On the cooler eastern exposures, there are some small pockets of late-succession grand fir, with trees reaching up to 40 inches dbh. Slope is primarily in the 15-39% range, although there are some areas that exceed 39%, especially on the west bank of the stream channel. Almost the entire stand is within the 300 foot riparian buffer zone.		
	Overstory	**Mid-Story**	**Understory**
Tree Canopy Structure	70% Douglas-fir 25% Grand fir 1-5% Ponderosa pine 0-1% Red Cedar	70% Douglas-fir 25% Grand fir 0-1% Ponderosa pine 0-1% Red Cedar	50% Douglas-fir 50% Grand fir 0-1% Ponderosa pine 0-1% Red Cedar
Crown Closure	~80% and up to 100% in places		
Tree Stocking	~200 Trees/Acre ~428 ft^2 BA/Acre	~90 Trees/Acre ~38 ft^2 BA/Acre	~90 Trees/Acre ~10 ft^2 BA/Acre
Tree Size	~10-40" DBH ~20 Average DBH	~4-13" DBH ~9" Average DBH	~1-6" DBH ~2" Average DBH
Dominant Plant Associations	PSME/SYAL/CARU, PSME/SPBEL/CARU, ABGR/ACCI		
Shrub Layer	A tall shrub component is abundant and can reach to 20 feet tall. Dominant shrub species include common snowberry, ocean spray, hazelnut, vine maple, Douglas maple, scouler willow, serviceberry, shiny-leaf spirea, Cascade Oregon grape, and little wood rose.		
Herbaceous Layer	Pinegrass and elk sedge are the dominant native grasses. Common forbs include silky lupine, few-flowered peavine, and vanilla leaf.		
Forest Fuels	The risk of a stand replacement fire is high. CWD and Ponderosa pine snags of varying height and condition are abundant in this stand.		
Insect and Disease	This stand had a relatively high amount of beetle kill during the 1990 mountain pine beetle infestation. Current western pine beetle infestation is moderate, but may be susceptible to increasing attack.		
Noxious Weeds	Currently not a problem.		
Trails	There is a trail on an existing roadbed that trends from south to north. This road is currently closed to public vehicles and is widely used by local residents for access to the Roslyn Ridge.		
Historic Places	There are no registered historic places in this stand.		

Stand H

Location and Description	Approximately 23 acres located in the northeast corner of section 17. Stand G is adjacent to the northwest and Stands I and J are to the northeast. This stand is primarily the slope that separates the stream in Stand G, Crystal Creek, and a fairly level bench to the northeast (Stand I). It is primarily west and south facing. Slope is primarily 15-39%, although there are some areas that exceed 39%, especially in the sliding rock area. Sliding rock is listed on the Roslyn Register of Historic Places, and is located in the southeastern portion of the stand and is included in the 300 foot riparian buffer from Crystal Creek. There is an opening/meadow approximately 2 acres in size in the northwest portion of the stand.		
	Overstory	**Mid-Story**	**Understory**
Tree Canopy Structure	90% Ponderosa pine 10% Douglas-fir 0-1% Grand fir	75% Douglas-fir 20% Ponderosa pine 5% Grand fir	50% Douglas-fir 45% Grand fir 0-1% Ponderosa pine
Crown Closure	~80% and up to 100% in places		
Tree Stocking	~167 Trees/Acre ~207 ft^2 BA/Acre	~90 Trees/Acre ~13 ft^2 BA/Acre	~20 Trees/Acre ~3 ft^2 BA/Acre
Tree Size	~10-35" DBH ~15 Average DBH	~2-12" DBH ~5" Average DBH	~1-6" DBH ~2" Average DBH
Dominant Plant Associations	PSME/SYAL/CARU, PSME/CARU		
Shrub Layer	A tall shrub component is abundant and can reach to 20 feet tall. Dominant shrub species include common snowberry, ocean spray, hazelnut, vine maple, Douglas maple, scouler willow, serviceberry, shiny-leaf spirea, and little wood rose.		
Herbaceous Layer	Pinegrass and elk sedge are the dominant native grasses. Common forbs include silky lupine, heart-leafed arnica, few-flowered peavine, and white hawkweed.		
Forest Fuels	The risk of a stand replacement fire is high. CWD and Ponderosa pine snags of varying height and condition are abundant in this stand.		
Insect and Disease	This stand had a relatively high amount of beetle kill during the 1990 mountain pine beetle infestation. There are significant patches of western pine beetle kill around the perimeter of the opening/meadow.		
Noxious Weeds	There is a significant amount of knapweed, scotch broom, and many introduced grasses and forbs in the opening/meadow.		
Trails	There is a trail on an existing roadbed that runs north-south along the western boundary into Stand G. This road is currently closed to vehicles and is widely used by local residents for access to the Roslyn Ridge. There are also user-built trails throughout the stand that travels along the northeast boundary and another that trends southwest to northeast near the center of the stand.		
Historic Places	Chimney Rock, Sliding Rock, Picnic Rock and the Roslyn Electric Star/Cross are located in this stand.		

Stand I

Location and Description	Approximately 26 acres located in the northeast corner of section 17. Stand G is adjacent to the northwest, Stand H is adjacent to the southwest, Stand J is to the southeast and Stand K to the east. This stand is the fairly level bench to the northeast of Stand G. The stand is primarily south facing, but there are some east and west aspects present. Slope is primarily in the 0-15% range, although the northern portion of the stand falls in the 15-39% range. Small portions of this stand on the eastern and northwestern boundaries are within the 300 foot riparian buffers of the channels in Stands G and K.		
	Overstory	**Mid-Story**	**Understory**
Tree Canopy Structure	75% Ponderosa pine 25% Douglas-fir 0-1% Grand fir	75% Douglas-fir 25% Ponderosa pine 0-1% Grand fir	50% Douglas-fir 45% Grand fir 1-5% Ponderosa pine
Crown Closure	~80% and up to 100% in places		
Tree Stocking	~100 Trees/Acre ~126 ft^2 BA/Acre	~100 Trees/Acre ~48 ft^2 BA/Acre	~133 Trees/Acre ~8 ft^2 BA/Acre
Tree Size	~10-30" DBH ~15 Average DBH	~4-12" DBH ~9" Average DBH	~1-7" DBH ~3" Average DBH
Dominant Plant Associations			
Shrub Layer			
Herbaceous Layer			
Forest Fuels	The risk of a stand replacement fire is high. CWD and snags of varying of heights and condition classes are abundant in this stand.		
Insect and Disease	This stand had a relatively high amount of beetle kill during the 1990 mountain pine beetle infestation. There are significant patches of western pine beetle kill throughout this stand.		
Noxious Weeds			
Trails			
Historic Places			

Stand J

Location and Description	Approximately 13 acres located in the northeast corner of section 17. Stand H is adjacent to the southwest, Stand I is adjacent to the northwest, and Stand K to the east. There are primarily east aspects, with some areas of south and west exposures. Slope is primarily 15-39%, although there are areas that exceed 39%. The eastern half of this stand is within the 300 foot riparian buffer zone.		
	Overstory	**Mid-Story**	**Understory**
Tree Canopy Structure	75% Ponderosa pine 25% Douglas-fir 0-1% Grand fir	50% Douglas-fir 40% Ponderosa pine 10% Grand fir	50% Douglas-fir 45% Grand fir 1-5% Ponderosa pine
Crown Closure	~80% and up to 100% in places		
Tree Stocking	~110 Trees/Acre ~181 ft^2 BA/Acre	~80 Trees/Acre ~44 ft^2 BA/Acre	~40 Trees/Acre ~7 ft^2 BA/Acre
Tree Size	~10-30" DBH ~17 Average DBH	~4-16" DBH ~10" Average DBH	~1-7" DBH ~5" Average DBH
Dominant Plant Associations	ABGR/SYAL/CARU, PSME/SYAL/CARU		
Shrub Layer	A tall shrub component is abundant throughout the entire stand and can reach over 20 feet tall. Dominant shrub species include common snowberry, ocean spray, hazelnut, vine maple, Douglas maple, scouler willow, serviceberry, shiny-leaf spirea, and little wood rose.		
Herbaceous Layer	Pinegrass and elk sedge are the most dominant native grasses. Common forbs include silky lupine, few-flowered peavine, and white hawkweed.		
Forest Fuels	The risk of a stand replacement fire is high. CWD and snags of varying of heights and condition classes are moderately abundant in this stand.		
Insect and Disease	This stand doesn't show much sign of pine beetle infestation.		
Noxious Weeds	Currently not a problem.		
Trails	A portion of the No. 8 mine incline traverses through the stand from southeast to northwest, and is commonly used by local residents to access the Roslyn Ridge.		
Historic Places	The No. 8 incline is located in this stand.		

Stand K

Location and Description	Approximately 19 acres located in the northeast corner of section 17. Stands H, I, and J are adjacent to the west, Stand M is adjacent to the east, and Stand L to the south. There is a variation of south, east, and west aspects. Slope is primarily 15-39%, although there are areas scattered throughout that exceed 39%. This stand is primarily the north tributary of Crystal Creek, and the entire stand is within the 300 foot buffer		
	Overstory	**Mid-Story**	**Understory**
Tree Canopy Structure	65% Ponderosa pine 25% Douglas-fir 10% Grand fir	50% Douglas-fir 30% Ponderosa pine 20% Grand fir	50% Douglas-fir 45% Grand fir 1-5% Ponderosa pine
Crown Closure	~80% and up to 100% in places		
Tree Stocking	~160 Trees/Acre ~280 ft^2 BA/Acre	~60 Trees/Acre ~38 ft^2 BA/Acre	~30 Trees/Acre ~3 ft^2 BA/Acre
Tree Size	~10-30" DBH ~18 Average DBH	~5-17" DBH ~11" Average DBH	~1-5" DBH ~3" Average DBH
Dominant Plant Associations	ABGR/SYAL/CARU, PSME/SYAL/CARU		
Shrub Layer	A tall shrub component is abundant and can reach to 20 feet tall. Dominant shrub species include common snowberry, ocean spray, hazelnut, vine maple, Douglas maple, scouler willow, serviceberry, shiny-leaf spirea, and little wood rose.		
Herbaceous Layer	Pinegrass and elk sedge are the dominant native grasses. Common forbs include silky lupine, few-flowered peavine, and white hawkweed.		
Forest Fuels	The risk of a stand replacement fire is high. CWD and snags of varying of heights and condition classes are moderately abundant in this stand.		
Insect and Disease	This stand doesn't show much sign of pine beetle infestation.		
Noxious Weeds	Currently not a problem.		
Trails	A small portion of the No. 8 mine incline traverses through the stand from southeast to northwest, and is commonly used by local residents to access the Roslyn Ridge.		
Historic Places	The No. 8 incline is located in this stand.		

Stand L

Location and Description	Approximately 21 acres located in the northeast corner of section 17. Stands H, K, and M are adjacent to the north/northwest, and Stand N is adjacent to the east. There are varying aspects of south, east, and west. Slope is primarily 0-15%, although there are areas in the 15-39% range. This stand is primarily in the intermittent drainage of Crystal Creek, and a small portion of the north tributary of Crystal Creek. Except for a small portion in the western edge, most of the stand is within the 300 foot riparian buffer zone. This stand is heavily disturbed from historical mining activities.		
	Overstory	**Mid-Story**	**Understory**
Tree Canopy Structure	70% Ponderosa pine 25% Douglas-fir 1-5% Grand fir 5% Cottonwood	50% Douglas-fir 50% Ponderosa pine 0-5% Grand fir	85% Douglas-fir 10% Grand fir 1-5% Ponderosa pine
Crown Closure	~70% -90% , and 50%-70% in places		
Tree Stocking	~160 Trees/Acre ~278 ft^2 BA/Acre	~60 Trees/Acre ~38 ft^2 BA/Acre	~30 Trees/Acre ~3 ft^2 BA/Acre
Tree Size	~10-30" DBH ~18 Average DBH	~5-17" DBH ~11" Average DBH	~1-5" DBH ~3" Average DBH
Dominant Plant Association	PSME/SYAL/CARU		
Shrub Layer	A tall shrub component is abundant and can reach to 20 feet tall. Dominant shrub species include common snowberry, ocean spray, hazelnut, vine maple, Douglas maple, scouler willow, serviceberry, shiny-leaf spirea, and little wood rose. Big-leaf maple is also present.		
Herbaceous Layer	Pinegrass and elk sedge are the dominant native grasses. Common forbs include silky lupine, few-flowered peavine, and white hawkweed.		
Forest Fuels	The risk of a stand replacement fire is high. CWD and snags of varying height and condition are moderately abundant in this stand.		
Insect and Disease	This stand shows little sign of pine beetle infestation.		
Noxious Weeds	Knapweed is abundant, and Dalmatian toadflax is present near the slag piles.		
Trails	There is a trail on an existing roadbed that parallels crystal creek that is commonly used by local residents as access to the Roslyn Ridge. A fiber optic line is located in this stands which runs up through Stand M is commonly used as a trail to access the Roslyn Ridge.		
Historic Places	There many historical features scattered throughout the stand, including 3 mine slag piles. Both the No. 8 and No. 6 inclines originate in this stand.		

Stand M – Current Conditions

Location and Description	Approximately 24 acres located in the center of the east half of section 17. Stand K is adjacent to the west, Stand M and Stand L to the south. It is primarily west and south facing. Slope is primarily 15-39%, although there are few areas that exceed 39%.		
	Overstory	**Mid-Story**	**Understory**
Tree Canopy Structure	55% Ponderosa pine 45% Douglas-fir 0-1% Grand fir	50% Douglas-fir 50% Ponderosa pine 0-1% Grand fir	50% Douglas-fir 45% Grand fir 5% Ponderosa pine
Crown Closure	~80% and up to 100% in places		
Tree Stocking	~260 Trees/Acre ~298 ft^2 BA/Acre	~90 Trees/Acre ~31 ft^2 BA/ACRE	~70 Trees/Acre 9 ft^2 BA/ACRE
Tree Size	~10-35" DBH ~15" Average DBH	~2-17" DBH ~8" Average DBH	~1-8" DBH ~5" Average DBH
Dominant Plant Association	PSME/SYAL/CARU		
Shrub Layer	A tall shrub component is abundant and can reach to 20 feet tall. Dominant shrub species include common snowberry, ocean spray, hazelnut, vine maple, Douglas maple, scouler willow, serviceberry, shiny-leaf spirea, and little wood rose. Big-leafed maple is found in a few areas.		
Herbaceous Layer	Pinegrass and elk sedge are the dominant native grasses. Common forbs include silky lupine, few-flowered peavine, arrow-leaf balsamroot, and white hawkweed.		
Forest Fuels	The risk of a stand replacement fire is high. CWD and snags of varying height and condition are moderately abundant in this stand.		
Insect and Disease	This stand shows little sign of pine beetle infestation.		
Noxious Weeds	Currently not a problem.		
Trails			
Historic Places	There are no registered historic places in this stand.		

Stand N – Current Conditions

Location and Description	Approximately 14 acres located in the center of the east half of section 17. Stand L is adjacent to the west and north. The stand is primarily west and south facing. Slope is primarily 15-39%, although a band of sandstone outcroppings in the center of the stand exceeds 39%. Almost the entire west half of the stand is included in the 300 foot riparian buffer of Crystal Creek.		
	Overstory	**Mid-Story**	**Understory**
Tree Canopy Structure	70% Ponderosa pine 25% Douglas-fir 0-1% Grand fir	75% Douglas-fir 20% Ponderosa pine 5% Grand fir	85% Douglas-fir 15% Grand fir 0-1% Ponderosa pine
Crown Closure	~70% and up to 100% in places		
Tree Stocking	~170 Trees/Acre ~210 ft^2 BA/Acre	~90 Trees/Acre ~13 ft^2 BA/Acre	~20 Trees/Acre ~3 ft^2 BA/Acre
Tree Size	~10-35" DBH ~15 Average DBH	~2-12" DBH ~5" Average DBH	~1-6" DBH ~2" Average DBH
Dominant Plant Associations	PSME/CARU, PSME/SPBEL/CARU, PSME/SYAL/CARU		
Shrub Layer	A tall shrub component is abundant and can reach to 20 feet tall. Dominant shrub species include common snowberry, ocean spray, hazelnut, vine maple, Douglas maple, scouler willow, serviceberry, shiny-leaf spirea, pinemat manzanita, and little wood rose.		
Herbaceous Layer	Pinegrass and elk sedge are the dominant native grasses. Common forbs include silky lupine, few-flowered peavine, and white hawkweed.		
Forest Fuels	The risk of a stand replacement fire is high. CWD and snags of varying height and condition are moderately abundant in this stand.		
Insect and Disease	This stand shows little sign of pine beetle infestation.		
Noxious Weeds	Currently not a problem.		
Trails	There is a trail that parallels the west side of Crystal Creek running north-south in this stand, and is commonly used by local residents.		
Historic Places	None.		

Stand O – Current Conditions – Needs further assessment

Location and Description	Approximately 3 acres located in the center along the west boundary of section 17. It is isolated from the rest of the RF. The stand is primarily west and south facing. Slope is primarily 0-15%. The stand is largely an abandoned field that has a small aspen wetland in the southern portion. Water comes from the spring located in Stand B. There are a few historic structures that are not yet on the City of Roslyn Historical Register that could be restored.		
	Overstory	**Mid-Story**	**Understory**
Tree Canopy Structure	None except for a small portion of an aspen stand.	None	Very sparse Ponderosa pine and Douglas-fir.
Crown Closure	Primarily 0%, ~70% in aspen wetland		
Tree Stocking	Need aspen stocking	None	~5 Trees/Acre
Tree Size	~5-10" DBH Aspen	None	~1-6" DBH ~2" Average DBH
Dominant Plant Associations	PSME/SYAL/CARU		
Shrub Layer	Dominant shrub species include common snowberry and little wood rose. Needs further assessment.		
Herbaceous Layer	The dominant herbaceous component is comprised of a variety of introduced grasses. Needs further assessment.		
Forest Fuels	Fire would primarily be a grass fire; the risk of a stand replacement fire is high in the aspen stand. Very low volumes of CWD and snags in this stand.		
Insect and Disease	Currently not a problem.		
Noxious Weeds	Needs further assessment.		
Trails	None.		
Historic Places	No registered historical places.		

Appendix I: Landscape Permeability Model

Similar methods to Singleton et al (2002) were used to model general dispersal habitat suitability (DHS) in order to evaluate landscape permeability of the RF for wildlife species such as deer, elk, black bear, bobcat, and mountain lion. This analysis is based on the idea that resistance to movement across a landscape can be mapped by assigning values to cells in raster data sets. These values depict the relative "cost" for an animal to move across areas represented by each cell. The cost of each cell is determined by habitat characteristics of the cell. Cells with "good" habitat characteristics (i.e. forested land cover, low road densities, and low human population densities) have low costs of movement, whereas cells with "poor" habitat characteristics (i.e. high road densities, and high human population characteristics) have high movement costs.

GIS datasets were compiled of land use zoning, roads, lakes, streams/rivers, and slope. Coefficients for the focal species were attributed with values ranging from 0.1 (high cost of movement) to 1 (low cost of movement) for each of the above parameters based on literature review and expert opinion (See Table 1). These values can be adjusted based on new findings. Each of the attributed raster datasets were multiplied together resulting in an overall score between 0 (low permeability) and 1 (high permeability). This analysis results in a map that depicts the difficulty for an animal to move across the landscape, and is expressed as "dispersal habitat suitability" (see Figure 1). This is represented in terms of the cumulative effect of landscape barriers based on the coefficients of each parameter. Although this analysis weights the parameters equally, the relative importance of each parameter is reflected in the permeability value assigned to it. Parameters with more influence will be attributed with coefficients of lower values and a higher range of scores (i.e. 0.1-1) than parameters with less influence (i.e. 0.6-1). This is designed to be an adaptive/working map that can be modified and changed with actually changes on the ground and any updated information that becomes available.

To perform a least-cost corridor analysis, a cell weight is applied to the DHS model by using the following formula:

cell size*(10-[10(DHS)])

The cell weight is expressed as distance (in feet), based on the value of the cells of the DHS model. For example, a 100x100 foot cell with a value of 1 (high permeability) directly adjacent to the source area will have a weighted distance of 100, and a cell with a value of 0.1 (low permeability) will have a weighted distance of 900 feet (See Table 1). This is followed by performing a weighted distance function using the cell weights and any two defined "source areas." A least-cost corridor analysis is then performed on the two weighted distances that displays the most permeable route from two areas. A 100-foot raster size was used and all spatial analysis was done using ModelBuilder in ArcInfo 9.0 (ESRI 2004) in a Windows NT environment.

Table 1 - Dispersal habitat suitability model parameters and permeability values for weighted-distance and least cost corridor analysis.

Landscape Characteristic	**Relative Permeability**
Land Use Zoning	
Forest and Range	1.0
Commercial Forest	1.0
Planned Unit Development	0.4
Highway Commercial	0.1
Commercial	0.1
Rural 3	0.5
General Commercial	0.1
Commercial Agriculture	0.3
Historic	0.1
MPR	0.1
Agriculture 20	0.8
General Industrial	0.1
Residential 2	0.1
Urban Forest	1.0
Residential Low Density	0.1
Public	0.3
Central Commercial	0.1
Light Industrial	0.1
Residential Medium	0.1
Agriculture 3	0.5
Suburban	0.1
Residential	0.1
Public Reserve	0.1
Entryway Commercial	0.1
Industrial	0.1
Suburban	0.1
Old Town Commercial	0.1
City of South Cle Elum	0.1
Blank	0.1
Limited Commercial	0.1
Residential Suburban	0.1
Commercial Tourism	0.1
Industrial Light	0.1
Commercial Neighborhood	0.1
Commercial Highway	0.1

Table 1 Continued: Dispersal habitat suitability model parameters and permeability values for weighted-distance and least cost corridor analysis.

Industrial Heavy	0.1
Mobile Home Park	0.1
Residential Office	0.1
R1 Single Family Residence	0.1
R3 Mobile Home Park	0.1
Central Business	0.1
City of Kittitas	0.1
Trailer Court Zoning District	0.1
Managed Open Space	0.8
Perimeter Open Space	0.8
Cle Elum River Corridor	1.0
Natural Open Space	1.0
Stream C Corridor	1.0
Slope (degrees)	
0-20	1.0
20-40	0.8
>40	0.6
Riparian Buffer (300ft and 100ft)	
Within	1.0
Outside	0.8
Road Buffer (300ft)	
Within	0.8
Outside	1.0
Large Lakes	
No Lake	1.0
Large Lake	0.1

Figure 1 – Dispersal Habitat Suitability Model

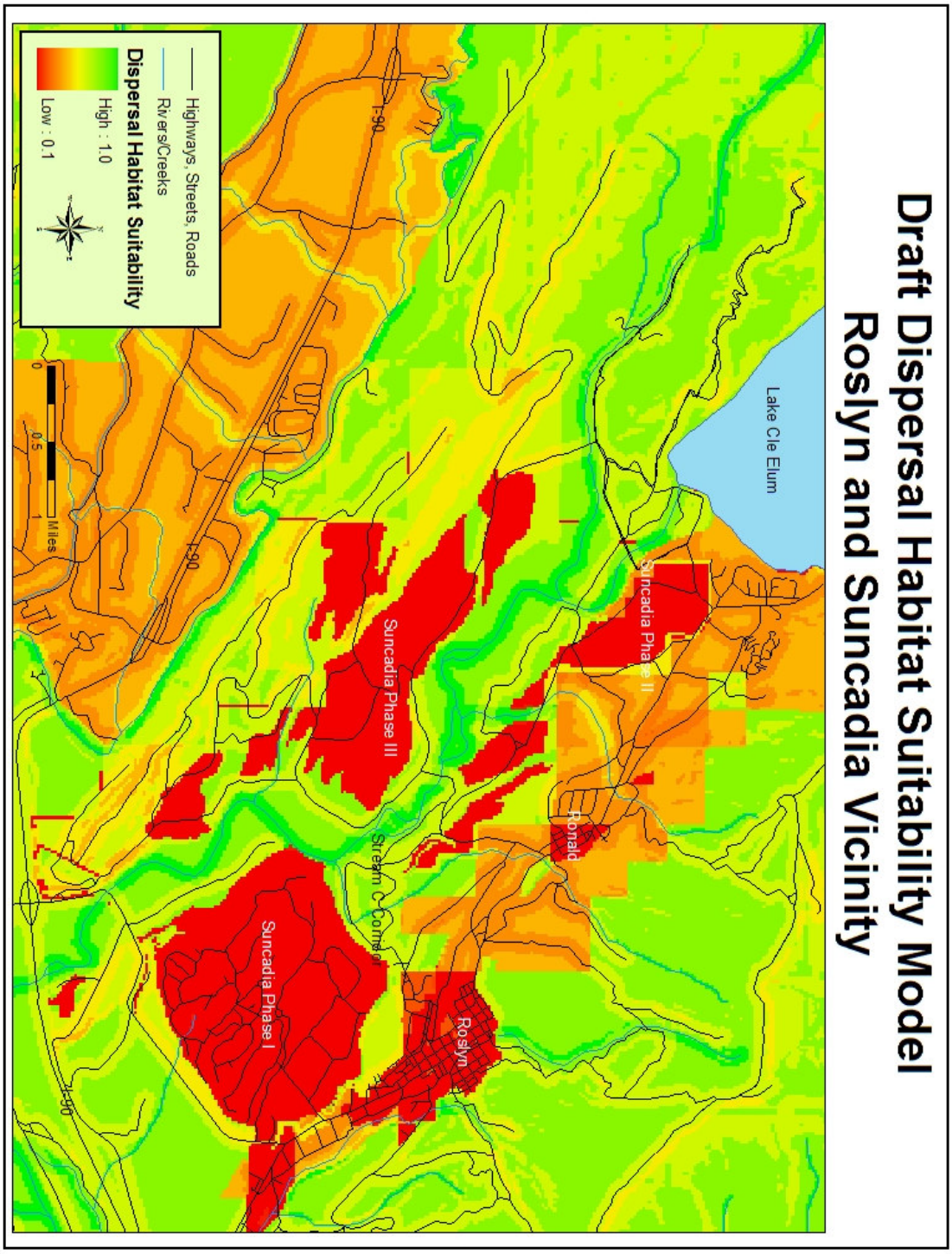
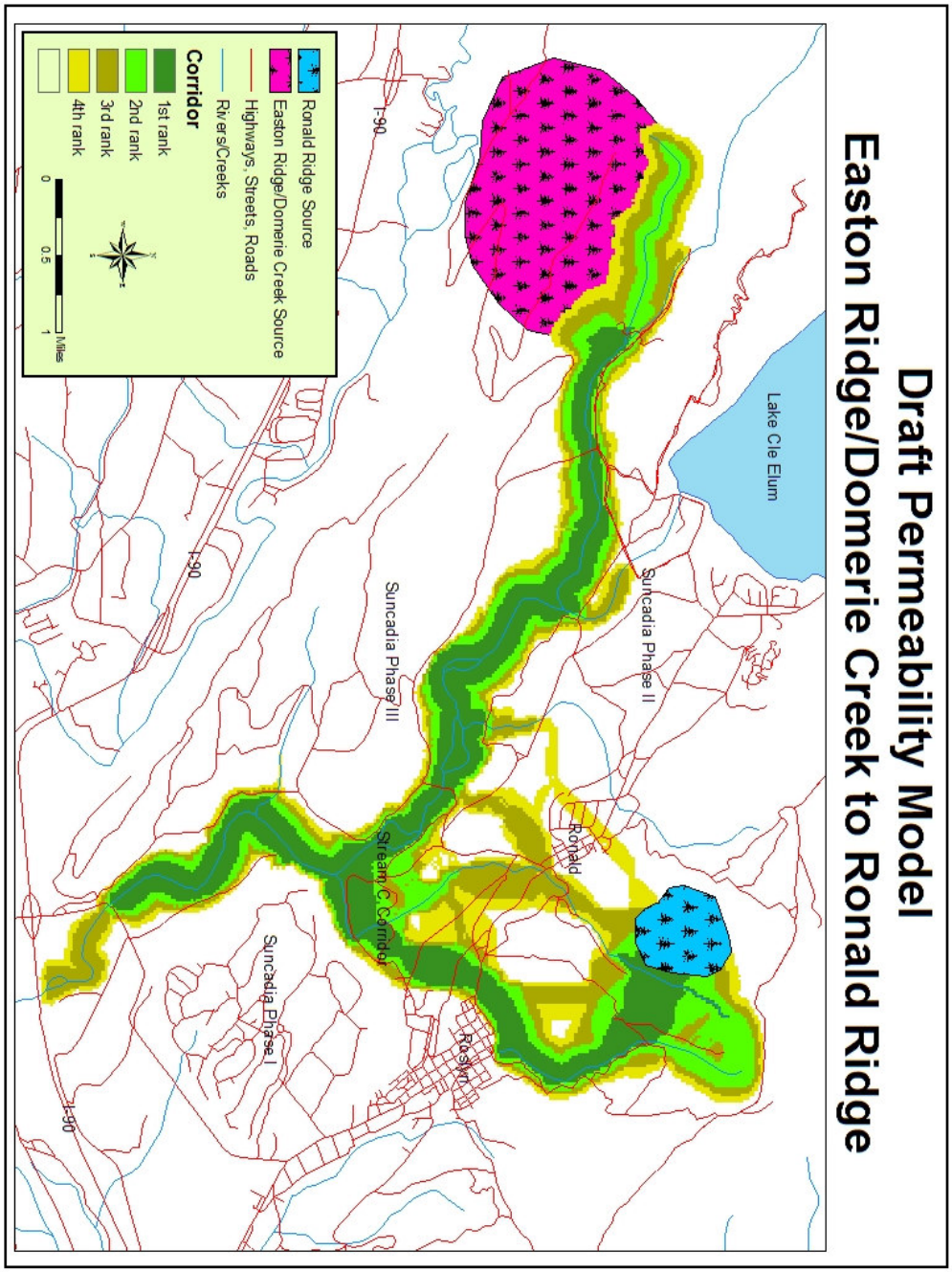


Figure 2 – Least Cost Corridor Model Example



Appendix J: Land Stewardship Monitoring

The use of monitoring is essential in determining whether or not management options are meeting goals and objectives described in the LSP. Gaines et al. (1999) express that monitoring is necessary for an adaptive management approach and the successful implementation of ecosystem management. It is important that monitoring is done to ascertain whether management prescriptions for each stand are effective The following outline discusses goals for monitoring and suggests possible methods.

Wildlife values associated with the RF:

1. The ability of wildlife such as deer, elk, black bear, mountain lion, bobcat, and coyotes to move as easily as possible through the RF and into other areas of open space, as well as from one area of source habitat to another.
2. Adequate habitat for denning, nesting, bedding, foraging, and security for a wide range of wildlife species (promoting species diversity).
3. The provision of foraging and roosting opportunities for wildlife species that migrate or have large home ranges (i.e. northern goshawk, pileated woodpecker).

Potential monitoring goals and outcomes:

1. Help identify forest health and hazardous fuels issues.
2. Help determine site-specific prescriptions for wildlife enhancement and hazardous fuels reduction.
3. Identify areas with high ecological integrity or restoration potential.
4. Provide evidence of areas of conservation priority.
5. Determine the status of plants and animals that are indicators of ecological integrity, and the presence of "special status species."
6. Assess impacts and threats to native biodiversity.
7. Monitor cumulative impacts of plant and wildlife community stressors (i.e. human disturbance).
8. Monitor ecological changes across the landscape over time.
9. Inspire community stewardship, including plant and animal field inventory.
10. Provide information to assess and resolve potential conflicts and *mitigations* before they occur.
11. Create a framework in which community members can share and teach.
12. Provide a standardized basis for information collection and exchange among local and regional groups.
13. Use an ongoing monitoring system that continues to help identify wildlife and forest health issues that can be correlated to habitat conditions.
14. Provide methodology and data for informed land-use planning.
15. Familiarize interested community members with some "tools of the trade" for ecological inventory, including wildlife tracking, bird point counts, habitat assessment, and mapping. (This will help create better awareness of wildlife and their habitat in our area, and help teach the community to collect scientifically valuable data for use in conservation and land use planning decisions.)

Monitoring Process
The initial phase of monitoring is to estimate species diversity at one point in time and location to determine what species and communities are present. Delineated stand descriptions, bird point counts, and vegetation sampling can constitute this first phase.

The second phase in the monitoring process is estimating diversity at the same location over time. RF changes should be monitored over time at the landscape level (identity, distribution, overstory series, and plant associations). At the community or ecosystem level, richness, evenness, and diversity of species and wildlife groups can be monitored. At the species or population levels, abundance, density, and biomass of each population are important measures. For this LSP, the second phase of monitoring should consist of the continuation of bird point counts and vegetation sampling. The focal species approach described below can be incorporated in this phase, and is a pragmatic way to gain insight into the integrity of the larger ecosystem to which species belong.

Like the LSP process as a whole, monitoring should be understood to be an adaptive process; as new information and issues surface, they will need to be tied to the identified management goals of this LSP. The continued monitoring, as well as the land stewardship planning, must be done through (but not limited to) further contracting or through volunteer groups.

Monitoring results should be reviewed in a collaborative manner by professionals, managers, and any other interested and involved parties. This can be done using a stewardship/monitoring committee that has scheduled annual or biannual meetings to monitor LSP implementation and effectiveness. Continued use and expansion of volunteer groups and the constructive use of public input should be high priorities.

Ongoing Monitoring Questions:
1. Are site specific prescriptions meeting goals?
2. What impacts will new trails and increased human use have on wildlife?
3. What edge effects and impacts are taking place due to adjacent development?
4. Are more exotic and/or invasive species becoming established in the RF?

Possible Monitoring Methods:
1. Bird point counts
2. Vegetation surveys
3. Snow tracking
4. Visual observation and recording

Four possible monitoring methods could be implemented through bird point counts, vegetation surveys, snow tracking, visual observation, and focal species monitoring, as described below.

Bird Point Count Surveys

Birds are excellent indicators of forest and ecosystem health. Trends of bird populations have been widely used to monitor and assess changes in habitat composition and quality. The objectives and goals for this type of survey are to collect data and to describe the characteristics and dynamics of the various populations of local bird species that nest in the RF. Monitoring bird populations can help determine the health and character of the easement and the types of treatments to be prescribed on a stand-by-stand scale. Birds vocalize with distinct songs and calls which make them identifiable and relatively easy to survey. Point count surveying is an inexpensive method that requires no special equipment other than a pencil, paper, binoculars, and a trained ear. Most importantly, monitoring will help determine bird composition and abundance over time and to assess whether or not prescription goals and objectives are being met. This can also help provide early warning signs of potential problems with local native bird populations to help determine if adaptive management measures should or can be taken. These surveys are designed to be compatible with similar efforts throughout the region. These surveys have the potential to help contribute to the regional conservation effort by the Oregon and Washington Partners in Flight (www.orwapif.org).

There were five bird point count surveys conducted from late May through late June of 2005 under a protocol used and recommended by Point Reyes Bird Observatory (PRBO) (www.prbo.org). This protocol suggests 5 point counts to be conducted from May through the beginning of July. There are 12 established point count stations in the RF (Figure 1). During each survey, all birds are recorded that are heard and seen within 125 meters during a 5 minute period at each station. Table 1 shows a basic summary of the results of the five survey visits for the RF in the spring of 2005.

There were a total of 834 detections of 44 different bird species in the RF. The most abundant species found were the Nashville warbler (78 detections), Townsend's warbler (64 detections), yellow-rumped warbler (64 detections), dark-eyed junco (57 detections), evening grosbeak (56 detections), western tanager (56 detections), MacGillivray's warbler (53 detections), and red-breasted nuthatch (52 detections). These species are associated with dense tree canopies and dense shrub cover.

Species that are underrepresented for healthy forest types typical for this area are: (1) white-breasted nuthatch (0 detections), (2) western bluebird (0 detections), (3) chipping sparrow (1 detection), and (4) Cassin's finch (3 detections). The reason for the low numbers of detections of these species is due to the dense tree canopy found throughout the RF. Prescribed dry site strategy treatments will open the tree canopy to about 50% from current closure nearing 100%, and an expected result will be an increase in the underrepresented species and a decrease in birds such as the Townsend's warbler.

Point count surveys should have two consecutive years of initial monitoring and be repeated every 3-5 years. This will give a good indication if the RF is being negatively impacted by the surrounding development, if exotic bird species (i.e. European starling) are establishing, if management prescriptions are producing predicted results, and if prescriptions need to be adapted to new findings.

Vegetation Surveys
Vegetation surveying help determine whether prescriptions are meeting goals and objectives or if they need to be adapted. It will also help identify the vectors of change in surveyed bird populations over time, and determine and measure any encroachment of exotic and/or noxious plant species. Vegetation surveys can be done in conjunction with the bird point count surveys simultaneously in spring/early summer months. Combining vegetation surveys with bird surveys will help with quantifying the relationship between wildlife and their habitats, as well observing vegetation changes over time. Vegetation surveys should continue to occur concomitantly with bird point count surveys, every 3-5 years.

The PRBO vegetation protocol uses 50-meter circular plots around each bird point count station (Figure 1). The plant association, percent overstory crown closure, snag abundance, downed woody debris, shrub layer, herbaceous component, aspect, and slope are all measured or estimated. Species of shrubs and herbs that have 5% coverage have total percent coverage estimated in the 50-meter circular plot. Lists of other species identified that comprise less than 5% coverage are documented.

Table 2 has a list of all the shrub and herb species recorded in the RF in the spring and summer of 2006. More detailed vegetation surveys should be completed in the RF, again, ideally in conjunction with bird point counts.

Snow Tracking
Modified techniques developed by Halfpenny (in Zielinski and Kucera 1995) and Singleton and Lehmkuhl (2000) could be used to assess and monitor wildlife activity and occurrence within the corridor during winter months. Goals of the snow tracking surveys are as follows:

1. Determine movement patterns and areas of concentrated use by ungulates within the corridor.
2. Assess the occurrence of cougar, bobcat, and coyote.
3. Determine winter use and possible dens of black bear.
4. Develop an "index of abundance" for snowshoe hare and ruffed grouse.

Success of snow tracking is weather-dependent. The uncharacteristically dry winter of 2004-2005 did not create good conditions for snow tracking. The ideal time to track animals is from 24 – 48 hours after a snowfall; this gives a confident estimate of wildlife activity during that window of time.

Visual Observation and Recording
Visual observation and records entail periodic (every 3-5 years) checks for any use of habitat piles and created wildlife trees by small mammals or birds. All created habitat piles and wildlife trees should be mapped and recorded using GPS in order to determine whether or not these features are being utilized. It may require a few visits per season to determine habitat pile utilization. This will help determine whether wildlife habitat

construction is being utilized effectively, and whether or not to adapt prescriptions if the LSP is not achieving desired objectives and goals.

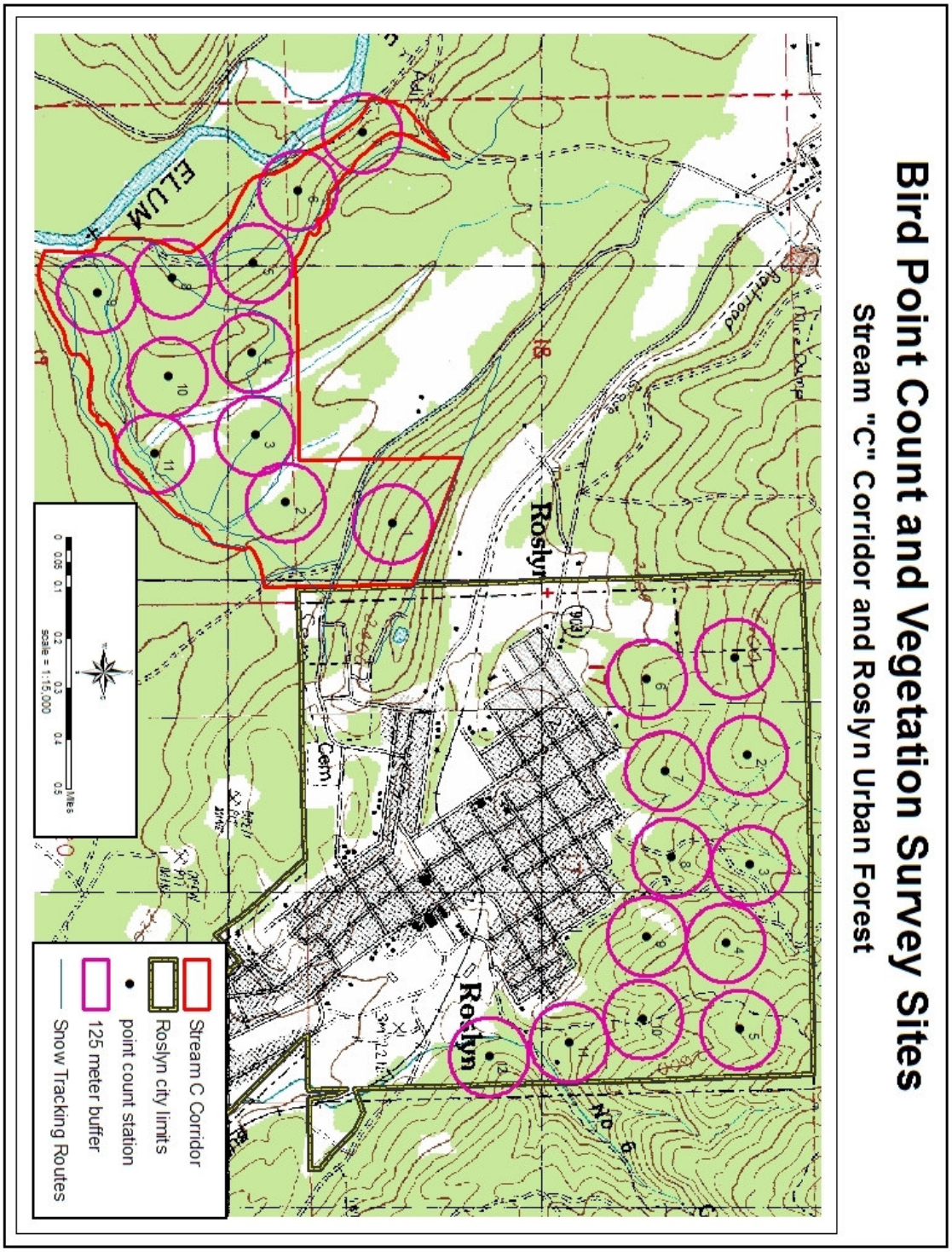
Focal Species Monitoring

Focal species monitoring is based on identified groups that are significant and representative of the overall health and ecological integrity of the RF. Focal species are used as representative species to indicate both positive and negative changes on the landscape. These species are to be selected based on habitat relationships, identifiable risk factors, and the relative ease of monitoring. When summarizing and analyzing the different monitoring activities, these are the critical species of attention. The trends of these species can help determine the efficacy of LSP management techniques, and can help provide possible solutions to problems when necessary. These trends can also aide in identifying potential problems in the RF either before they occur or at the earliest possible onset. Table 1 lists potential focal species that can be monitored in the RF.

Table 1 - Potential focal species and wildlife groups

Focal Species	Wildlife Group	Associated Risks	Monitoring Method
Ruffed Grouse	Prey Species	Habitat Loss Fragmentation Road Associated Factors	Snow Tracking
Snowshoe Hare	Prey Species	Habitat Loss Fragmentation Road Associated Factors	Snow Tracking
Bushy-tailed Woodrat	Prey Species	Habitat Loss Fragmentation Road Associated Factors	Snow Tracking
Winter Wren	Late Successional Riparian Mesic Forest	Habitat Loss Edge Effects	Point Counts
Warbling Vireo	Late Successional Riparian Mesic Forest	Edge Effects	Point Counts
Townsend's Warbler	Forest Interior	Edge Effects	Point Counts
Chipping Sparrow	Dry Forest	Road Associated Factors Trail Associated Factors Edge Effects Displacement/Avoidance	Point Counts
Red-breasted Nuthatch	Secondary Cavity	Snag Reduction	Point Counts
White-breasted Nuthatch	Mature/Dry Forest Secondary Cavity	Snag Reduction Road Associated Factors Trail Associated Factors Edge Effects Displacement/Avoidance	Point Counts
Brown Creeper	Late Successional	Snag Reduction Road Associated Factors Trail Associated Factors Edge Effects	Point Counts
Golden Mantled Ground Squirrel	Prey Species	Road Associated Factors CWD Reduction	Point Counts

Figure 1 – Bird Point Count and Vegetation Survey Map



Appendix K: Preliminary Land Stewardship Monitoring Results

Table 1 - 2005 Bird Point Count Results

Species	Number of Detections
Nashville warbler	78
Townsend's warbler	64
yellow-rumped warbler	64
dark-eyed junco	57
evening grosbeak	56
western tanager	56
MacGillivray's warbler	53
red-breasted nuthatch	52
brown-headed cowbird	46
hermit thrush	33
Cassin's vireo	25
spotted towhee	25
American robin	22
mountain chickadee	20
dusky/Hammond's	15
black-headed grosbeak	14
American crow	12
pine siskin	12
brown creeper	11
dusky flycatcher	11
black-throated gray warbler	10
Stellar's jay	10
winter wren	10

Species	Number of Detections
western wood-pewee	9
Hammond's flycatcher	7
purple finch	7
red crossbill	7
caliope hummingbird	6
golden-crowned kinglet	5
pileated woodpecker	5
violet-green swallow	5
chestnut-back chickadee	4
common raven	4
Cassin's finch	3
Lazuli bunting	3
northern flicker	2
Townsend's solitaire	2
western flycatcher	2
Wilson's warbler	2
chipping sparrow	1
European starling	1
hairy woodpecker	1
house wren	1
warbling vireo	1

Total Detections	834
Total Species	44

Table 2 - Vegetation Survey List

SPECIES	SPECIES
Acer circinatum	*Hieracium albiflorum*
Acer glabrum	*Holodiscus discolor*
Acer macrophyllum	*Hydrophyllum capitatum*
achillea millefolium	*Lathyrus pauciflorus*
achlys triphylla	*Linnaea borealis*
Adenocaulon bicolor	*Lomatium triternatum*
Agoseris sp.	*Lonicera cilosa*
Alnus sp.	*Luina nardosima*
Amelanchier alnifolia	*Lupinus sp.*
Amsinckia sp.	*Mahonia aquifolium*
Anenome oregana	*Mahonia nervosa*
Apocynum androsaemifolium	*Moehringia macrophylla*
Aquilegia formosa	*Osmorhiza chilensis*
Arctostaphylos nevadensis	*Pachistima mycsinites*
Arenaria congesta	*Poa bulbosa*
Arenaria macrophylla	*Poa pratensis*
Arnica cordiflora	*Poa secunda*
Astragalus sp.	*Poa wheeleri*
Balsamorhiza sagittata	*Prunus emarginata*
Bromus commutatus	*Prunus virginiana*
Bromus tectorum	*Pteridium aquilinum*
Calamagrostis rebescens	*Pterospora andromedea*
Carex geyeri	*Purshia tridentata*
Castilleja parviflora	*Rosa gymnocarpa*
Chimaphila menziesii	*Rosa nutkana*
Chimaphila umbellata	*Rubus parviflorus*
Cirsium sp.	*Rubus ursinus*
Claytonia perfoliata	*Rumex acetosella*
Clintonia uniflora	*Salix scouleriana*
Collinsia parviflora	*Sambucus cerulea*
Corylus cornuta	*Sedum lanceolata*
Dactylis glomerata	*Spirea betulifolia*
Disporum trachycarpum	*Symphocarpus albus*
Elymis sp.	*Symphocarpus mollis*
Epilobium brachycarpum	*Taraxacum officinale*
Festuca idahoensis	*Thalictrum occidentale*
Frageria vesca	*Tragopogon dubis*
Frangula purshiana	*Trietalis latifolia*
Galium aparine	*Trillium ovatum*
Galium triflorum	*Veratrum viride*
Gilia aggregata	*Vicia americana*
Goodyera oblongifollia	*Viola sp.*

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