Appendix A – Silviculture Specialist Report and Vegetation Treatments Proposed

SILVICULTURAL REPORT FOR HANLON TIMBER & FUELS MANAGEMENT PROJECTS

This document incorporates the requirements and guidelines as set forth in the Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) for the Colville National Forest Land and Resource Management Plan (LRMP) which was signed December 29, 1988, as amended by the continuation of Interim Management Direction Establishing Riparian, Ecosystem, and Wildlife Standards for Timber Sales (hereafter referred to as "eastside screens", Lowe, 1995), the Environmental Assessment for Integrated Noxious Weed Treatment, Colville National Forest (USDA, 1998) and the Inland Native Fish Strategy Environmental Assessment (INFISH), which was signed June 28, 1995. This document is also part of the analysis file for the Hanlon Environmental Assessment. Content from these documents and the LeClerc Watershed Analysis (Colville National Forest, 1997) are incorporated into the analysis by reference.

EXISTING CONDITION

The roughly 66,000-acre LeClerc watershed lies east of the Pend Oreille River in the far northeastern corner of Washington State. The watershed is located in the southeast corner of the Sullivan Lake Ranger District. An additional approximately 3,000 acres lies due west which are face drainages directly into the Pend Oreille River. The Hanlon planning area is a 14,259 acre piece of these watersheds. The whole planning area lies below 3,500 feet in elevation, with the exception of the top of Hanlon Mountain which is on privately owned property.

As categorized in Volume I of An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins (USDA/U.S. Department of the Interior [USDI] 1997), the LeClerc watershed lies within the Okanogan Cool/Moist Forest subregion in the Northern Rocky Mountain-Steppe-Coniferous Forest-Alpine Meadow Province of the Northern Glaciated Mountains Ecological Reporting Unit (ERU). Biophysical characteristics of these categories within the watershed are discussed further in following sections of this document.

The watershed contains landforms representative of the Northern Glaciated Mountains. More specifically, the watershed is within the Selkirk Mountain Range. Elevations in the watershed range from approximately 2,000 feet to 6,464 feet at the summit of Molybdenite Mountain. Slopes range from 1% to 75% across the watershed.

Annual precipitation ranges from 21 inches at the mouth of LeClerc Creek to 50 inches on Monumental Mountain.

Land Ownership

The Hanlon planning area is a mix of public and private ownership. Table 1 displays distribution of ownership.

Table 1. Land Ownership in the Hanlon Analysis Area

Type of Ownership	Acres	Percent of Analysis Area
National Forest	8,996	63
Non-Forest Service	5,263	37
Total	**14,259**	**100**

Land Allocations, Plan Objectives, and Regulatory Constraints

Currently, there are four primary documents containing directives for managing natural resources in the planning area. Three of them guide actions on federal lands. The remaining one is a state document that directs management on state and privately owned lands. Each is described briefly below.

Colville National Forest Land and Resource Management Plan, December 1988, as amended. Promulgated by the National Forest Management Act (NFMA) of 1976, this plan is the foundational precursor to present day directives. The LRMP was developed to direct management of the Colville National Forest (CNF). It provides a management program that promotes multiple use objectives, balancing resource utilization with environmental protection (USDA 1988). Certain sections of the LRMP have been amended by the Interim Management Direction of 1994 in an effort to incorporate ecosystem management principles into forest management objectives. Nevertheless, there are numerous standards and guidelines still applicable that are used to direct project-level planning.

Decision Notice for the Revised Continuation of Interim Management Direction Establishing Riparian, Ecosystem, and Wildlife Standards for Timber Sales, Amendment No. 2, June 1995. (Eastside Screens) This directive was set in motion in response to conservation strategies mandated to "westside" forests by the President's Northwest Forest Plan (NWFP) (USDA/USDI 1994). "Eastside" forests, recognizing the need to address similar conservation issues, moved to consider strategies that, like the NWFP[1], are mindful of ecosystem complexities. As a result, the eastside screens were enacted to ensure that ecosystem management objectives are contained in forest planning ventures (USDA 1994). The eastside screens amend specific standards and guidelines in the LRMP; they are a revision of the first interim amendment adopted in May 1994.

INFISH, Environmental Assessment, Decision Notice and Finding of No Significant Impact, June, 1995. This mandate also provides interim direction that amends the LRMP and supersedes the "eastside screens." This direction pertains to those watersheds that support resident native fish. It is a strategy to protect and conserve habitat and populations of resident native fish on National Forest System lands in the Interior Columbia River Basin (USDA 1995).

Washington Forest Practices Act, 1974. This act provides authority for state regulation of forest management practices on Washington's 12.5 million acres of state and private lands. As a result of this law, rules were developed to govern timber harvesting activities on non-federal lands. Regulations are primarily designed to provide resource protection and ensure reforestation. It is implemented and enforced by the Forest Practices Board (WFPB), a division of the Washington Department of Natural Resources (WFPB 2001).

[1] Northwest Forest Plan.

Selected Resource Management Direction for National Forest System Lands

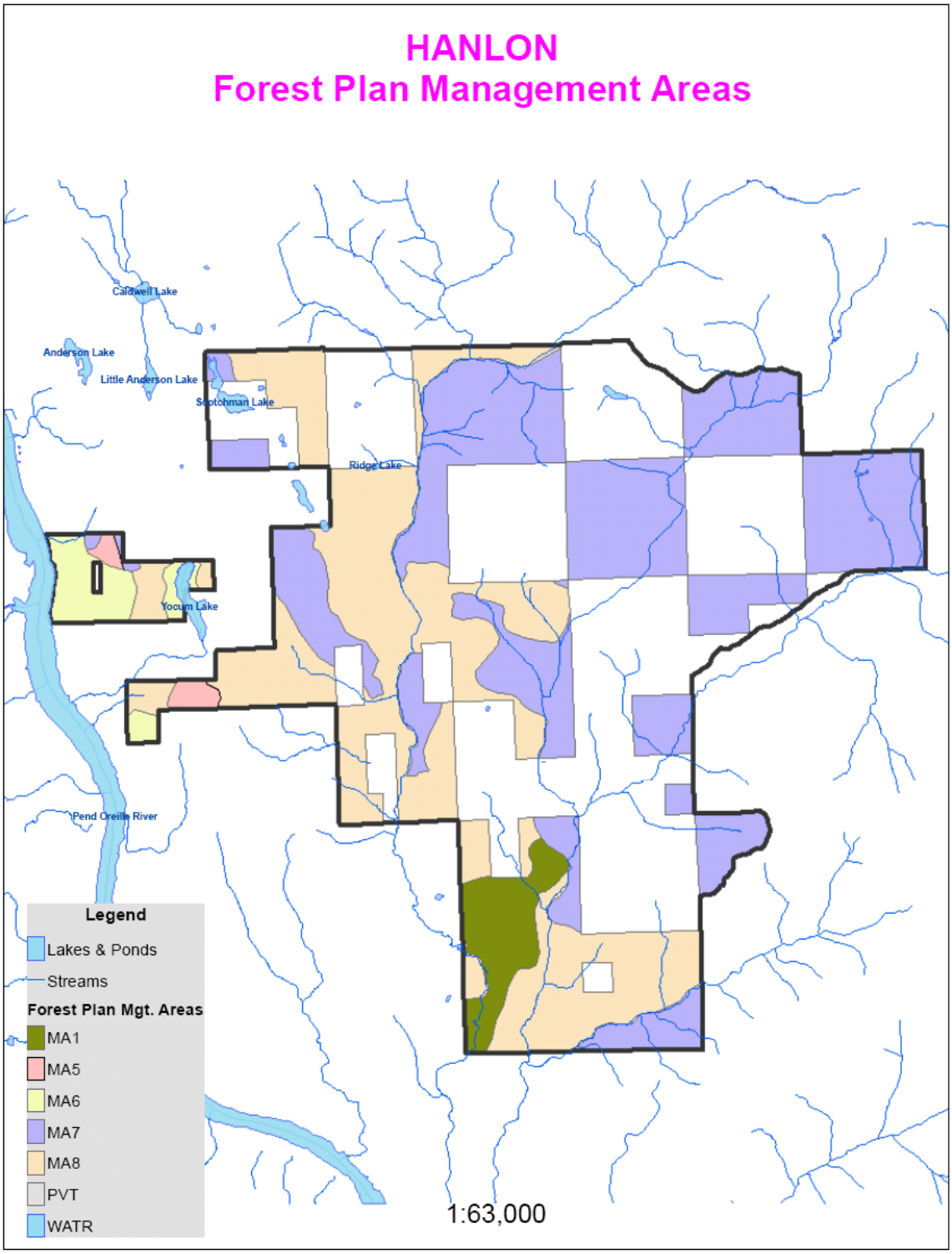
The LRMP identifies five different management areas (listed in Table 2) mapped in the planning area. These management areas pertain only to National Forest System lands within the Colville National Forest boundaries. Each allocation has a set of prescriptions pertaining to objectives emphasizing the management of a particular resource. Comprehensive descriptions and details of management area prescriptions are defined in Chapter 4 of the LRMP. Figure 1 shows the locations of the management areas in the Hanlon planning area.

Table 2. Management Areas (MA's) in the Hanlon Planning Area

LRMP Management Area	Management Area Goal	Acres	Percent of Analysis Area
MA1: Old Growth Dependent Species Habitat	Provide essential habitat for wildlife species that require old growth forest components, and contribute to the maintenance and diversity of wildlife habitat and plant communities.	465	5
MA5: Scenic Timber	Provide a natural-appearing foreground, middle, and background along major scenic travel routes, while providing wood products.	91	1
MA6: Scenic/Winter Range	Provide a natural-appearing foreground, middle, and background along major scenic travel routes, while providing for winter range management.	347	4
MA7: Wood/Forage	Manage to achieve optimum production of timber products, while protecting basic resources.	4434	49
MA8: Winter Range	Meet the habitat needs of deer and elk to sustain carrying capacity at 120% of the 1980 level, while managing timber and other resources consistent with fish and wildlife management objectives.	3659	41
Total		**8996**	**100**

Source: USDA 1988

Figure 1 Management Areas in the Hanlon Analysis Area



Management Area Standards and Guidelines

MA 1
Provides those forest components needed for old growth dependent species. No scheduled timber harvest would be proposed within this management area. Prescribed fire may be proposed to help achieve old growth habitat objectives within this management area.

MA 5
Utilize even- and uneven age management to provide a natural appearing fore, middle and background along major scenic travel routes while providing wood products. Any proposed activity in this analysis would meet the VQO (Visual Quality Objective) of retention or partial retention.

MA 6
Utilize even and uneven age management to provide natural appearing fore, middle and background along major scenic travel routes while emphasizing development of elk habitat. Any proposed activity in this analysis would meet the VQO of retention or partial retention. Unit size for areas proposed for even age management would have an emphasis on 10 to 20 acre regeneration units.

MA 7
Management focuses on a combination of wood and forage production while protecting basic resources. Any proposed activity in this analysis would meet the VQO of modification or maximum modification. All silvicultural treatments may be utilized although even age management is emphasized.

MA 8
The objective for this management area is the development and maintenance of winter range for elk while managing timber and other resources consistent with fish and wildlife management objectives. Any proposed activity in this management area would meet the VQO of modification or maximum modification. Even age management is preferred with an emphasis on regeneration units of 10 to 20 acres.

In addition to the above standards, most of the analysis area is within the LeClerc Grizzly Bear Management Unit. This designation does not preclude the treatment of stands, but does add some additional constraints like not allowing the construction of new system roads, limiting the opening of existing roads in or near core habitat areas and specifying the season that management activities can occur.

There are also five pine marten core habitat areas within the analysis area. These are approximately 160 acres in size, and no harvest activities would be allowed. These areas were chosen as the best available habitat within a certain distance from grid points specified by the Forest Plan, and any treatments based upon silvicultural or fuels/wildland urban interface needs were not considered.

Past Management Activity

Past harvest activities on Forest Service land from approximately 1960 to present are identified in Table 4a. Table 4b shows past harvest activity by all ownerships. Past harvest activity on Forest Service land is significantly less than on other ownerships.

Harvest activities also occurred during the early 1900s. The stand destruction fires in the 1930s removed most of the timber available for harvest. These fires were due to the buildup of fuels which in turn supported more intense fires that killed smaller trees and breeched the protective outer bark of larger trees. Some of the residual trees that survived the fires were then logged to support the local mills. Some of these residual trees, if not harvested, would have still remained alive today. Logging in the early 1900s favored removal of western white pine (WP) and western redcedar (RC) (Watershed Analysis, 1997). Past harvest activity and western white pine blister rust have reduced the presence of WP in the watershed.

The WP that is present in the planning area, outside of more recent plantations, is not from rust resistant stock and is being lost to blister rust. Removal of western redcedar, western white pine, ponderosa pine (PP) and western larch (WL) before or immediately after the fires in the early 1900s removed available seed sources and influenced the current species composition. Stumps throughout the planning area indicate that these species were higher in numbers and of larger diameter than the current stand compositions. Grazing by cattle and big game in the riparian habitat conservation areas (RHCAs) has also reduced the regeneration of western redcedar on some of these sites. Lodgepole pine (LP) was able to quickly colonize these disturbed sites probably due to some of these trees being left after the logging and their serotinous cones being suitable for surviving disturbance.

Some stands were reforested after the 1930s fires, during the civilian conservation corps era, and were planted with stock suspected to be from the Black Hills in South Dakota. This offsite PP stock is present within the planning area and is evident by slow growth, poor live crown ratios and high mortality. The offsite PP may cross pollinate with the local PP and cause future problems if the resulting regeneration becomes established. The picture on the right shows 2 snags in the foreground which were off-site ponderosa pine.

The fire history study done in the South Deep Watershed has similar fire regimes and is being used to provide insight into the history within the Hanlon analysis area. Mean fire size during the pre-settlement period (pre 1860) in the South Deep watershed averaged 520 acres in size. Fire size does not imply 100% mortality within the fire boundary (South Deep Fire History, Schellhaas and others, 2000). Past timber harvest in stands with sawlog-sized trees has fragmented a portion of the watershed by creating smaller patch sizes than have been represented historically.

Management activities have changed the relative amounts of various species, but the combination of natural regeneration and planting has maintained a diversity of species within the planning area. Current species composition indicates a higher amount of LP and less RC, PP, WL and WP than was present before the logging and fires in the early 1900s.

Regeneration in past harvest units has been quite successful within the planning area. Regeneration techniques in the past included natural and artificial. Species that were planted included ponderosa pine, western white pine, western larch, Douglas-fir and Engelmann spruce. Most units that are planted also have an abundance of natural regeneration so a release/precommercial thinning type operation is needed by age 15 to retain optimum growing

conditions for the desired species. The following two pictures are examples of regeneration harvest from previous timber sales.

Whiteman Unit 2, planted in 1997

Kelly Timber Sale, planted in 1982, precommercial thinned in 1995

Other past harvests were designed to remove a portion of the stand; in most cases either released an existing cohort of regeneration or initiated regeneration under a partial overstory. These types of treatments favor an understory of shade tolerant species such as grand fir, western redcedar, western hemlock and to some extent Douglas-fir.

Potential problems for regeneration harvests based on previous experience in this area include brush competition, mortality caused by blister rust or *Armillaria* root rot and damage due to foraging by wildlife. Some of the past regeneration harvests have required a replant to certify the unit as restocked. Planting techniques have improved and seedling survival has increased over the years, and percent of regenerated acres satisfactorily stocked after 3 years on the district now range from 83% to 94%. Appropriate site preparation activity and timing of site preparation and regeneration activities would minimize the effects of brush competition and provide successful regeneration of the proposed harvest units. Competing vegetation, especially from alder, willow, ceanothus, oceanspray, and ninebark, in some of the proposed regeneration units may require manual release. Browsing by wildlife is expected to occur at scattered locations throughout the planning area, but is not expected to create large scale problems for the establishment of regeneration on the sites. Planting of RC within the RHCA's may need to use vexar tubing, netting or wire cages to prevent browsing damage until the seedlings become established.

Table 4a: Past Harvest Activity on National Forest System Land

Harvest Rx	Acres Harvested	% of Total Harvest
HCC	198	12
HCR	17	1
HCU	101	6
HSH	375	23
HPR	678	41
HOR	92	6
HTH	176	11
Total	1,637	100

Table 4b: Past Harvest Activity On All Ownerships

Harvest Rx	Acres Harvested	% of Total Harvest
HCC	448	9
HSL	28	<1
HOR	942	19
HPR	2108	43
HCR	197	4
HSH	839	17
HSV	80	2
HTH	176	4
HCU	101	2
Total	4,919	100

Silvicultural Prescriptions

HCC Clearcut- Removal of all merchantable trees.
HTH Commercial Thin- Generally thinning from below removing approximately 33% of the basal area in the stand.
HSH Shelterwood- Residual stand retains 16-20+ trees/acre in the overstory.
HCR Reserve Seed Tree- Regeneration harvest generally leaving 12 to 15 seed trees/acre
HSV Salvage Cut- Harvest of dead and dying trees.
HSL Selection Harvest- Selection of individual trees or small groups of trees to retain a stand with high forest cover while simultaneously providing for an orderly development of trees with a range of ages and/or size classes.

HCU Cull Tree Removal- Cutting of trees with no commercial value to release and/or reduce competition with desired trees to be retained.

Tree Improvement

This planning area has designated select trees which are used for the collection of seed to develop genetically improved tree stock and for general reforestation needs. A portion of these seed trees have met the seed needs for tree improvement purposes but should be maintained for future general reforestation needs. To maintain future seed sources that are locally adapted to the site, sale area improvement and/or appropriated funds may be used to provide for select tree maintenance, cone surveys, cone collections and seed extraction.

No evaluation plantations, seed orchards or other tree improvement projects currently exist or are planned within this analysis area.

Current Vegetation

In most cases the current vegetation is the result of past disturbances. These disturbances include logging, mining, homesteading and fires. Two timber companies, the Panhandle Lumber Company and the Diamond Match Company owned the majority of the land in this area in the 1920s and 1930s when most of the original logging was done. Their major focus was on removing the white pine and cedar poles. In the summer of 1929 a major fire burned through the LeClerc Creek basin. Much of the land reverted back to the county, then ultimately to the Forest Service following this time period of heavy logging. The 1936 map of Pend Oreille County Vegetation types shows most of the area dominated by “restocked” stands of small diameter trees. The areas typed with large trees are dominated by ponderosa pine, which likely were able to withstand fire. An interesting sidebar to this map is that many of the “restocked” stands were stocked with presumably naturally regenerated white pine. White pine blister rust was noted to have come into the area in the late 1920s, so it stands to reason that it would have taken a few years for it’s affects to become widespread through the area.

The niche within the landscape that would have been occupied by white pine is now occupied mainly with Douglas-fir. While Douglas-fir is an important and valuable timber species, it is more susceptible to root disease and bark beetles than white pine. Since these early fires there have been no other major fires in the basin. Timber harvest on Forest Service land has been relatively minor and sporadic. The area can now be generally characterized as being densely stocked with a preponderance of shade tolerant species growing under an overstory of medium to sparsely stocked seral species which came in immediately after the original disturbances, either logging or fire. Few remnant trees dating to presettlement remain. The ones that are present can be recognized by very large diameter and usually have fire scars on the bole near the base of the tree. Most of these remnant trees are either western larch or ponderosa pine, with an occasional western white pine or western redcedar being found in some of the creek bottoms.

Throughout the planning area there are many flat terraces adjacent to the major creeks in the analysis area that are now dominated by a lodgepole pine overstory which initiated following the fires. Approximately 2400 acres are lodgepole dominated or contain a substantial percentage of lodgepole pine. Lodgepole pine is relatively short lived compared to other species. Most of the lodgepole pine in the analysis area is approaching 80 years of age. As these trees approach the end of their life cycle they become increasingly stressed, which is evident by their live crown ratios. A majority of the mature lodgepole pine have a live crown ratio of less than 30%. The amount of mortality in stands dominated by mature lodgepole pine appears to be increasing. The most frequent causes are attacks by mountain pine beetle, root disease and stress due to competition from other trees. As these trees drop out of the stand, the species composition is shifting towards more shade tolerant species such as grand fir, cedar, hemlock and Douglas-fir. Engelmann spruce and subalpine fir are also in abundance in some areas that are cold air drainages.

The ridges that are adjacent to the major creeks in the analysis area support more mixed species stands. The south facing slopes favor stands dominated by Douglas-fir and ponderosa pine. The east and west facing slopes are dominated by Douglas-fir with scattered ponderosa pine, western larch and grand fir. Some of the scattered ponderosa pine are 25+ inches in diameter at breast height and were able to survive many past fire events. Small draws and sheltered benches have western redcedar, western white pine, and western hemlock in addition to the afore-mentioned species. The north facing slopes are dominated by cedar, hemlock and grand fir with scattered Douglas-fir and larch.

Three species of hardwoods are represented in the analysis area. Paper birch and aspen occur as individual trees or small patches throughout the area. Most of these trees are about the same age having initiated following the large fires. These species have a relatively short life span and are now reaching maturity. These two species for the most part have become successional to conifers and some type of disturbance which drastically opens up the stand is needed for regeneration. Some aspen saplings can be found in past regeneration harvests. Large cottonwood trees exist as single trees or in small clumps mainly in the major creek drainages.

During 2006 and 2007 stands totaling 4,170 acres were inventoried with the Common Stand Exam protocol. These acres represent 47% of the total planning area on National Forest System land. This sampling should be a fairly good representation of the upland acres in the planning area which have not had previous regeneration type timber harvest. The following are the plant associations that occur in the planning area and the percent of area that they represent.

Western redcedar/queencup beadlily (16%)
Douglas-fir/ninebark-twinflower (13%)
Grand fir/Douglas maple/queencup beadlily (13%)
Grand fir/dwarf huckleberry (7%)
Western redcedar/wild sarsaparilla (6%)
Douglas-fir/ninebark (11%)
Western hemlock/queencup beadlily (23%)

The rest of the area is in small percentages of Lodgepole pine/russet buffaloberry, western hemlock/ wild sarsaparilla, western redcedar/big huckleberry, Douglas-fir/pinegrass, Douglas-fir/common snowberry, subalpine fir/queencup beadlily, subalpine fir/bunchberry dogwood, subalpine fir/grouse huckleberry, and subalpine fir/dwarf huckleberry.

The following shrubs are represented in varying amounts and locations throughout the planning area. More detailed information based on plot data from the above-mentioned inventory is on file at the ranger district office. The species include, but are not limited to, ocean spray, common snowberry, twinflower, huckleberry species, Oregon grape, bearberry, western prince's pine, pachistima, bunchberry dogwood, Douglas maple, western thimbleberry, serviceberry, Utah honeysuckle, ninebark, ceanothus, baldhip rose, sitka alder, shiny-leaf spirea, russet buffaloberry, willow species, devil's club and bearberry honeysuckle. Likewise many herbs, forbs and grasses occur within the planning area and include, but are not limited to, sweet root, strawberry species, sweetscented bedstraw, pinegrass, pathfinder, white hawkweed, round-leafed violet, queencup beadlily, starry solomonplume, wild sarsaparilla, Hooker fairy bells, western rattlesnake plantain, wild ginger, claspleaf twisted stalk, elk sedge, lupine species, pioneer violet, western meadowrue, oak fern and bracken fern.

Ecosystem Screening for the LeClerc Cr. Watershed

Biophysical Environments

There are four biophysical environments within the LeClerc Cr. watershed: warm dry Douglas-fir shrub, cool mesic western redcedar/western hemlock forb-shrub, cold dry/mesic subalpine fir shrub, and cool mesic Douglas-fir/grand fir forb-shrub. In addition there is an area mapped out that has no data for historic range of varibaility which is subaplpine fir parkland.

The biophysical environments are characterized by cross referencing the plant association groups (PAGs) that occur in the LeClerc Cr. watershed with the North Idaho fire groups. The historical range of variability for structural stages was developed by a team of specialists from the Colville and Okanogan National Forests and is based on conditions in the pre-settlement era. The current structural stages are based on the stand exams and walk-through exams conducted for this analysis. Additional data for areas outside the project area comes from data collected from past projects. Historic range of variability calculations apply only to National Forest System lands, (Devlin, 1998, 1999).

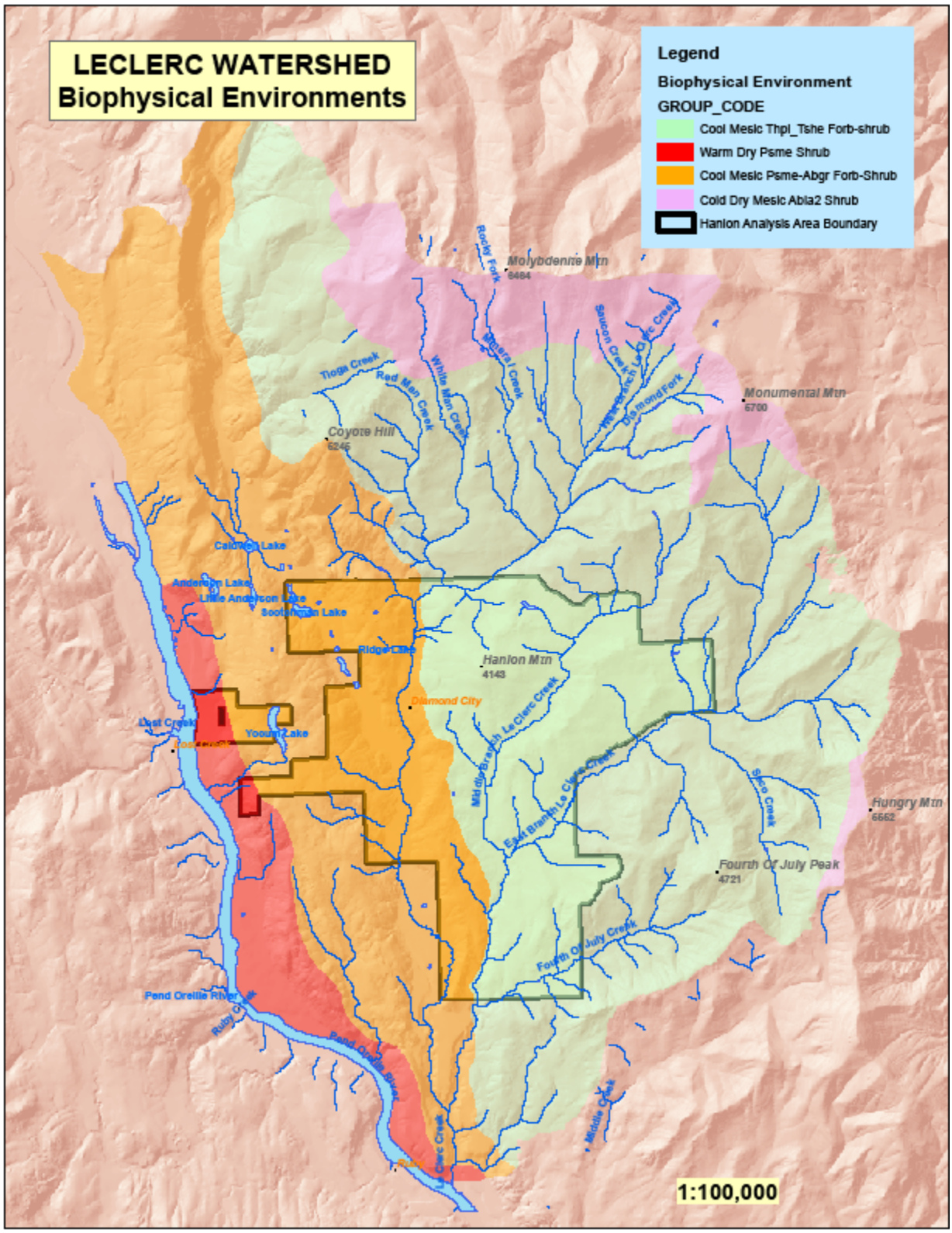
Table 5 shows the percentages of each biophysical environment in the watershed. Figure 2 shows the general locations of the biophysical environments.

Table 5 Percent of Area by Biophysical Environment

Biophysical Environment	Percent
Group 3 Warm Dry Psme[2] Shrub	5
Group 5 Cool Mesic Psme-Abgr Forb-Shrub	31
Group 7 Cold Dry Mesic Abla2 Shrub	8
Group 11 Cool Mesic Thpl-Tshe Forb-shrub	56
Total	100

[2] Psme – Douglas-fir, Abgr – Grand fir, Abla2 – Subalpine fir, Thpl – Western redcedar, Tshe – Western hemlock

Figure 2 Biophysical Environments in the LeClerc Creek Watershed



The following are the general characteristics of each biophysical environment found in the watershed.

Warm Dry PSME Shrub

This biophysical environment is best represented by fire ecology group two from Fire Ecology of the Forest Habitat Types of Northern Idaho (Fischer and Smith, 1997). Approximately 300 acres of this biophysical environment is found within the Hanlon planning area, mainly on the west side overlooking the Pend Oreille River.

Vegetation
The forests in this biophysical environment usually consist of Douglas-fir and ponderosa pine, with western larch and grand fir on the more moist sites. Both tall and low shrubs dominate the understory and may include Oregon grape, baldhip rose, shiny-left spirea, serviceberry, common snowberry, oceanspray, ninebark, ceanothus, mockorange, prickly currant and western thimbleberry. Herbs found here are pinegrass, elk sage, strawberry, feather solomonplume, pathfinder, Piper anemone, queencup beadlily, Hooker fairybells and sweetroot. The overstory of mature forests is somewhat open, although canopy cover often exceeds 50 percent. Dense Douglas-fir or grand fir regeneration often develops in the understory. These stands are most often found on southwest to southeast facing slopes.

Role of Fire
Prior to the 20th century many of the stands in this biophysical environment were burned frequently by low-severity or mixed-severity fires, but occasional stand-replacement fires occurred as well. Frequent, low- and mixed-severity fire control structure and species compsosition in these stands. Ponderosa pine reproduces well in fire-created openings is seed is available and moisture is plentiful. Douglas-fir and western larch may also reproduce well, depending on moisture conditions. Underburns thin regeneration, removing Douglas-fir and grand fir and leaving few ladder fuels. Long fire-free intervals favor Douglas-fir and grand fir regeneration.

Twentieth century fire exclusion has not produced conditions completely different from pre-settlement times. What has changed is the extent and continuity of these conditions due to fire exclusion, selective harvesting of ponderosa pine and western larch, and poor pine and larch regeneration after harvesting. Stands with dense grand fir and Douglas-fir understories have become wide spread and increase the potential for crown fire and severe underburning.

Forest Succession
The most prevalent successional pathways produce open-grown ponderosa pine, and ponderosa pine/Douglas-fir communities; historically these communities were perpetuated by nonlethal underburns. A less common pathway occurs on cold sites occupied by Douglas-fir and grand fir habitat types where lodgepole dominates early succession.

Prior to modern times, stand-replacing fires were rare, and most stands were characterized by open, mature ponderosa pine, Douglas-fir and western larch, maintained by frequent nonlethal underburning. The fire frequency for these sites came often enough to maintain lower fuel loading and prevent fuel build-ups to where torching or crowning could occur. These areas underburned often enough to eliminate fir regeneration while also thinning pine regeneration.

When the rare stand-replacing fire (or other disturbance) removes the overstory, grass species resprout rapidly; after a few years, the shrubs dominate. Moving through the succession of seedlings and saplings, low-severity burns would eliminate Douglas-fir and grand fir but leave some ponderosa pine; more severe fire (unusual in natural fuels but possible in activity fuels) can return the stand to grasses and shrubs.

Without fire, growth continues to the pole stage. Depending on initial stocking density, growth may be suppressed and a low-severity thinning fire unlikely. In moderately stocked stands, low or moderate-severity fires remove the fire-intolerant species and leave a thinned stand of ponderosa pine.

Should the stand mature without fire, ponderosa pine and Douglas-fir dominate, with an understory of Douglas-fir and grand fir. Nonlethal underburning can thin the overstory and remove understory trees as long as ponderosa pine and Douglas-fir are present. This becomes less likely as ladder fuels develop and overstory mortality increases the fuel loads on the forest floor. If fire is excluded for a long time, shade-tolerant species increase in importance and eventually dominate an uneven-aged stand. Low severity fires change these stands very little, but fires of moderate to high severity return these stands to grasses and shrubs.

Fire Management
Fire can be used in this Biophysical Environment to enhance forage, maintain open forest structure, reduce fuel continuity, and enhance tree regeneration.

Cool Mesic PSME-ABGR Forb-Shrub

This biophysical environment occurs is best represented by fire ecology group seven from the Fire Ecology of the Forest Habitat Types of Northern Idaho (Fischer and Smith, 1997). The Hanlon planning area has about 5,350 acres that would fit into this biophysical environment. This area is generally east of the Pend Orieille River breaks to the center of the planning area.

Vegetation
This fire group consists of dry to mesic sites from valley bottoms to elevations as high as 6,500 feet. Grand fir is the climax species and Douglas-fir is the most important seral species. The presence of lodgepole pine, western larch and western white pine depends on moderate moisture conditions and favorable fire history. Quaking aspen, paper birch and black cottonwood are seral on some sites. Bearberry, Oregon grape, twinflower, Utah honeysuckle, baldhip rose, western thimbleberry, scouler willow, shine-leaf spirea, common snowberry, huckleberry, and snowbrush ceanothus are some of the shrubs found in this fire ecology group. The herbs found include queencup beadlily, strawberry species, sweetscented bedstraw, starry solomonplume, and round-leaf violet.

Role of Fire
Before the time of effective fire suppression, this fire group burned in both stand-replacing fires and mixed-severity fire. Low- and mixed-severity fires increase structural complexity within stands and heterogeneity across the landscape. Low-severity fires often damage the boles of Engelmann spruce, fir, western white pine and lodgepole pine, forming entry points for decay mechanisms. Species with thicker bark such as Douglas-fir, western larch and ponderosa pine are favored. Severe fire eventually disrupts mature stands, which usually leads to vigorous regeneration of Douglas-fir and Engelmann spruce mixed with western larch, western white pine, ponderosa pine and lodgepole pine.

Forest Succession
Two major successional pathways are used to describe this process. In the first, following severe fire, a stand is quickly dominated by forbs and grassy species. Within 8 to 10 years, shrubs dominate. Tree regeneration is dominated by Douglas-fir, but includes many other species. Western white pine was a common seral species before the advent of white pine blister rust. In mixed-species stands white pine often overtopped competitors about 40 years after disturbance. Where white pine was dominant, Douglas-fir declined after about 40 years because of root disease, and western larch declined due to competition. Ponderosa pine is common on warm sites,

especially those with a history of low-severity fires. Lodgepole pine and Engelmann spruce are favored by cool conditions. Grand fir and subalpine fir may establish along with shade-intolerant species, but in this pathway they do not dominate until late succession. As the stand matures, lodgepole pine dies out at 100-160 years of age. Because Douglas-fir, western larch, and western white pine continue vigorous growth as mature trees, they can continue to dominate even though they do not reproduce under the closed canopy. Low severity fire at this stage favors Douglas-fir, western larch and ponderosa pine. Severe fire returns the site to herbs and shrubs, or produces a stand dominated by relict trees. Without disturbance, species dominance gradually shifts from Douglas-fir and other seral species to grand fir. Ponderosa pine, western larch and white pine persist because of their longevity, but they do not regenerate in the mature stand. If fire is excluded for two or three centuries, these species decline, leaving an old-growth stand of grand fir and scattered Engelmann spruce. The other pathway is one dominated by lodgepole pine. These occur in cold air drainage on gentle topography. The lodgepole pine dominates for 100-150 years. Since these stands usually burn before the lodgepole seed source declines, they tend to regenerate to lodgepole pine after disturbance. Fire free intervals in stands dominated by lodgepole pine are usually less than 100-150 years. Longer fire free intervals give way to dominance by Douglas-fir, Engelmann spruce, grand fir or a mixture of these species.

Cold Mesic ABLA2 Tall Shrub

This biophysical environment is best represented by fire ecology group four from the Fire Ecology of the Forest Habitat Types of Northern Idaho (Fischer and Smith, 1997). This biophysical environment does not occur within the Hanlon planning area but does occur within the watershed at higher elevations.

Vegetation

This biophysical environment usually occurs on south to west facing slopes or near ridgetops. Subalpine fir is the climax tree species. Lodgepole pine or a mixture of lodgepole pine, Engelmann spruce, Douglas-fir, and subalpine fir can dominate early succession. Whitebark pine intergrades with lodgepole pine at the higher elevations. Western larch, western white pine, grand fir and quaking aspen are less prevalent seral species.

Huckleberry, fool's huckleberry, white rhododendron, snowbush ceanothus, Utah honeysuckle, currant, willow, shiny-leaf spirea and mountain-ash are some of the more common shrubs found in this environment. Beargrass, piper anemone, broadleaf arnica, western rattlesnake plantain, smooth woodrush and round-leafed violet are common in the herb layer. Columbia brome, pinegrass, elk sedge and Ross sedge are present in some areas and can form a dense sward under a partially closed canopy.

Role of Fire

Stand replacing fires occurred at average intervals ranging from 52 to 200 years. Stand replacing fire occurred less frequently at high than low elevations because of slower tree growth and less continuous fuels at high elevations. Most stand replacing fires originated at relatively low elevations, often in lodgepole pine cover types. Fires originating at high elevations tended to be small and burn with low severity. Fires in this fire regime often cover 5,000 to 100,000 acres.

Forest Succession

Severe burns can be regenerated by a mixture of Douglas-fir, lodgepole pine, and Engelmann spruce, or by nearly pure lodgepole pine. As the stand matures, subalpine fir and Engelmann spruce regenerate under the partially open canopy. Mature lodgepole stand vary in structure from very dense to partially open. Low-severity fires remove tree regeneration along with fir and spruce creating conditions that favor regeneration with seral species. If the stand continues without fire, subalpine fir eventually dominates as mature lodgepole are eventually eliminated by mountain pine beetle. Severe fire follows at some point in time to return the stand to herbs and shrubs.

Cool Mesic THPL-TSHE Forb-Shrub

This biophysical environment is best represented by fire ecology group eight from the Fire Ecology of the Forest Habitat Types of Northern Idaho (Fischer and Smith, 1997). The Hanlon planning area contains approximately 8,609 acres in this biophysical environment and occurs in the east half of the planning area.

Vegetation

This habitat type is common on northerly aspects at all slope positions and is found on southerly aspects where soils have favorable moisture-holding properties. These areas usually contain a mixture of climax species of western hemlock and western red cedar. Other seral tree species include: Douglas-fir, Engelmann spruce, grand fir, lodgepole pine, ponderosa pine, subalpine fir, western larch, and western white pine. This type also includes three deciduous species; black cottonwood, western paper birch and quaking aspen. Common shrubs include Douglas maple, Sitka alder, twinflower, Utah honeysuckle, rusty menziesia, pachistima, baldhip rose, western thimbleberry, common snowberry, Pacific yew, and huckleberry. Pathfinder, Piper anemone, heartleaf arnica, broadleaf arnica, wild ginger, queencup beadlily, western prince's pine, bunchberry dogwood, Hooker fairybells, sweetscented bedstraw, western rattlesnake plantain, oak fern, sweetroot, sickletop pedicularis, pyrola, starry solomonplume, claspleaf twisted stalk, western meadowrue, trillium, pioneer violet, and round-leaved violet are present in the herb layer.

Role of Fire

Stand replacing fires probably occurred at average intervals of 200-250 years in presettlement times. However, the diverse species and structure of stands in this type indicate that presettlement fire regimes were highly variable. Individual intervals can be as short as 18 years and as long as 452 years. Low-severity fire is likely to occur two to three times more often than moderate- or high-severity fire. Stand replacing fires left a few large surviving trees, which moderated climatic conditions and influenced species composition of the new stand. Western larch occurs most often as a relict with some Douglas-fir and ponderosa pine. Western redcedar also occur as a relict for some time following a fire. The fire regimes interact with insects and diseases to shape these forests. Low- and mixed-severity fires increase structural complexity within stands and heterogeneity across the landscape. Root disease proliferates in the more shade-tolerant species favored by fire exclusion and can reach levels at which usually resistant species are threatened. Increasing disease mortality can increase woody fuels and increase potential fire severity.

Forest Succession

The path that succession is likely to follow in this biophysical environment depends on the site itself, the species present before the fire, the size and intensity of the burn, and post burn conditions. One pathway describes succession in stands where both seral and climax species become established soon after stand-replacing fire. Western white pine was once a prevalent seral species in this scenario. Due to white pine blister rust its role has been replaced by Douglas-fir and grand fir. Another path is described by succession dominated by shade-tolerant species. This occurs in moist, sheltered stands and on north-facing slopes. Cedar and hemlock can establish in nearly pure stands after fire. A third successional path occurs on benches and flats that are cold air drainages, and also occurs on sites with thin rocky soils and on sites with seasonally high water tables. A mature lodgepole pine on these sites can gradually lower the stresses caused by temperature and water table fluctuations making the site more favorable for regeneration of other species. Lodgepole pine here peaks in vigor at about 50 years. As the lodgepole pine declines due to senescence and mountain pine beetle infestation, other species regenerate or are released. Douglas-fir, grand fir, western larch, Engelmann spruce and white pine typically follow the lodgepole. Lodgepole pine mortality produces heavy fuels, increasing the potential for severe fire, which perpetuates lodgepole pine dominance.

Structural Stages

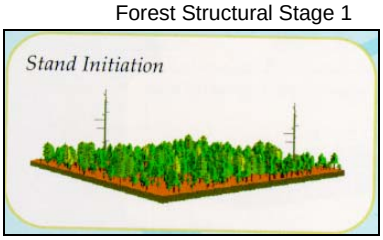
There are seven structural stages identified under the Regional Forester's Forest Plan Amendment #2: Revised Standards for Timber Sales on Eastside Forests (Lowe, 1995). All structural stages are represented in varying proportions in the watershed. Structural stages 1, 2 and 3 are considered an early structural stage of stand development. Structural stages 4 and 5 are considered a middle structural stage. Structural stages 6 and 7 are considered late or old structural stages. The specific stage of structural development is the result of disturbances (or lack there of) such as fire, insects, diseases, timber harvest wind, and inter-tree competition, just to name a few.

As forests grow, they progress through different developmental stages or structures. Although the word "stage" implies a simple linear sequence, contemporary ecological theory does not view it as such. When affected, forests do not immediately return to a single pathway of vegetative change (succession) or a single stable condition (climax). Instead, both natural and human disturbances have long-term influences on the appearance and composition of forests and on the successional pathways followed (Johnson et al, Biotic and Abiotic Processes of Eastside Ecosystems, Forest Service, PNW-GTR322, February 1994).

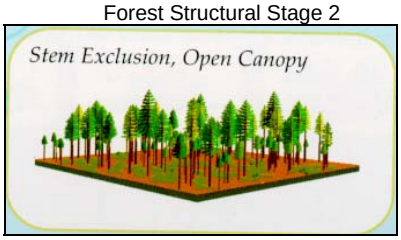
The process of forest aging called "succession" transforms the composition of forested ecosystems as biotic communities respond to and modify their environment. The process of succession is not restricted to plant communities. It occurs at all levels within the animal and microbial communities. These communities can experience sequential changes that are concurrent with the vegetative seral stage.

The following series of graphical examples depict points of structural stand development in a mixed conifer stand type. Each stage is defined by language in the Regional Forester's Amendment with considerations for local interpretation. The Biophysical Environment determines the ranges of each structural stage that indicate a sustainable landscape. The biophysical condition would affect the longevity of the desired landscape character.

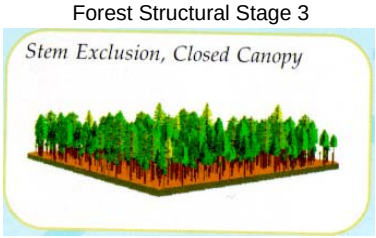
Forest Structural Stage 1



Forest Structural Stage 2

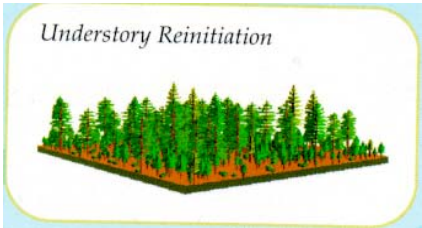


Forest Structural Stage 3



Stand Initiation through Stem Exclusion (Stages 1-3). These early stands are fully stocked by conifer trees that may range in size from seedlings through 15" diameter trees. The distinguishing characteristic is that all the trees are near the same age (same cohort), and all the trees are in the same canopy layer. A second canopy layer of shade tolerant trees has not yet started to develop in the understory.

Forest Structural Stage 4



Forest Structural Stage 5

Understory Reinitiation and Multi-Stratum without Large Trees (Stages 4 & 5). A second cohort of trees is established under an older overstory in these middle stages. Openings start to appear in the canopy, and the amount of down wood increases. The trees in the overstory are typically early seral (larch, pine, Douglas-fir, etc.) while the trees in the understory are typically shade-tolerant (western redcedar, hemlock). The stand may contain many sizes of trees, but large trees are uncommon.

Forest Structural Stage 6

Multi-stratum with Large Trees (Stage 6). These late and old stands contain two or more cohorts of trees, and trees of all sizes are present. The overstory canopy is discontinuous, and large trees are common (8 tpa >21" dbh)

Forest Structural Stage 7

Single-Stratum with Large Trees (Stage 7). A single layer of large seral trees is present in this late and old stage. The understory may be absent or may contain sparse or clumpy seedlings and saplings. These stands are sometimes called park-like.

Figure 3 shows the location of stands by structural stage in the LeClerc Cr. Watershed.

Figure 3 Structural Stages for the LeClerc Watershed including the Hanlon Analysis Area

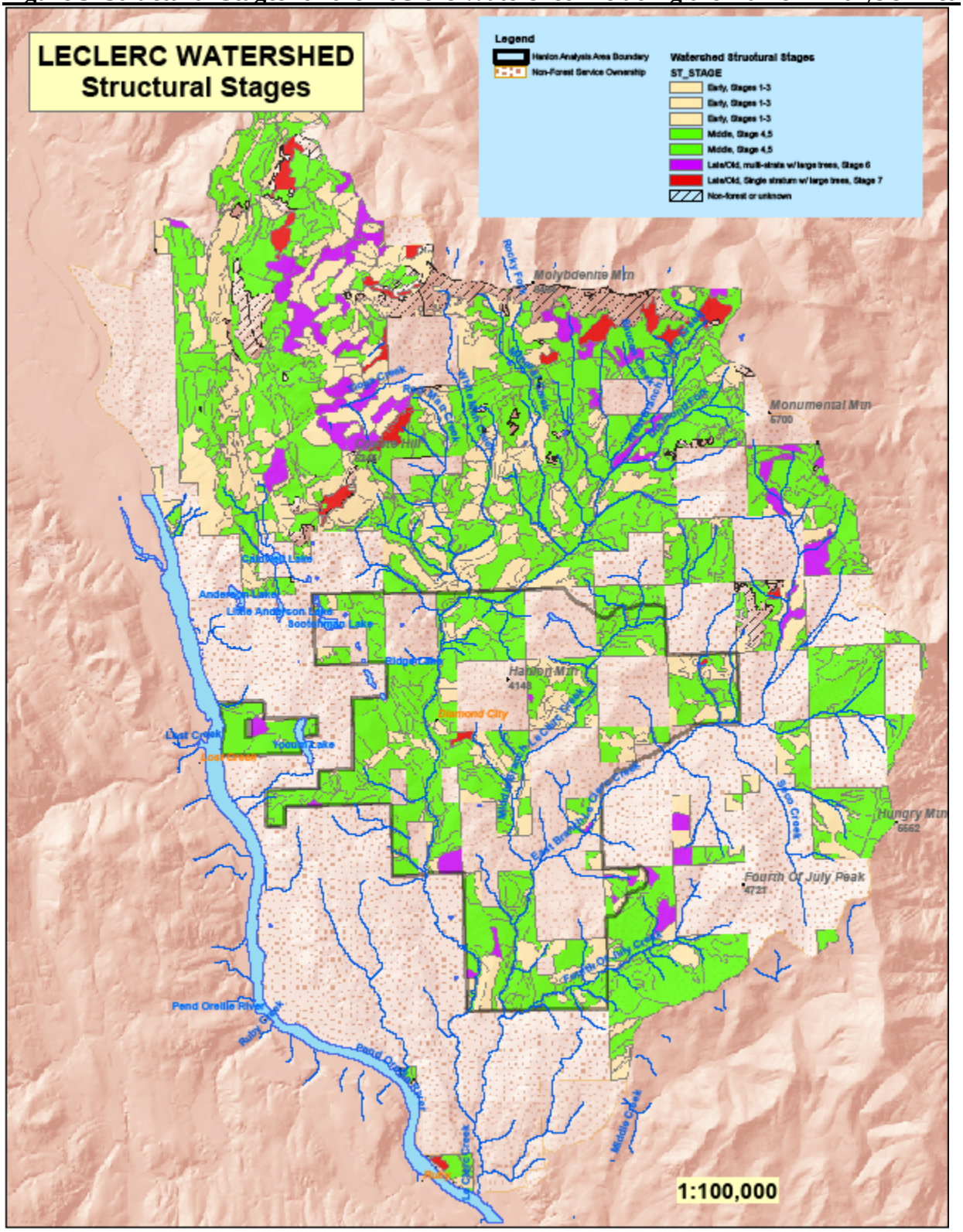


Table 7 compares the historical range of variability as compared to the current condition within the analysis area.

Table 7 Biophysical Environment - Structural Stage Matrix

Biophysical Environment	Early Stage 1, 2, 3		Middle Stage 4, 5		Late and Old Stage 6		Stage 7	
	H %	C %	H %	C %	H %	C %	H %	C %
Group 3 Warm Dry Psme Shrub	10-25	6*	10-25	87*	5-20	3*	30-75	4*
Group 5 Cool Mesic Psme-Abgr Forb-Shrub	15-35	30	20-50	67*	20-30	2*	10-25	1*
Group 7 Cold Dry Mesic Abla2 Shrub	15-40	28	35-75	53	10-30	9*	2-5	10*
Group 11 Cool Mesic Thpl-Tshe Forb-shrub	10-30	27	20-50	66*	30-70	6*	N/A	1

H = Historical Range
C = Current Condition
* = Denotes currently outside of the Historical Range of Variability

With the exception of the Cold Dry Mesic Abla2 Shrub (group 7) all the biophysical environments are outside the historic range of variability with an excess of young, multi-story forest and a deficit of late and old structure. This is not surprising given the logging activity and subsequent fires during the early 20th century. Many of the timber harvest activities that occurred from the 1960s through the early 1980s were designed to remove the large mature trees to release the understory trees. As a result, timber harvest activities in the Groups 3, 5, and 11 biophysical environments are prohibited within late and old structural stages because their current condition is outside of the historic range of variability. Group 7 is in the watershed but is outside of the project area.

Harvest activities outside late and old structural stands should be designed to move the stand towards old and late structural conditions as soon as possible. This can be accomplished in many stands by using an intermediate thinning harvest to maintain growth on the desired trees. In Group 3 the thinning can be supplemented with underburning to create the more open stand conditions which would have occurred with more frequent low intensity fires. The stands that are the most problematic to move towards late and old structure are the ones composed mostly of mature lodgepole pine. Many of the lodgepole pine stands in the Hanlon planning area are reaching their biological rotation age. Because these trees are relatively short lived and usually do not achieve large diameter before they senesce, they do not contribute very much to late or old structure. Moving these stands towards late and old structure can be accomplished by removing the lodgepole pine and releasing a cohort of trees that has become established under the mature trees or removing the lodgepole pine, preparing the site and planting desired species. In both cases any pre-existing larger long-lived specie trees would be retained to provide some structure.

Old Growth

Due to logging in the early to middle 1900s, and stand destruction fires in the 1930s large areas of even- aged western larch, lodgepole pine, and Douglas fir exist. Stand ages are typically 65 to 85 years old for the overstory with an occasional western larch, Douglas fir, western red cedar, western hemlock or ponderosa pine remnant 150+ years old. These living remnants and all live trees $\geq$ 21 inches have been identified to be retained for current and future diversity (Lowe, 1995). The most likely areas where old growth might exist are in areas of fire refugia.

A number of stands have been identified as late or old structure by reviewing stand exam data, aerial photo interpretation and site visits. A certain number of trees over 21" dbh alone does not make a stand old growth. A more intensive survey of these areas that include all of the attributes of the North Idaho Zone Old Growth (NIZOG) definition would be needed to determine if the stand is old growth. However, one stand in particular, stand number 5140276 is suspected to meet the definition. This stand would not be included in any timber harvest or road building activities. Also, since late and old structure is lacking in all of the biophysical environments represented in the planning area, stands that have been identified as late or old structure would not have harvest activity in them. If any other stands are identified as old growth during future reconnaissance or unit layout, they would be excluded from any harvest activity.

Forest Health Analysis

The Hanlon Analysis Area was surveyed for insects and diseases in September and October of 2007 by Connie Mehmel, Forest Entomologist, and Angel Saavedra, Forest Pathologist, of the Wenatchee Forest Health Service Center. Their report is attached in Appendix A.

As discussed in their report, several factors related to past management and introduced diseases have caused the planning area to see an increase in insect and disease activity. Douglas-fir and grand fir have replaced stands which historically had a high component of western white pine due to past logging and the introduction of white pine blister rust. Douglas-fir and grand fir are more susceptible to agents such as root disease and bark beetles. Also, a lack of disturbance, some of which can be attributed to fire suppression, has allowed these stands to develop highly stocked multi-story conditions that did not occur historically.

Many of the stands of lodgepole pine in the planning area are now reaching the conditions where they are most susceptible to mountain pine beetle mortality. This occurs when they exceed 80 years old, stands are stocked with 80+ square feet/acre basal area and average 8"+ diameter at breast height. Many of these stands occur on flat benches that are adjacent to the major creeks within the planning area.

Another result of overstocked stands is a preponderance of suppressed trees. These trees, especially shade intolerant species such as larch, lodgepole pine and ponderosa pine, see a decrease in their live crown ratios due to being over-topped by the more dominant trees. Once the live crown ratio falls below 35%, there is a decreasing probability that the tree would release through thinning and gain its live crown back. Many of the suppressed trees also develop poor height:diameter ratios when they grow and can't increase their diameter fast enough due to tight growing conditions. When the height:diameter ratio exceeds 100, the trees are more susceptible to windthrow and snow breakage.

Climate change is a concern that will affect the health of stands and individual trees within the planning area. Climate change can have a direct affect, such as many drought years in a row or a continuance of decreasing amounts of available water during the growing season over into the future, or indirect affects such as an increase in large fires or an increase in extreme weather events which cause windthrow and breakage.

Effects Of Alternatives

Alternative A (No Action)

Alternative A is the no action alternative. This alternative would result in no improvement in stand vigor and related forest health or moving the stands toward target condition on National Forest System lands. Stagnated stands within the proposed project area, left untreated, would lack adequate crown and diameter development. Structural development would be delayed due to the suppressed or non existent understory. Development of

wildlife habitat would be delayed for a long time if the stands are left untreated. No treatment would also delay moving stands toward the historical range of variability. In treatment areas that have the potential to be moved toward structural stage 6 or 7 encroachment of more shade tolerant species have created a hazard due to the increased fuel loading and ladder fuels. Stands would continue to have a high risk of catastrophic fires. If a fire was to occur, many of the preferred early seral leave trees (i.e., western white pine, western larch and ponderosa pine) may be killed by the fire and the site would be delayed in moving towards stage 6 or 7. Natural fires may or may not burn under conditions that would thin out the smaller trees and would have limited control over residual tree spacing and species selection. High intensity fires can reduce soil productivity drastically and cause major changes in the hydrological and erosion processes (Hessburg and others, 1999). Severe fires can also cause stand destruction and create potential brushfields that may last for many years.

There would be no silvicultural treatments to reduce stocking levels and improve stand vigor, improve the RHCAs or to plant early serals such as WP, WL and PP. Conversion of stands to shade tolerant species would continue, increasing the future hazard to insects and diseases. Hardwood trees would continue to be out-competed by conifers and continue to be eliminated from the landscape. This alternative would not treat stands that occur along the urban interface to reduce the risk of insect, disease or wildfire. The areas of mature lodgepole pine would continue to build up surface fuels as the trees die out and fall to the ground. There would be no money generated from timber sales to aid in monitoring and stand improvement. Within the next ten year period the risk of insect outbreak and the risk of increased levels of disease are moderate to high. In the long term, the risk of insect outbreak in the next ten to twenty years would be approaching high. Forest health would decrease from no treatment.

Alternative B (Action)

This alternative proposes both commercial and non-commercial treatments to meet the purpose and need and to move the area towards the Desired Future Condition. These units are somewhat gross in that as the project is actually laid out on the ground, conditions such as unmapped riparian areas, heritage sites, local changes in logging system design and road design, sensitive wildlife areas, etc. would cause changes in acreage and the shapes of the polygons. Thus, the planned acres in the table below are approximate.

Approximately 4,647 acres (52%) of the 8,996 acres in the proposed project area would receive some type of silvicultural treatment to improve stocking levels, stand vigor, move the stands toward target condition and towards the historical range of variability of structural stages. Highly stocked stands would be treated to reduce the future hazard of insect and disease outbreaks and to modify the expected fire behavior if a wildfire were to occur. Approximately 1750 acres of treatment are within stands with a high percentage of lodgepole pine and are the highest priority for treatment.

The proposed treatments in Alternative B would contribute to increasing the general health of the trees within the planning area. The Disease and Insect Field Review conducted by the zone entomologist and pathologist noted many forest insects and pathogens that are currently residing in the planning area. A significant change in the last 100 years is the change from white pine dominated stands to Douglas-fir dominated stands in some portions of the planning area and lodgepole pine dominated stands in other portions. Even though white pine was harvested in the early part of the 20th century, white pine blister rust prevented early attempts to regenerate this species from being successful. The approximately 900 acres of shelterwood harvest that would occur in Alternative B would have a significant portion planted with rust-resistant western white pine seedlings. In addition some of the smaller openings created in the selection harvest units could also be planted with some white pine seedlings. Some of these openings may be root disease pockets where white pine would be more resistant to the root disease. Western larch would also be planted in root disease pockets as this species is also quite resistant to root disease.

In general, thinning would keep the retained trees growing more vigorously and thus would allow them to be more resilient and more resistant to an insect or disease attack. Trees which would not live until the next entry,

trees with live crown ratios less than 35%, trees with height to diameter rations greater than 100, and trees with mechanical defects, are preferred for removal over trees with vigorous healthy crowns with relatively few defects. Some exceptions would be allowed to provide for trees used by certain wildlife species. Removal of trees through thinning can also be used to control the species composition of the stand. Shade tolerant trees that have a low tolerance for fire can be discriminated against and shade intolerant seral species which are more fire tolerant can be favored. There would also be exceptions to this such as in the case of developing thermal cover for big game and for providing shade adjacent to riparian areas.

The treatments in Alternative B, especially in west half of the planning area would provide a large and continuous fuel break between the backcountry and homes along the LeClerc county road (9325) and some small clusters of homes along the west branch county road (3503). The units would break up the continuity of a rather solid expanse of dense timber and allow for areas where a fire could be fought while providing more safety from extreme conditions for fire fighters. The picture at the right shows the buildup of fuels that is occurring. The areas slated for thinning and selection harvest would have the crown bulk density of the stand reduced to lessen the chance that a crown fire could be sustained. Thinning would also target the smaller, mid-story trees (ladder fuels) which would reduce the probability that a surface fire would move into the crowns. The areas slated for regeneration harvest would develop stands that have a higher percentage of trees that are more tolerant of fire.

Treatments following timber harvest would be designed to further reduce fuels and lessen the chance of extreme fire behavior. Prescribed underburning and site preparation treatments under controlled conditions would reduce the continuity of fuels and the currently high existing fuel loads in some areas. The picture at left shows the

results of thinning that occurred in the East LeClerc Timber Sale about 5 years ago. A follow-up prescribed burn is planned for this area to further reduce surface fuels. The underburning, primarily in biophysical environment groups 3 and 5, would be accomplished under optimum fuel moisture levels to reduce the impact to the residual stand, protect the soils, maintain fire tolerant species, reduce fire intolerant regeneration and maintain stocking levels. If conditions cannot be met, then alternative treatments such as grapple piling or mastication would be used. Encroachment of shade tolerant species could be reduced by repeated, periodic treatments (see fire/fuels specialist report).

When considering the effects of alternative B against the existing structural stages, there would not be any change in the currently identified late structural stage stands, since no harvesting is proposed in these stands within the watershed. Most of the watershed is currently in the middle structural stages. Alternative B would treat acres that would move these stands towards a future late structural stage and would provide more structural diversity in the short term. Alternative A would change more slowly from the current condition and would lose structural diversity in many areas due to forest health issues. Stands with a thinning or selection harvest prescription would develop structure relatively quickly as the larger trees are released and diameter growth can be increased. Most of the larger trees would be retained and small gaps that are created would encourage new trees to initiate. The areas dominated by mature lodgepole would be regenerated as the quickest way to move the stand towards late or old structure. In these areas, large existing seral species trees would be retained to maintain some structure. Seral species such as ponderosa pine, western larch and western white pine would be planted. It is expected that some natural Douglas-fir and lodgepole pine regeneration would occur which would supplement the trees that were planted. During the development of this stand regular thinnings would occur to maintain the growth rate on these trees.

Approximately 2,104 acres of proposed units are in designated elk winter range. Management guidelines call for a 50:50 mix of cover and forage areas. Proposed regeneration harvests in the winter range would provide forage until the regenerated stand grows to the point that it is providing cover. Areas within the winter range that are proposed for thinning and selection harvests would develop large diameter trees with large crowns that would provide thermal cover at some point in the future. Inclusions within units that are presently providing thermal cover may have the proposed treatment deferred. These areas, in addition to other areas which may be deferred from harvest activity in this entry, would still be at risk of insect and disease outbreaks and subject to more extreme fire behavior in the event of a wildfire. Using only a sanitation or salvage harvest in these stands would do little to minimize crown fire initiation or spread (Graham and others, 1999).

This alternative would also allow for restoring longer-lived trees that provide shade, such as Engelmann spruce, western redcedar, western hemlock, grand fir and hardwoods adjacent to some riparian areas. Approximately 42 units would have a portion of the unit acres close to the major streams, lakes or reservoir. Treatments would not occur in actual riparian vegetation but would occur in the upland vegetation that is adjacent. Unit boundaries would meet direction found in the Inland Native Fish Strategy. Most of the harvest would occur during the winter and are on flat benches rather than steep slopes. Treatments would mainly focus on removing some mature lodgepole pine to release existing advanced regeneration of desired species or to create a gap in the overstory to initiate regeneration. The actual layout of unit boundaries would be coordinated with the fisheries biologist, hydrologist and wildlife biologist.

This alternative provides for reforestation with WP, WL and PP in the regeneration harvest units. Harvesting some of the dead and dying trees, while still maintaining snags to meet the 100% potential population levels of primary cavity excavators, and thinning to reduce stocking levels would recover some of the economical value of the wood (see economical analysis for more information). This economic return could be used to aid in monitoring and stand improvement projects. This alternative is estimated to produce 26 million board feet of timber. Treatments along the urban interface would aid in reducing the risk of insect, disease and fires spreading from National Forest System lands onto private and other ownerships lands. Also these treatments would help to protect the Forest Service lands along the urban interface from these agents, which may spread from private or other ownership lands. Table 10 shows the silvicultural treatment recommended per stand for this alternative.

Alternative B allows the opportunity to release aspen trees and clones which are being suppressed by conifers. If the area to be released is expanded to 1-2 tree lengths beyond the outermost aspen trees, then the probability that some aspen regeneration would occur is increased. Additional disturbance such as underburning would most likely further the reproductive response.

Roads are an important part of necessary infrastructure used to carry out the management activities describe above. Alternative B does not construct any new system roads other than the relocation of the road along the Middle Branch of LeClerc Creek. Instead a number of temporary roads would be constructed and then decommissioned following their use. The reason for this is due to possible impacts to habitat in a grizzly bear management unit. (See wildlife specialist report) Following implementation of proposed regeneration units, a commercial entry would not be anticipated for approximately 40 years. Most of these stands would require a subsequent entry in about 12-18 years. In other areas roads would not be built at all and helicopter yarding would be utilized. In units slated for thinning, the residual basal area would need to be managed at a lower level than areas that can be managed using a ground-based system. This is so logs can be lifted through the canopy with less hang-ups which could endanger the pilot and his ship and to minimize damage to the residual trees from chokered logs banging into trees which would cause wounds on the boles and breaking out tops.

There are three rock pits proposed for this project which are on National Forest System ownership. All or most of these areas are currently forested. Development of a rock pit would remove that area from the manageable timber base on the forest for several generations of humankind.

Another issue that has surfaced recently due to the high cost of energy is the removal of biomass material. This material is sub-merchantable green trees or cull logs which would not make any other type of product. Some thought needs to go into determining how much of this material should be removed from any given unit. A certain amount of material that would provide for nutrient recycling should be retained. Also, whether or not the material is removed when the sawtimber products are removed or if a second entry would be needed could affect future tree growth within the stand where the activity takes place. This would be due to additional soil compaction affects from heavy equipment, especially if the biomass entry is done without a slash mat or if the activity occurs during a period when the ground is not frozen or there is adequate snow cover. Silviculturally, the removal of biomass, at least the green sub-merchantable tree portion, should not occur in overstory removal areas or selection harvests where the advanced regeneration would be managed for the future stand until it is known if there is an excess of trees which could be removed. In the overstory removal areas this would be determined after a pre-commercial thinning/damaged tree removal treatment has occurred.

From time to time disturbances such as fire, wind, insects, diseases, heavy snow can cause mortality. Salvage harvest can be used as a tool to reduce future impacts that may occur by leaving these dead and/or dying trees in place. In certain areas fuels buildup, trees which harbor broods of insects which can cause large areas of mortality when their populations explode, or trees that jeopardize the safety of workers using certain roads should be considered for salvage harvest.

Blowdown in Hanlon Unit 11, July 2008

These areas cannot be planned for ahead of time as the locations could occur anywhere. The highest priority for treatment should be given for areas adjacent to open roads, restricted roads where project sale and post-sale activities have or are occurring. In most cases, the area within 200 feet of the road could be harvested without any additional constructed roads or main skid trails. The appropriate specialist would provide input to insure that the salvage harvest is consistent with Forest Plan direction and their analysis and project design for the Hanlon project E.A.

TABLE 10 -- HANLON ALTERNATIVE B

Unit	Unit Ac	Stand #	Stand Ac	Rx	Mgt Area	Logging Sys	Major Species
1	124			HSL	5,6,7	G	GF,DF
2	109			HSL	6	G	GF,DF
3	23			HSL	6	G	GF,PP
4	19			HSL	7	G	WL,LP
5	4			HTH	7	G	DF
6	62			HSL	8	G	WL,LP
7	22			HTH	8	G	WL
8	33			HTH	7	H	DF
9	4			HTH	7	S	DF
10	25			HTH	7	G	DF
11	120			HSH/HTH	8	G	LP
12	65			HSH/HTH	8	G	LP,WL
13	63			HTH	7,8	G	DF
14	114			HTH	7	H	DF
15	18			HTH	7	S	DF
16	27			HSL	7	G	DF,PP
17	81			HTH	7	G	DF
18	63			HSL	7,8	H	DF
19	149			HSL	8	G	DF,LP
20	107			HTH/HSH	8,5	G	DF,LP
21	61			HSL	5,8	G	WL,LP
22	83			HSL	8	G	DF
23	31			HSH/HTH	8	G	LP
24	36			HSH/HTH	7	G	LP
25	38			HSL	7,8	G	WL,LP
26	29			HTH/HOR	8	G	WL
27	35			HTH/HOR	8	G	WL,LP
28	14			HTH/HOR	8	G	DF,LP
29	27			HTH	8	G	DF,PP
30	132			HTH	8	G	DF
31	52			HTH	8	G	WL,LP
32	34			HSH/HTH	7,8	G	LP
33	45			HSL	8	G	DF
34	29			HSL	8	G	DF
35	62			HTH/HSH	8,7	G	DF
37	61			HSH/HTH	7	G	LP,DF
38	44			HSH/HTH	7,8	G	LP,WL
39	17			HSL	8,7	G	PP,LP
40	15			HSH	8,7	G	LP
41	175			HTH/HSH	7,8	G	DF,RC,LP
42	44			HSH/HTH	8	G	LP
43	110			HTH	8	G	DF
44	19			HTH/HSH	8,7	G	LP
45	9			HTH	8	G	DF
46	38			HTH	8	S	DF
47	35			HTH	8	S	DF

Unit	Unit Ac	Stand #	Stand Ac	Rx	Mgt Area	Logging Sys	Major Species
48	17			HTH/HSH	8	G	WL,LP
49	5			HSH	8	G	LP
50	28			HTH	8	G	DF
51	26			HSL	8	G	DF
52	54			HSH/HTH	7,8	G	LP
53	25			HSH/HTH	8	G	LP
56	62			HTH	7	H	DF
57	78			HSL	7	G	DF
58	135			HTH	7	G	DF,RC
59	44			HTH	7	G	WL
60	117			HTH	7	G	DF,RC
61	8			HSH	7	G	LP
62	15			HSL	7	G	DF,LP
63	40			HTH	7	G	RC,DF
64	139			HTH/HSH	7	G	RC,LP
65	22			HSL	7	G	DF
66	42			HTH	7	G	WL,RC
67	42			HSL	7	G	DF
68	9			HTH	7	G	WL
69	67			HSH/HTH	7	G	LP,DF
70	18			HTH/HSH	7	G	LP,DF
71	25			HTH/HSH	7	G	WH,LP
72	22			HSL	7	G	WH
73	129			HTH/HSH	7	G	DF,LP
74	8			HSL	7	G	ES,LP
75	34			HTH	7	G	DF,GF
76	44			HTH	7	G	DF
77	37			HTH	7	G	DF
78	71			HSH/HTH	7	G	LP,DF
79	15			HSH/HTH	7	G	LP,RC
80	36			HSL	7	G	WL,LP
81	24			HSH	7	G	LP
82	14			HSH	7	G	LP
83	60			HSH/HTH	7	G	LP,WL
84	57			HTH/HSH	7	G	DF,LP
85	9			HTH/HSH	7	G	DF,LP
86	8			HTH	7	G	DF
87	9			HTH	7	G	GF
88	16			HTH	7	G	DF
89	24			HTH	7	G	WH
90	33			HTH	7	G	DF
91	52			HSH/HTH	8,7	G	LP,PP
92	22			HTH	8	G	DF
93	41			HSH	8	H	LP
94	70			HSH/HTH	8	H	LP,WL
95	106			HTH/HSH	8	H	DF,LP
96	48			HTH	7	G	GF,WL
97	79			HSL	7	G	DF,WL

Unit	Unit Ac	Stand #	Stand Ac	Rx	Mgt Area	Logging Sys	Major Species
100	14			PCT/HCU	7	G	LP
101	40			PCT/HCU	8	G	LP
Total	**4647**						
		5120496	18	PCT			
		5120507	17	PCT			
		5120605	24	PCT			
		5130350	21	PCT			
		5150062	29	PCT			
		5140093	24	PCT			
		5150397	21	PCT			
		5150074	15	PCT			
		5140012	9	PCT			
		5140073	96	PCT			
		5140194	35	PCT			
		5150296	19	PCT			
		5140075	14	PCT			
		5150297	11	PCT			
		5150283	33	PCT			
		5150097	15	PCT			
		5150099	10	PCT			
		5150284	30	PCT			
		5150088	9	PCT			
		5140128	32	PCT			
		5150117	38	PCT			
		5140130	16	PCT			
		5140137	23	PCT			
		5140138	14	PCT			
		5140214	20	PCT			
		5140215	15	PCT			
		5140141	16	PCT			

Totals for Alternative B:

Rx	Acres
HSL	1177
HTH	2447
HSH	912
HOR	57
HCU	54
Total	4647

Logging System Legend:
G – Ground based, Mechanical/Tractor or Cut-to-length
S – Cable, Skyline
H – Helicopter

Post Sale Treatments: (See Fire and Fuels Report for unit specific treatments)

Commercial Trts	Acres	Non Commercial Trts	Acres
Plant	912	PCT	624
Broadcast/jackpot burn	2323	Broadcast/jackpot burn	1437
Mechanical Fuels	2324		

Silvicultural Prescriptions

- **Commercial Thinning Harvest (HTH) –** This is an intermediate harvest usually in even-aged stands to control stocking levels and favor desired trees based on certain criteria. This prescription combines elements of crown and low thinning to achieve the desired results. The objectives are to retain species that are most appropriate for the site. Some of the attributes that are desirable for a retention tree include large, healthy looking (not chlorotic in color or fading) crowns which are greater than 40% of the total tree height; trees not being attacked by insects or have major pathogen infections; don't have major mechanical defects (like "v" shaped forks) which could fail before the next entry; or don't have height:diameter ratios greater than 100 which would make them susceptible to wind and snow breakage. This would be accomplished by removing trees that are directly competing with the desired trees to a spacing that is somewhat variable based on the size of the trees. Diameter growth is directly related to crown expansion so, by giving tree crowns more room to expand, reducing stocking levels would increase the rate of diameter growth of the stand. Generally, a fully stocked stand with about 50 – 110 square feet of basal area per acre of residual trees larger than 6" in diameter would result from this treatment. It is expected that individual stands would have a narrower range of residual stocking depending on the species present, number of desirable trees present, and the objectives of the stand. This treatment would usually maintain the current structural stage, either early or middle, in the short term but would increase the growing space for the individual trees and accelerate the diameter growth and move the stands towards a late structural stage.

- **Single-tree Selection and Small group Selection Harvest (HSL) -** The removal of selected trees from specified size and age classes over the entire stand in order to meet a predetermined goal of size or age distribution and species composition in the remaining stand. The criteria for selecting trees are similar to the thinning prescription, but more emphasis is placed on controlling the stocking levels in various age and size classes within the stand. The result of this treatment is a fully stocked stand that exhibits a variety of stocking densities, usually a variety of species, and may have small openings created where a new crop of seedlings would become established. Residual basal area typically ranges from 50-100 sq. ft. The residual stocking level can be adjusted to favor either shade tolerant or shade intolerant species depending on the objectives for the stand.

- **Shelterwood Harvest (HSH) –** The main impetus for this treatment is to regenerate the existing stand. This treatment would be implemented where removing the undesirable trees would result in a less than fully stocked stand. In the Hanlon area this treatment would be used in areas that are dominated by mature lodgepole pine. The lodgepole pine in these areas are generally 75+ years old, have live crown ratios less than 35%, height to diameter ratios greater than 100 and numerous trees have died or are dying due to attacks by mountain pine beetle and/or competition with other trees. Existing long-lived, larger diameter trees would be left for wildlife, structure and shelter. The leave trees are most likely to be western larch, ponderosa pine and Douglas-fir. Any live tree that is over 21" dbh would be retained except as needed to be removed for safety or road construction. Trees left as reserves are expected to range from about 15-25 per acre and would be somewhat irregularly arranged based on how they occur through the stand. Following harvest some type of site preparation to establish the new seedlings would occur. Prescribed fire can be used to reduce slash and remove undesirable existing regeneration and brush which would compete with the newly established seedlings. Mechanical treatments such as whip falling and machine piling or masticating can be alternatively used to achieve the same results. Species to be planted include western white pine, ponderosa pine and western larch. Past experience in this area shows that a variety of other species would also regenerate naturally. Decisions on which trees to retain or remove would be made at the first pre-commercial thinning at about 10-15 years. Usually some natural Douglas-fir is retained in the species mix.

- **Overstory Removal (HOR) –** This treatment is used to release an already established cohort of seedling and sapling sized trees. It would be implemented similar to a shelterwood where a portion of the overstory would be removed. The trees to be removed would be trees that are not expected to become large diameter trees such as lodgepole pine, trees that have been infected by a pathogen such as western larch infected with dwarf mistletoe or trees that have been attacked by insects. Following harvest a pre-commercial thinning would be used to control the stocking and species composition in the newly developing stand. The residual overstory may range from 12-25 trees/acres depending on the species and condition of the trees that are present.

- **Submerchantable Material Removal (HCU) –** Operationally this prescription would be implemented similarly as the HTH described previously. However, the majority of the trees removed would be below the merchantability specifications for sawtimber. The material removed could be utilized as chipwood, poles or some other sort of biomass type material.

Harvesting Systems

- **Ground-based Skidding/Yarding –** A method of moving cut trees to a landing site for transportation to a mill via ground-based (track-mounted or rubber-tire) vehicles. This method is usually used on slopes less than 35 percent, with one end of the log suspended as it is moved to a landing site by a skidder. Skidding distances are generally less than ¼ mile. Skid trails usually average 130 feet apart in the harvest unit. The cutting of the trees is performed manually (with chain saws) or by use of tree- shearing equipment. Also cut to length (CTL) harvesters may be used. CTL harvesters cut the logs to length in the woods and leave the limbs in the path of the equipment. Forwarders are generally used with a CTL system to carry the logs free of the ground on bunks to the landing. CTL trails usually average 40 feet apart and forwarder skidding distances can be up to ½ mile or more in some cases.

- **Cable, Skyline Yarding –** A method of moving cut trees to a landing site for transportation to a mill by use of a suspended cable that is attached to a mobile tower located on a road. This is generally used on slopes greater than 35 percent slope, although the method has been used on less-steep slopes using intermediate supports. Yarding can be uphill or downhill. Yarding distances are generally 1200 feet or less. Cable corridors are usually at least 100 feet apart in the harvest unit. The cutting of the trees is performed manually (with chain saws) or by use of tree-shearing equipment

- **Helicopter Yarding –** A method of moving cut trees to a landing site for transportation to a mill by use of a helicopter. Trees are hoisted by a group of grapples attached to the helicopter and flown to a landing site, usually within ½ mile of the unit, but occasionally further away. The cutting of the trees is usually performed manually (with chain saws), as there is no access for the use of tree-shearing equipment

Understory Treatments

- **Planting –** Artificial reforestation to regenerate a stand or interplant with natural regeneration. Planting would reintroduce species that may be absent or lacking in the stand as a result of past disturbances. Planting allows us to plant a 1 to 3 year old seedling on the site to help overcome the competition of brush or grasses. Planting helps to rapidly re-establish the next stand and move it towards the desired future condition. Relying on only natural regeneration can often be difficult and unsuccessful in re-establishing the desired mix of species on the site.

- **Underburn (UB) -** A method of reintroducing fire on the landscape. This treatment would help in reducing fuel loadings to historic conditions. Treatments may include felling of trees to increase surface fuels followed by prescribed fire. Underburning would help reduce undesirable competing vegetation, including conifers and brush. Also a benefit of underburning would be to make browse species more palatable to big game by stimulating new sprouts. Underburning also would help to regenerate hardwood species, such as aspen and birch through sprouting. Repeated underburnings would be necessary in some stands on drier sites to maintain open parklike stands, mimicking historical fire return intervals. Underburning would also help in raising the lower crown height by reducing the lower live limbs, resulting in a lowered risk of surface or ground fires climbing into the crown of the trees.

- **Fuels/Fire -** A method to reduce fuel loadings to historic conditions. Treatments may include mechanical thinning from below and fuel breaks. Fuels/Fire could include commercial harvest of typical non commercial material (stewardship). The mechanical treatments are designed to prepare the sites for prescribed fire.

- **Mechanical Fuels (MF) -** Mechanical fuel treatments are being done in commercial treatment stands to reduce fuels to historic conditions and create planting spots for regeneration. Treatments may include machine piling, non commercial tree felling and hand pilling. Mechanical fuel treatments may also prepare the stands for future underburning. Mechanical fuel treatment may be done in areas where prescribed fire would likely result in losses to the residual overstory, such as trees species that are not fire tolerant or small diameter trees that have not yet developed enough bark to insulate them from the fire.

- **White Pine Pruning (WP Pruning) -** Treatment in plantations to reduce the risk of WP blister rust infection in the WP saplings. Pruning would be done by hand using saws or pruning shears to remove the lower portion of the crown, generally up to 4.5+ feet high. This lower portion of the live crown has been found to have the highest infection risk.

- **Precommercial Thinning (PCT) -** Treatment in plantations that do not have enough commercial value to treat with a harvest prescription, but would benefit by thinning out small-diameter trees, allowing residual trees to grow and increasing overall stand vigor. Cut trees would be bucked, lopped, and scattered on the site. Generally the stands would be thinned on a 14 feet by 14 feet spacing where topography and economics would allow for a future commercial thinning in 20 to 40 years. A tighter spaced thinning of 7 feet may be viable in LP stands to reduce future ingrowth and increase the potential yield of round wood, (Koch, 1996). I would not recommend thinning at this tight a spacing unless there is some insurance that there would be a market for LP roundwood to thin the stand at age 30 to 35. In stands that a future commercial thin is not considered to be economically feasible then the average PCT spacing should be increased to approximately 14ft by 14ft. A mix of different species including hardwoods is preferred after treatment with a priority on leaving the healthiest trees with greater than 40% live crown ratios and removing trees with damage or disease evident.

Many intermediate treatments, such as thinning or selection harvests on low volume stands would be uneconomical using a helicopter. If these intermediate treatments are not completed or delayed due to limiting the harvest system to a helicopter, the overall stand health, vigor and ultimately the insect and disease risk would increase, and there would be a delay in moving the stands towards late structural stages of stand development. Areas designed for helicopter logging in the analysis area may require more trees to be removed and of larger diameter to be economical and in some cases may make the silvicultural treatment recommended unavailable due

to the increased logging costs. Prebunching of trees with mechanical harvesters for helicopter logging may aid in reducing a portion of these increased costs when a ground based system can access the units. Cable and ground based logging equipment usually require more roading to treat the stands than a helicopter does. Alternative B would require approximately 4.4 miles of new temporary road construction to provide access to the proposed units.

There is a direct relationship with stocking level control and stand vigor. As more acres of the slow growing or stagnant stands are brought under stocking level control, stand vigor would improve. Insects and diseases can be species specific in the range of hosts they would attack. By maintaining a species mix that contains multiple species within the stand, the risk of stand loss to any one single insect or disease is reduced. Therefore, by controlling stocking and species mix, stands would be more resilient to insect and disease attack, and recreation, scenic, timber and winter range goals are more likely achieved.

Cumulative Effects

Throughout both alternatives, other ownerships would continue to have harvest activities. Table 9 identifies the proposed harvest activities based on Forest Practices Applications (FPAs) submitted to the Washington State Department of Natural Resources (DNR) since 2006. The FPAs identify the type of harvest and the acres treated.

Table 9 Proposed Harvest Activities on Other Ownerships

Silviculture Rx	Acres of Proposed Treatment
Even-aged	666
Uneven-aged	1,021
Salvage	80
Total Acres	1,767

Generally, the uneven-aged prescriptions leave more residual trees greater than 10” diameter at breast height than the even-aged prescriptions. Many of the uneven-aged prescriptions are removing most of an overstory to release a dense understory while the even-aged prescription initiates regeneration by leaving seed or shelterwood trees to provide seed and shade for natural seedlings to establish or to provide open areas where trees can be planted. Most of the managed private forest land relies on natural regeneration to provide seedlings following harvest. The Washington DNR is planning a timber sale at the south end of the Hanlon planning area where 417 acres would receive regeneration harvest and then be planted with western larch, ponderosa pine and white pine.

Outside of riparian areas, private and state land would usually have fewer residual trees greater than 21 inches diameter breast height following harvest. This is because their policies don’t prohibit removal as does the Forest Service and the objectives that guide their management is different.

Past and proposed harvest activities on both private and public lands within the Hanlon planning area would have an effect on the risk of insect and disease caused mortality. The risk of insect and disease spread is generally reduced as more acres within the analysis area are managed by using a combination of commercial and noncommercial stand treatments, and reintroduction of fire. Some past management activities such as fire exclusion and high grading may have actually increased the risk for insects and diseases.

Proposed stand treatments on National Forest System lands within the Hanlon analysis area would move the planning area towards being less susceptible to having large scale insect outbreaks. Reducing stocking, maintaining species diversity, increasing species diversity with respect to early seral species would all have a positive affect to this end. These treatments would also help in reducing the risk of outbreaks originating on public land and spreading to private land or other areas outside the Hanlon analysis area.

Several factors over the last 90 years have caused a major shift in the dominant species within this area. Selective logging, large fires partially fueled by logging slash followed by 80 years of fire suppression and introduction of white pine blister rust have contributed to the planning area changing from western white pine, western larch, and ponderosa pine domination to an area that is dominated by Douglas-fir, grand fir and lodgepole pine. Although Armillaria root disease has always been a part of the landscape, it occurred in somewhat of an equilibrium with the Douglas-fir and grand fir due to the more limited distribution of these species throughout the area. Most of the proposed treatments would initiate a copious amount of grand fir and Douglas-fir regeneration, the two species which are generally the most susceptible to Armillaria. To increase the successful establishment of less susceptible species an aggressive attempt during post sale activities needs to occur to reduce the stocking of grand fir and Douglas-fir. Treatments include whip falling, masticating, or prescribed fire with subsequent planting of desired species.

Increasing the amount of ponderosa pine and western larch in stands would move the landscape towards being more fire resilient. Western white pine, while not extremely fire tolerant, is fairly resistant to Armillaria and the planting stock that is available today is increasingly more resistant to blister rust than the planting stock available in the past. These treatments would occur on areas with shelterwood prescriptions. In areas where larch, ponderosa pine and Douglas-fir trees are significant parts of the overstory, shade tolerant species need to be reduced through thinning operations facilitated by logging. While some may argue that this process could be accomplished with prescribed fire, at this time there is too much fuel and the trees that would be retained are not big enough to withstand that intense of a fire. Due to mixed ownership within the Hanlon planning area the likelihood of large scale prescribed burning is slim to none.

The LeClerc Creek watershed falls below historical conditions for late and old structure. This project is designed to accelerate the development of late and old structure and to conserve what late and old structure currently occurs. In addition all live trees greater than 21 inches diameter at breast height and larger would be conserved except those needed to be removed to protect safety or for road construction. Most of the past harvest activities removed the large early seral tree component to release the understory trees. One exception is the Whiteman Timber Sale in the 1990s, which was one of the first sales to incorporate the Eastside Screening process. While a high percentage of the Whiteman project was regeneration harvest targeting areas of mature lodgepole pine, live trees greater than 21 inches diameter at breast height and some of the other larger remnant tress were retained. These areas are now fully established with younger trees while the larger older trees provide some structure to the area.

Recent research (Mitchell et. al., 2009) (Hudberg et.al. 2009) has shown that heavy thinning and fuels reduction can reduce the amount of carbon that these stands can store. The thinning in the Hanlon project is designed to remove understory trees, thus reducing the likelihood of extreme fire behavior which would destroy the large tree component which stores the most carbon. The areas slated for regeneration harvest have the most potential for stand replacing fire. These are the areas dominated by mature lodgepole pine where increasing mortality is causing a buildup of heavier fuels. The objective of sequestering carbon is quite complex by itself and it is difficult to predict outcomes with certainty due to many variables. The Hanlon project has many objectives and the decision-maker needs to determine which ones will be carried forward.

Alternative B would meet the direction provided in the Colville National Forest LRMP.

Optimality of Clearcutting

No clearcutting has been prescribed in any of the action alternatives. All the proposed units meet the National Forest Management Act and the Colville National Forest Land and Resource Management Plan (4-48,49) regulations for a created maximum opening standard of 40 acres.

Units receiving shelterwood treatments are designed to emulate natural fire events and create disturbance patterns similar to the natural mixed fire regimes, as identified in the South Deep Watershed Analysis (Shapiro and associates, 1999), Lost Ruby Watershed Analysis (Colville National Forest, 2001) and the South Deep Watershed Fire History (Schellhaas and others, 2000). These treatments would result in a variable density mosaic ranging from small openings to areas more resembling an open thinning with widely spaced larger diameter fire tolerant trees. Even though individual treatment units would be 40 acres or less, from a landscape perspective a mosaic of varying densities, age classes and specie types would be created. The regeneration harvest would specifically target areas of mature lodgepole pine where the live crown ratios have declined to less than 35% and or the height to diameter ratios are greater than 100.

LAND SUITABILITY

The Code of Federal Regulations states that during the forest planning process, lands which are not suited for timber production shall be identified in accordance with the criteria in paragraphs (a) through (d) of this section.

(a) During the analysis of the management situation, data on all National Forest System lands within the planning area shall be reviewed, and those lands within any one of the categories described in paragraphs (a) (1) through (4) of this section shall be identified as not suited for timber production-

(1) The land is not suitable forest land as defined in 36 CFR 219.28.

(2) Technology is not available to ensure timber production from land without irreversible resource damage to soils productivity, or watershed conditions.

(3) There is not reasonable assurance that such lands can be adequately restocked as provided in 36 CFR 219.28.

(4) The land has been withdrawn from timber production by an Act of Congress, the Secretary of Agriculture or the Chief of the Forest Service.

The following areas were determined to be unsuitable using formal stand exams, walk-thru reconnaissance and aerial photo interpretation. The larger blocks of unsuitable land are deemed to be grossly mapped. There are likely to be small areas within these blocks which are suitable, but are too small to be mapped. Conversely, there are small areas of unsuitable scattered throughout the whole analysis area which are also difficult to map. Most of these unsuitable areas are in the form of rock outcrops. These lands are deemed unsuitable due to being difficult to restock and in some cases not likely to produce 20 cubic feet/acre/year.

Table 8: Unsuitable Lands

GIS #	Acres	GIS #	Acres
5120493	32	5150396	68
5120491	63	5150116	6
5120497	10	5150126	7
5120597	21	5150130	44
5120604	13	5140045	64
5120506	49	5140046	107
5120512	51	5150023	15
5130395	4	5140147	15
5150060	35	5150194	13
5140213	6	5150048	3
5140212	3	5150247	43
5150050	3	5150392	4
5150058	4	5150055	9

Total Unsuitable = 692 acres

No stands identified as unsuitable or marginally suitable are proposed for commercial treatment within the analysis area. Underburning, fuel reduction, or reforestation projects may still be implemented in some of these stands.

Culmination of Mean Annual Increment (CMAI)

Stands in the action alternative that been prescribed for a regeneration harvest have reached or exceeded 95% of culmination of mean annual increment (CMAI).

Ability to Restock

All stands treated would have the ability to be restocked within five years. A combination of natural and artificial regeneration is scheduled. A primary objective of the artificial reforestation is to plant western larch, ponderosa pine and rust resistant western white pine to maintain these species in the landscape.

Knutson-Vandenberg (KV) Projects

No KV projects take place under the No Action Alternative (Alternative A).
KV collections are proposed under the action alternative to cover:
- Costs involved in regenerating harvest areas. Activities include site preparation for natural and artificial regeneration, planting, and the stocking and establishment surveys.
- Maintenance of select trees including cone surveys, cone collections, and seed extraction to maintain future seed sources that are locally adapted to the site.
- Western white pine pruning to reduce the risk of infection by white pine blister rust.
- Precommercial thinning of timber stands to improve growth, increase resistance to insects and disease, and encourage the species composition needed to meet the desired future condition for the area.
- Costs involved in planting in underburn areas that previously were open parklike stands of PP, WL and DF and do not have an adequate seed source to regenerate them as a result of past harvests and the fires in the 1930s.

Hanlon Site Preparation and Vegetation Management

Purpose of this part of the document is to complete a site specific analysis on the strategies of prevention and treatment related to site preparation and control of competing and unwanted vegetation in the Hanlon Project Area.

Site Analysis
The following three situations describe the nature and role of slash as competing and unwanted vegetation.

A. Slash that would be at an acceptable level for stand management needs after harvest. The residual fuel loading would be commensurate with stand regeneration, fire protection, and long-term site productivity needs.
B. Slash that would be at an unacceptable level from the standpoint of fire hazard following harvesting. Generally, this is approximately 25 tons per acre of total residual slash, with a significant component in fine fuels (less than 3" in diameter). Reduction of this slash load would be accomplished with brush disposal (BD) funds using both mechanical and prescribed fire treatment.
C. Slash that would be at an acceptable level from the standpoint of fire hazard, but at an unacceptable level for stand regeneration or establishment of individual seedlings in uneven aged management. Knutson-Vandenberg (KV) funds would be used to pay for both mechanical and prescribed fire treatments to accomplish regeneration objectives.

Items A and B, above, fall outside the scope of the Final Environmental Impact Statement for Managing Competing and Unwanted Vegetation (VEG FEIS), USDA-Forest Service, Pacific Northwest Region, 1988, and accompanying Mediated Agreement, 1989. Item C falls within the scope of the VEG FEIS and is the subject of the rest of this analysis.

The Need for Vegetation Management

The following describes the conditions which favor the presence of competing and unwanted vegetation.

As stated above, logging slash, together with woody material on the site prior to harvesting, is predicted to create a fuel loading condition that would be adverse to establishment of regeneration (conifer seedlings) in certain units. In most cases, a combination of artificial and natural regeneration would be the chosen method for reforestation. Planting would be at a wide enough spacing to allow for naturals to seed in before canopy closure of the planted seedlings occurs. A threshold level of slash loading has been established at 12-14 tons per acre, with a significant component in fine fuels (less than 3 inches in diameter). For the purpose of this analysis, this serves as both the damage and action threshold. Slash loadings below this level would not be considered prohibitive to establishment of seedlings.

In the case of natural regeneration, slash loadings in excess of the threshold level would constitute prohibitive ground cover. The potential for seedling establishment would be greatly reduced due to a lack of open patches of bare ground. Those seeds reaching mineral soil would receive severely reduced sunlight and precipitation, thus inhibiting germination and establishment. For planting seedlings, the predicted slash loading in excess of the threshold level may cause a reduced number of planting spots. This would reduce the number of planted seedlings to the point that stocking certification at the fifth year after planting may be hindered.

Alternative B proposes to regenerate 912 acres of commercial harvested stands. Predicted fuel loadings are anticipated to be in excess of the threshold level on portions of these units and would be broadcast burned, jackpot burned, grapple piled, masticated, underburned or yarded with tops attached to create planting spots.

Selection of Vegetation Management Strategy

A. Prevention

Logging slash from timber harvest would create a problem for seedling regeneration or planting. Prevention of this condition could be accomplished by either 1) not harvesting timber (Alternative A) or 2) a change in harvest prescription that would cause less logging slash to be created.

The selection of Alternative A (No Action) would obviously negate the concern for short term increased fuel loadings resulting from harvesting. However suppression mortality would continue to occur and would naturally increase fuel loadings. Without post harvest slash treatments, there may be an increase in fire risk for five or more years after harvest due to the increased fuel loading generated by the harvest. Yarding tops attached, whole tree yarding or cut-to-length systems remove much of the logging fuels to the landings where they are burned, removed as firewood or hog fuel. An increase in demand for biomass and developments in technology to remove this material from the woods and process it would alleviate the negative impacts of leaving this material in the woods.

Due to needs for forest health, constraints due to suitability, management area designations within the Colville National Forest Land and Resource Management Plan, and the structural screening process to meet the historical range of variability (Regional Forester's Forest Plan Amendment #2, June 8, 1995) the range of alternative methods for stand treatment over much of the Hanlon Project Planning Area is limited. Prescriptions within the action alternatives have been proposed to best meet the identified issues and the standards and guidelines of the

LRMP and to progress the stands towards a late or old structural stage of stand development, within the natural limitations that exist within the planning area. There is little opportunity to vary these prescriptions to reduce created slash below threshold levels. Provisions of the VEG FEIS do not apply to precommercial thinning or commercial thinning.

B. Early Treatment

Logging slash would be a problem from the moment of its creation in harvesting. Early treatment, i.e. initiation of action to control unwanted vegetation (slash) before the damage threshold is reached, could be accomplished by yarding tops attached (LTA) or using a cut-to-length and forwarder logging systems to modify the fuels during harvesting. Yarding tops attached and forwarder harvesting is expected to be effective over the majority of the units these are proposed in. This opportunity for early treatment is expected to be effective over most of these units, but there is a possibility of some created slash above threshold levels remaining within the units.

C. Maintenance

Maintenance strategy would support the current condition. No maintenance strategy exists that would reduce or keep the predicted slash load below threshold level.

D. Correction

Correction is action taken after the damage threshold has been exceeded. Proposed treatments include machine piling, hand piling and burning of piles, broadcast burning, jackpot burning, or underburning would qualify as correction. Jackpot burning or machine (grapple) piling is proposed in the units prescribed for leave tops attached if the damage threshold has been exceeded.

Slashing and/or precommercially thinning of saplings in the units may also be necessary to modify ladder fuels and help to create planting spots. Slash created in the treatment of saplings could be reduced by grapple piling, underburning, jackpot or broadcast burning, lopping and scattering, or hand piling.

E. No Action

A no action strategy would result if Alternative A were chosen for implementation. Use of a no action strategy under one of the action alternatives would result in creation of openings that would be extremely difficult to stock with desired seedlings within a 5 year time frame to meet reforestation certification requirements. Also in areas where natural seedlings may seed in and survive, shade tolerant species such as grand fir would tend to dominate the site and create a future risk to increased defoliation caused by the western spruce budworm (*Choristoneura occidentalis*). This strategy would also allow brush species to inhabit created small openings. Under this scenario, full stocking could be delayed by twenty years or longer in these areas.

Effects of Implementation

A. Anticipated Resource Output

The anticipated result of proposed vegetation management would be: Stocked stands in regenerated units within 5 years after harvest and established seedlings would be in a position to be "free-to-grow" without encumbering vegetation or slash to hinder growth. Rapid site preparation and stand re-establishment should reduce or eliminate the potential of competing vegetation or noxious weeds from getting established. Also rapid seeding of any new roads, landings, skid trails or existing roads that have had soil disturbance with a soil stabilizing seed mix would reduce the potential for unwanted vegetation to become established. If hardwoods and/or brush establishment is outcompeting the regeneration a manual release treatment may be necessary. Reduced slash levels especially in

the Douglas fir, lodgepole pine or ponderosa pine sites would aid in a reduction of future engraver beetle outbreaks.

B. Potential Risk to Human Health

Alternative A

The "No Action" Alternative would not implement any timber harvesting activities. No vegetation management would be necessary.

Alternative B

Under this alternative openings created by harvesting would either be jackpot burned, broadcast burned, underburned, machine (grapple) piled or yard tops attached (LTA). LTA units would be piled at the landing and burned. These openings would retain seed trees, shelter trees, and reserve trees for wildlife and visuals. Smoke from burning would likely be visible and possibly inhaled by forest visitors. This would last for a period of several hours per day when burning would take place. It is possible that the smoke would rise in a column, resulting in virtually no inhalation by residents or forest visitors (see fire specialist report for more information).

Contracted workers engaged in proposed machine piling would face risks common to working around heavy equipment in the logging industry. These workers would be familiar with the risks and trained in safety aspects of their jobs.

Forest workers participating in the proposed burning would be most at risk from inhalation of smoke, burns caused by flame or hot debris, and/or miscellaneous injury associated with hand or power tools in fire management. These risks are analyzed in workers' job hazard analysis, position descriptions, and the USDA-Forest Service Health and Safety Code Handbook.

C. Risk of Environmental Damage

Potential risk of environmental damage from prescribed fire has been described and documented in Chapter IV of the Colville National Forest Final Environmental Impact Statement (FEIS) for the Land and Resource Management Plan. Potential effects have also been disclosed in Chapter IV of the VEG FEIS. Specific impacts of the proposed activities are addressed in analysis documents for each affected resource. Refer to other specialist reports in the analysis file such as the Fire, Fuels and Air quality for more information.

In general, use of Best Management Practices (BMPs) and INFISH guidelines should be adequate to protect air quality, water quality, riparian and fish habitat. The greatest risk of environmental damage would be to soils and indirectly to long-term site productivity. The retention of soil organic matter would be maintained by retaining an average of 70% of the original duff layer. This should be done by burning when the duff moisture level is high and using a low intensity burn. Prescribed broadcast burning as site prep was avoided where competing vegetation has the potential for increased sprouting (Leege, 1971) and may result in an extensive and persistent shrubfield that would resist reforestation efforts for years (Williams, 1990). Also within the LTA, machine pile, underburn, broadcast burn and jackpot burn units approximately 10 to 16 tons/acre of large woody material generally greater than 3 inches in diameter should be evenly distributed and left to provide for long term nutrient replacement, wildlife habitat and protection of the regeneration. Maintaining the duff layer would also reduce some windborne seeds from getting established due to the reduced bare mineral soil available.

Species diversity would not be affected. No vegetation species would be eradicated from the site. Threatened, Endangered and Sensitive Species would be protected (Refer to the Wildlife specialist report for more information).

Machine piling, LTA and burning the piles would cause temporary small impact to no impact on big game and would provide increased palatable forage in the burned areas until the new stand has enough canopy closure to reduce the understory forage growth. Also by seeding the new roads, skid trails and landings additional preferred browse species can be maintained or reintroduced.

Slash and windthrown trees should be monitored for buildup of engraver beetles. Thinning or slash creation should be avoided in spring and early summer in areas containing ponderosa pine and lodgepole, due to the potential pine engraver buildup (Burns, 1989). Piles of slash created at the landing or with machine piling in the unit should be placed to protect leave trees. The piles should be burned as early as possible in the fall to reduce Ips populations. Units containing high amounts of ponderosa pine or lodgepole pine should be monitored for buildup of Ips populations. Leaving piles of slash in or adjacent to these units for firewood cutters beyond fall would create an increased risk of Ips caused mortality in the residual trees and possibly the adjacent stands.

Reduction of amounts of large woody debris and numbers of snags would be a potential impact to smaller animals and birds. Although by maintaining duff layers, retaining 10-16 tons/acre of woody debris, and following the wildlife tree marking guides these impacts would be reduced.

D. Project Feasibility/Economics

Action

The decision to implement specific vegetation management treatments would be made with the Hanlon Project decision. Action treatments would occur during and after the timber harvest activities. Prior to broadcast, underburning, machine piling or jackpot burning and reforestation treatments, a review of the post harvest vegetation and fuel conditions would occur and should involve, at a minimum, specialists from fire and silviculture. This analysis would determine if the anticipated vegetation management treatments are actually needed and if any modifications to the project plans are required. Any needed modifications would be coordinated through the interdisciplinary NEPA process.

Monitoring

All vegetation management projects would be monitored both during and after treatment to gather site specific information to aid in future project planning.

Project Design Criteria

1. Areas of root rot infection would be regenerated to resistant or tolerant species.

2. A wildlife biologist, recreation specialist, fisheries biologist or hydrologist would assist the silviculturist in developing site specific prescriptions, marking guidelines and monitoring if units are located within RHCA's, wildlife habitat, recreation and visual emphasis areas.

3. Reforest areas receiving regeneration harvest within 5 years after harvest.

4. Slash piles containing high amounts of LP which are at risk to create or continue the spread of bark beetles should be burned as early as possible in fall. Delaying the slash pile burning for firewood cutting may increase the potential for pine engraver and mountain pine beetle buildup. Firewood cutting or biomass utilization from piles should be allowed as soon as possible after the unit is completed as long as it does not conflict with other resource needs. This would reduce the slash available for the beetles to invade.

5. No old growth stands or structural stage 6 or 7 (late or old) stands are proposed for treatment within the analysis area. If any stands are identified as old growth or structural stage 6 or 7 during future reconnaissance or unit layout, they would be excluded from the harvest activity.

6. Protect all select trees within the project area. This includes retaining shelter trees around the select tree to reduce the risk of blowdown. Remove or modify both the ground and ladder fuels adjacent to the select tree to insure it's survival in the event of a wildfire or during site prep burn activities. Select trees are part of the Forest tree improvement program and are designated for cone/seed collection.

7. Protect the existing advanced regeneration from logging damage to the extent possible in units with overstory removal (HOR) prescriptions.

8. Timing of harvest activities should be considered in intermediate silvicultural treatments when there is a high risk of bark slippage and damage to the residual trees. Bark slippage is the highest in spring and early summer when the cambium is active. Monitoring by sale administrators for excessive harvest damage during logging operations may allow for harvesting during the bark slippage period. Cambium damage in the residual trees can introduce disease organisms through the wound and further stress the trees increasing their risk to insect attacks.

Prepared by:

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September 14, 2009

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Appendix A

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April 28, 2008

Hanlon Vegetation Management and
Fuel reduction Project
Disease and Insect Field Review
Newport-Sullivan Lake Ranger Districts

In September and October, 2007 we conducted an assessment of forest disease and insect conditions in the Hanlon area, around the west branch LeClerc and Fourth of July Creeks, on the Colville National Forest. Field observations were done by walking along transects within targeted forest stands and recording tree species, GPS data points, and damages caused by forest insects and forest pathogens.

The following is a summary of our observations:

General Observations

There is Armillaria root disease caused by *Armillaria ostoyae* in many locations throughout the analysis area. Armillaria root disease is a major management problem in the Hanlon project area. Declining and dead trees, components of root disease centers were frequently observed. An Armillaria root disease center is characterized by dead trees in the center of the opening and symptomatic trees in the margin. *A. ostoyae*, the causal agent of Armillaria root disease was found actively growing on root collars of symptomatic trees. As described later in this report, trees with above ground Armillaria symptoms are about 25% of the number of trees that are actually infected.

We found many large Douglas-firs that were dying of Armillaria root disease. None of these weakened trees had been attacked by Douglas-fir beetles within the last two years. Apparently the Douglas-fir beetle outbreak that began in the late 1990s has collapsed, and the population is now at a very low level. If large pockets of Douglas-fir blowdown occur, the beetle population may increase and begin attacking root diseased Douglas-firs in the analysis area.

Larch dwarf mistletoe (*Arceuthobium laricis*), is a serious pathogen of western larch in the Hanlon area. Infected trees were observed throughout the analysis area. Almost all the larch mortality is probably due to dwarf mistletoe.

We observed two stands with Douglas-fir trees infected with Douglas-fir dwarf mistletoe, (*Arceuthobium douglasii)*. Douglas-fir dwarf mistletoe infestations were scattered discretely in the assessed areas of the two infested stands. The infection caused by this pathogen generally leads to the formation of witches' brooms and eventually to premature tree mortality. The infected trees have dwarf mistletoe infection ratings from light to moderate.

White pine blister rust disease caused by *Cronatium ribicola* is present on western white pines throughout the analysis area. This pathogen infects its host through the needles. The fungus grows from the needles into the branches and moves down toward the main bole, causing cankers and eventually killing the host. This non-native

disease was introduced into western North America in 1910, and has had devastating impacts on native five-needle pines.

We found a small amount of western gall rust infecting lodgepole pine trees in four stands. *Endocronartium harknessii* is the causal agent of this disease. This pathogen causes round to pear-shaped swellings on branches and stems (Goheen and Willhite 2006). Most of the galls occurred on branches of mature and young trees.

Indian paint fungus, *Echinodontium tinctorium*, was seen in several stands. Indian paint is a damaging heart rot of true firs and hemlock. It causes a brown, stringy rot. The fruiting bodies are hoof-shaped, woody conks usually found on the undersides of branches or branch stubs. The conks release spores that enter new hosts through suppressed branch traces. The fungus can remain dormant in the new host for decades, until it is activated by an injury such as a frost crack or logging damage (Filip 2001).

Old conks of *Phaeolus schweinitzii*, the causal agent of Schweinitzii root and butt rot, were found on the ground in two stands. *P. schweinitzii* causes butt rot in old growth trees, especially Douglas-fir. We did not find any conks near the bases of host trees or on their lower boles.

Conks of *Phellinus igniarius* were frequently seen growing on down birch trees. This fungus is the cause of extensive white rot decay of the trunk of several hardwood tree species in North America. We did not find any conks on live birch trees.

We found a standing and a down lodgepole tree with conks of *Phellinus pini*, the causal agent of red ring rot. This tree species is occasionally attacked by this fungus. No other lodgepole pines or any conifer trees species bearing conks of *P. pini* on their boles were found in the assessment area.

Bronze birch borer *(Agrilus anxius)* is damaging birch throughout the analysis area. This native insect can attack any birch, but white barked birch species are the most susceptible. Typically, these insects infest trees that have begun to decline. The first symptom of birch borer attack is usually dieback in the upper crown which progresses for several years until the entire tree is eventually killed.

Many lodgepole pine stands in the Hanlon area are densely stocked, over 80 years old, and have average stem diameters greater than 8 inches. These stands are highly susceptible to mountain pine beetle attack. We observed very little current mountain pine beetle activity.

Stand 5120580

The overstory is dominated by Douglas-fir and grand fir mixed with ponderosa pine, western larch, western redcedar, and birch. Average diameters are 15” to 25”. This is a very variable stand. It includes wet areas and dry brushfields.

There is Douglas-fir dwarf mistletoe but the infection is very light. Armillaria root disease is common. We observed several grand fir and Douglas-fir trees dying and killed by *A. ostoyae*. There is larch dwarf mistletoe infecting western larch trees. Larch dwarf mistletoe infection is light to moderate.

Stand 5120581

Trees of the overstory include lodgepole pine, ponderosa pine, and western larch. There are Douglas-fir, western redcedar, grand fir, spruce, lodgepole pine, ponderosa pine, and birch in the understory. There is light to moderate infection by larch dwarf mistletoe. No other diseases were observed in this stand.

Lodgepole pines are about 100 years old and 10” in diameter. They are highly likely to be attacked by mountain pine beetles. Many show evidence of strip attacks that occurred in the 1990s.

Stand 5120582
The overstory is dominated by Douglas-fir and ponderosa pine, with some western larch. There is larch dwarf mistletoe in this stand. The mistletoe infection is light to moderate.
We also observed heart rot in some western redcedar trees. The rotting in the boles resembled decay caused by *Postia sericiomollis*, a common heart rot pathogen of western redcedar. Most heart rot in western redcedar is associated with trunk injuries that expose wood to infection.

Stand 5120588
Most of the overstory is dominated by ponderosa pine and Douglas-fir with a few birch trees and some western larches growing in the mixed stand. Larch dwarf mistletoe was observed wherever western larch was present. The mistletoe infection is light to moderate.

Stands 5120589 and 5120590
Douglas-fir dominates the overstory. Other overstory species include western redcedar, western larch (few), western white pine, and birch. The understory, which is very dense, includes Engelmann spruce and grand fir. The stands appear fairly vigorous overall.

There is considerable heart rot in western redcedar.

Stand 5120591
Trees that are part of the overstory include grand fir, Douglas-fir, western redcedar, Engelmann spruce, western larch and western hemlock. There are few western redcedar trees showing mechanical injuries. Larch dwarf mistletoe was observed throughout the stand.

Conks of *Phellinus igniarius* were frequently seen on down birch trees. We did not find any conks growing on live birch trees.

There is Armillaria root disease in many locations throughout the stand. Declining and dead trees, which are components of root rot disease centers, were frequently observed.

Phaeolus schweinitzii conks were found in this stand. It is most common to find this pathogen affecting Douglas-fir. We did not find any conks growing near the bases of host trees or on their lower boles.

Stand 5120592
Tree species of the overstory in this very dense stand include lodgepole pine, western larch, Douglas-fir, grand fir, and western redcedar. Tree species of the understory include western redcedar, grand fir, and western hemlock. There is larch dwarf mistletoe in the stand. Larch dwarf mistletoe infection is mostly light to moderate but in some places infection is severe.

Conks of the Indian paint fungus, *Echinodontium tinctorium*, were found growing on down and on a few standing grand fir trees.

Stand 5120593
Tree species include western larch, Douglas-fir, and western redcedar in the overstory. Species in the understory include grand fir and western redcedar. We observed Douglas-fir and grand fir of all sizes dying and killed by *Armillaria ostoyae*. There are a number of western larch trees with moderate to severe infection by larch dwarf mistletoe.

There are conks of *P. schweinitzii* (Schweinitzii root and butt rot) on the ground within the stand. No symptomatic or killed trees were seen in this stand.

Stand 5120594
The overstory is composed of Douglas-fir, western larch, ponderosa pine, birch, and few western hemlock trees. There is larch dwarf mistletoe in this stand. Larch dwarf mistletoe infection is light to severe. No other disease or insect activity was observed.

Stands 5140184, 5140186 and 5140188
Tree species in the overstory are Douglas-fir, western white pine, lodgepole pine, grand fir, ponderosa pine, and western larch. There is larch dwarf mistletoe in this stand. Larch dwarf mistletoe is light. There is some white pine blister rust disease.

There is a small amount of western gall rust infecting lodgepole pine.

Stand 5140185
This is a very dense, multi-storied stand with a large component of western white pine. Western white pines are heavily infected with white pine blister rust. Large (>12" dbh) western white pines with blister rust have been attacked by mountain pine beetles. Lodgepole pines in this stand have reached an age and size that makes them susceptible to mountain pine beetle attack.

Stands 5150238 & 5150243
The overstory is dominated by a mix of Douglas-fir and birch, with areas of lodgepole pine. There are several birch logs with *P. igniarius conks* on them. We found mycelium of *A. ostoyae* on uprooted Douglas-fir trees. Typical root rot disease centers were observed with many declining Douglas-firs.

There are western larch trees with moderate to severe infection by larch dwarf mistletoe; including several killed by this pathogen.

Lodgepole pines in these stands are about 80 years old, densely stocked and declining. Average diameters are eight to 12". These lodgepole pine patches are highly susceptible to attack by mountain pine beetles.

Stand 5150242
The overstory on this previously logged unit showed a diversity of species including grand fir, Douglas-fir, western larch, and lodgepole pine; and an understory of grand fir, Douglas-fir, western redcedar, western hemlock, western white pine, and birch.

Phellinus igniarius conks were observed growing mostly on down birch trees but in few occasions on snags. Many birch tops have died back as a result of attacks by bronze birch borer.

There is Armillaria root disease affecting Douglas-fir and grand fir. Mycelial fans of *A. ostoyae* were found on Douglas-fir trees, snags and uprooted logs with root balls. Grand firs weakened by root disease are being attacked by fir engraver beetles. We observed no recent attacks by Douglas-fir beetles on Douglas-fir. However, Douglas-firs weakened by root diseases are highly susceptible to Douglas-fir beetle attack.

Mountain pine beetles are active in the lodgepole pine component.

Stand 5150313
Trees in the overstory include western larch, Douglas-fir, ponderosa pine, lodgepole pine, western redcedar, and birch. Average diameters are 15" to 25".

There is light larch dwarf mistletoe in this stand. There is also light to moderate infection by *Arceuthobium douglasii* (Douglas-fir dwarf mistletoe).

Many birch tops have died back as a result of attacks by bronze birch borers.

Stand 5150314
Trees in the overstory include western redcedar, Douglas-fir, and western larch, with some pockets of birch. Average diameters are 15" to 25". No disease or insect damage was found other than light larch dwarf mistletoe infection on western larch.

Stand 5150315
Trees in the overstory include western larch, ponderosa pine, and Douglas-fir, with some subalpine fir in the creek bottom. Trees in the understory include western redcedar, ponderosa pine, western hemlock, Douglas-fir, western white pine, grand fir, Engelmann spruce, and lodgepole pine. White pine blister rust was observed in the stand. We saw several western white pine trees with infected boles and branches. We found one grand fir killed by *Armillaria*.

Stand 5150316
This is a mixed stand of lodgepole pine, western redcedar, and western larch in the overstory. The understory trees species include Douglas-fir, grand fir, western white pine, western redcedar, and some subalpine fir. There is light to moderate infection by larch dwarf mistletoe. We also observed several grand firs in the understory infected with *A. ostoyae*.

Lodgepole pines are 10" to 15" dbh. They have reached an age and size that is susceptible to mountain pine beetle attack.

Stand 5150349
We walked the north side of this stand. The overstory is dominated by grand fir and Douglas-fir. Overall vigor appears quite low. A lot of snags were observed in this portion of the stand. Many of the grand fir trees and snags have Indian paint conks on them. Fir engravers have attacked these weakened trees.

The understory is composed of grand fir, Douglas-fir, western hemlock, western white pine, and western red cedar. Armillaria root disease was observed on many Douglas-fir trees in the understory. White pine blister rust was also found on western white pines.

Stand 5150366
Tree species in the overstory include aspen, birch, cottonwood, lodgepole pine, ponderosa pine, grand fir, Douglas-fir, western hemlock, and western larch. Trees of the understory include western redcedar, grand fir, and western hemlock. There are western larch trees with light to moderate infection by larch dwarf mistletoe.

There is Armillaria root disease in this stand. Many symptomatic grand fir trees were observed. A few lodgepole pine trees, which are seldom damaged by *Armillaria,* were also infected. Mountain pine beetles have attacked these weakened lodgepole pines.

Western white pines trees were found infected with *C. ribicola*. Most of the infected trees have well developed bole canker lesions. It is likely that those trees will be killed by this pathogen
We found a standing lodgepole pine and a down tree with conks of *Phellinus pini*. This tree species is occasionally attacked by this fungus.

Stand 5150368
Dominant tree species in the overstory included grand fir, Douglas-fir, and lodgepole pine, with a few western white pine, ponderosa pine, and western larch. We found growing in the understory some western hemlock mixed with Douglas-fir, grand fir, western redcedar, and some scattered Engelmann spruce. There are western larch trees with moderate to severe infection by larch dwarf mistletoe.

There were several Douglas-fir trees killed and infected with *A. ostoyae*. Some of these weakened Douglas-firs had their tops killed by Douglas-fir engraver, *Scolytus unispinosus.* Armillaria root disease is spread throughout the stand.

Stand 5150369

This is a well-spaced stand with Douglas-fir and ponderosa pine dominating the overstory, but in some areas lodgepole pine is the dominant species. Larch dwarf mistletoe was observed throughout the stand. Larch dwarf mistletoe infection is light to severe. Throughout the stand, scattered Douglas-fir trees showed symptoms of Armillaria root disease. Western gall rust was also observed on branches of mature lodgepole pines.

Crown ratios in this stand are low and height to diameter ratios are high. We observed several patches of snow-down and breakage. There are few acceptable leave trees in this stand.

Stand 5150370

Overstory trees are ponderosa pine, lodgepole pine, Douglas-fir, birch, western larch, western white pine, and few western hemlock trees. Average diameters are 15” to 20”. Understory trees are Douglas-fir, grand fir, and Douglas maple. The stand appears relatively vigorous.

The portion east of the road is dominated by lodgepole pine that has reached a size and age that is susceptible to mountain pine beetle attacks. Timely removal of these trees would reduce losses to bark beetles.

White pine blister rust is infecting some western white pines.

The tops of many birch trees have been killed by bronze birch borer.

We found one small pocket of Armillaria root disease.

Stand 5150380

This stand was composed mostly of Douglas-fir and grand fir in the overstory mixed with western larch. There are several western larch trees with moderate to severe infection by larch dwarf mistletoe.

Armillaria root disease was observed in the stand. Typical forest gaps were frequently found. Many down trees killed by *A. ostoyae* were also observed.

Discussion and Recommendations

Twenty-seven stands were evaluated in September and October 2007 in the Hanlon project area, on the Colville National Forest. We recorded insect and disease conditions we saw during our visits. We observed several insect and disease problems in the stands. We noted three major disease problems. Our discussion and recommendations will focus on those diseases. We found damage caused by western gall rust, heartwood-rotting fungi, and Douglas-fir dwarf mistletoe; but they did not cause significant damage.

Armillaria Root Disease

Our assessment of the Hanlon area showed that Armillaria root disease is present in at least thirteen stands (48%). Aboveground symptoms observed on infected trees include heavy resin flow and soaking at the base of trees, decreased height growth, and crown discoloration. The presence of the fungus itself (mycelial fans growing underneath the bark and shoestring-like rhizomorphs) was also used to identify the disease on infected trees. Symptoms of Armillaria root disease were not seen in the remaining 14 stands but the disease may still be present in those stands. Armillaria root disease is significantly more abundant in infested stands than the presence of

aboveground Armillaria symptoms indicates (Filip 1986; Morrison *et al*. 2000). For every living tree with aboveground symptoms there are probably three infected living trees that are not displaying aboveground symptoms.

Most of the infected stands are composed of a mix of conifer species, including Douglas-fir, grand fir, ponderosa pine, western larch, and other tree species. Armillaria root disease affects all conifer species but their susceptibility to *A. ostoyae* varies (Goheen and Willhite 2006). Douglas-fir and grand fir are very susceptible to *A. ostoyae* infection. Western larch, ponderosa pine, western white pine, and lodgepole pine are more tolerant.

Armillaria root disease is common in most of the grand fir, western hemlock, and western redcedar plant associations in northeast Washington. According to Morrison *et a*l. (2000) "Armillaria root disease is found in most biogeoclimatic subzones in the dry, moist, and wet climatic regions in southern interior British Columbia". Biogeoclimatic subzones used in British Columbia are equivalent to the plant association groups used by the USFS in the Pacific Northwest as a mean of classifying potential vegetation characteristics of sites. The greatest incidence of Armillaria root disease in southern interior British Columbia is in the Interior cedar/hemlock and interior Douglas-fir biogeoclimatic zones. Many of the Hanlon area stands would be classified into those biogeoclimatic zones. Morrison indicated Armillaria root disease is uncommon or absent from hot-dry, cool-wet, and cold-dry biogeoclimatic zones in British Columbia. McDonald (1987) reported Armillaria species findings from a large number of plots in eastern Washington, eastern Oregon, northern Idaho, and western Idaho. Armillaria species were uncommon or absent from hot-dry and cold-dry plant associations. Armillaria species incidence was discontinuous in the two least productive series: Douglas-fir and subalpine fir. McDonald (1990) stated that Armillaria root disease is a significant management problem on Douglas-fir in the Inland West where the 100-year site index is between 100 and 65. Most of the Hanlon area stands probably are within such a range of site indexes.

Armillaria ostoyae is indigenous to the forests in northeastern Washington. In most natural forests in northeast Washington that have not had a history of timber harvesting *A. ostoyae* is in a state of dynamic equilibrium with the trees. The fungus causes lesions on the roots of trees but many trees are vigorous enough to confine the fungus to the lesions. The fungus survives by acting as a saprophyte on dead and dying roots. Occasionally, when the trees with lesions are stressed the fungus can break out of the localized lesions and spread on the roots and aid in killing the trees.

An explanation for the severe occurrence of Armillaria root disease found in the Hanlon area can be attributed to several factors. Studies have demonstrated that selective harvesting exacerbates damages caused by *A. ostoyae* (Filip and Goheen 1982; McDonald *et al*. 1987; Filip 1990; Morrison *et al*. 1991; and Filip *et al*. 2007). *A. ostoyae*, as previously stated, causes localized lesions on the roots of many trees. Many trees are capable of confining the fungus to the small pitchy lesions. When the stems of trees with root lesions are cut the fungus quickly breaks out of the lesions and spreads on the roots and to the stumps. The fungus uses the woody substrate of the roots and stumps as a food base. The fungus then spreads from the colonized roots and stumps to infect adjacent, susceptible trees. Most of the assessed Hanlon stands have been previously logged. Many large stumps are in those stands. These stumps have been used as food bases by *A. ostoyae*. Most of the Armillaria spread is from the growth of rhizomoprphs directly through soil from the colonized roots and stumps. The rhizomorphs can grow up to 30 inches from their food bases. When rhizomorphs contact roots of susceptible trees they can initiate infection. This is called primary spread and it is associated with the large stumps. Secondary spread happens when the fungus subsequently spreads from the initially infected trees to adjacent trees. The spread can continue for many decades if susceptible tree species are present. Some disease spread occurs when healthy roots of susceptible host trees make contact with infected roots and the fungus mycelium passes from root to root.

Grand fir is a fire-intolerant tree species and Douglas-fir is fire-intolerant when stems are relatively small. Fire exclusion policy has allowed grand fir and Douglas-fir to gradually become a major part of the overstory. Douglas-fir and grand fir are the species most susceptible to *A. ostoyae* infection and subsequent damage in

northeast Washington. Most of the assessed stands have grand fir and Douglas-fir present. Long term effective fire suppression efforts have allowed grand fir and Douglas-fir to become dominant or more abundant parts of the community and have contributed to the increase of Armillaria root disease severity. The past history of logging in the stands also contributed to an increase in the amount of grand fir and Douglas-fir. It was common to encounter naturally regenerated grand fir and Douglas-fir infected with *A. ostoyae* in the assessed stands.

White pine blister rust is a problem on western white pine in the Hanlon project area. We believe the disease has been present in the area since about 1926 and it has significantly reduced the white pine component of the Hanlon area stands to the point where white pine is now a minor stand component. Western white pine decline has allowed other tree species, specifically Douglas-fir and grand fir, to become more abundant. Western white pine is more resistant to Armillaria root disease than Douglas-fir and grand fir (Goheen and Willhite 2006). A strong component of western white pine would have impeded the spread of Armillaria root disease because it is less likely to become infected and damaged than Douglas-fir and grand fir. The importance of encouraging more western white pine in the area, thus dealing with white pine blister rust, will be discussed later in this report.

Armillaria root disease is not easily controlled in forests. However, several researchers have suggested that critical stages in the life cycle of *A. ostoyae* can be used to reduce damages caused by Armillaria root disease (McDonald *et al*. 1987; Morrison *et al*. 1991; Filip 2000 and Roth *et al*. 2000). These critical stages can be summarized on the ability of this fungus to: 1) infect, kill, colonize and survive as a saprophyte in colonized stumps and roots, and 2) spread from colonized food bases to adjacent healthy trees to infect them via rhizomorphs or by root contact (Morrison *et al*. 1991).

Six Armillaria root disease management options are offered for consideration:

1). Take no corrective action to stop the spread of the disease. Do no active management. Taking no vegetation management actions in the Hanlon stands will contribute to the continuation and spread of Armillaria root disease. The disease will not go away if nothing is done. However, the disease will not accelerate in terms of numbers of trees infected and damaged if no active management is undertaken. The risk of trees falling due to infected, decayed root systems is highly probable.

With the alternative of taking no vegetative correction actions the probability of the disease remaining actively killing trees on these sites is high, since the understory is dominated by Douglas fir and grand fir.

Root disease weakened trees are often attacked by bark beetles (Filip and Goheen 1984; Goheen and Hansen 1993; and Carlson 2007). Some of the assessed stands are already being infested by fir engraver beetles. Furthermore, several of other assessed stands are highly susceptible to beetle attacks. Taking no corrective action will contribute to maintaining bark beetle populations and the possibility of increasing bark beetle populations that could result in extensive tree mortality. This is especially a concern in stands with many large Douglas-firs that are susceptible to Douglas-fir beetle attack.

2). Removal of dead and symptomatic trees. Removal of dead and symptomatic trees will not stop or slow down the spread of Armillaria root disease. It is highly likely to increase Armillaria root disease because this treatment creates more stumps for the fungus to colonize. We stated earlier *Armillaria* is using stumps and roots to survive and spread (Morrison *et al*. 1991). Unfortunately, it is difficult to detect root infection on trees that do not have crown symptoms. Filip (1986) and Morrison *et al.* (2001) reported that crown symptoms occur on living infected trees within disease centers on a very low percentage, around 20 to 25 percent. Infected asymptomatic trees around root disease centers should also be considered for removal from the stand. Selective logging will exacerbate the disease, especially if a lot of firs are retained.

3). Inoculum reduction. Stump and root removal following harvest is another way to control Armillaria root disease (Morrison *et al*. 1991; and Omdal and Shaw III 1996). Removing infected stumps, their associated root systems and woody infected material from the soil has been demonstrated to be a biologically effective

way to reduce the inoculum in diseased stands (Roth *et al*. 2000). Stump and root removal removes the woody substrate the fungus uses as its food base and from which it spreads to nearby trees. Morrison *et al*. (1991) reported that mechanical stump removal can be accomplished during harvest by pushing trees over using wide-tracked excavators. Obviously, stump and root removal is an expensive treatment and should be applied to areas where there are no soil or topographic constraints. Inoculum reduction is expensive to accomplish, but it can be effective if done properly

4) Favoring poor host species. There is a wide variation in the conifer species susceptibility to infection and subsequent damage from Armillaria root disease. Douglas-fir and grand fir are most susceptible, whereas pines and larch are rather tolerant of Armillaria root disease. Western hemlock, spruce, and western redcedar are intermediate in susceptibility. All the stands in the Hanlon area have multiple tree species. Favoring less susceptible tree species is likely to be the most effective method for reducing long term losses to Armillaria root disease. Planting or favoring more resistant tree species will contribute to reducing losses due to Armillaria root disease. Birch is a resistant tree species but probably has marginal commercial value. Western larch is the most tolerant conifer species after it reaches 15 to 20 years old. Ponderosa pine, western white pine, and lodgepole pine are tolerant to *A. ostoyae* (Filip 2000). Morrison *et al*. (2000) stated that using resistant and poor host tree species will create conditions in which the pathogen eventually could become non-effective and in some cases to die out of sites if the highly susceptible tree species can be excluded. Canadian forest pathologists have also recommended mixing of birch and larch trees to enhance the survival of the later. In our opinion, using tree species of low susceptibility to Armillaria root disease is the best approach for dealing with the Armillaria root disease problem in the Hanlon project area. We advocate favoring western larch, ponderosa pine and western white pine.

5) Uneven-age management. Uneven-age or all-age forest management is highly likely to exacerbate Armillaria root disease in the infected Hanlon stands. Large stumps and associated roots, especially of Douglas-fir and grand fir, will be quickly colonized by *A. ostoyae* and the fungus will spread from those stumps and roots to infect and kill nearby trees. Grand firs and Douglas-firs are quite likely to regenerate naturally in an uneven-age setting and the regeneration will become infected and die.

6) Even-age management. Even-age management can provide the best opportunities to proactively manage the stands to reduce the impacts of Armillaria root disease. Western larch should be a significant component (perhaps the most abundant species) in the stands with Armillaria root disease. Larch needs large openings to grow and thrive. Similarly, ponderosa pine should be a prominent part of the stands. Clearcutting would provide the best conditions for planting larch, ponderosa pine, and rust resistant western white pines. Shelterwood cutting would also be effective if larch and pines were to be planted. Douglas-fir seedlings should not be planted next to large Douglas-fir and grand fir stumps. Inoculum reduction could only be done in areas clearcut or shelterwood cut.

Larch Dwarf Mistletoe

Larch dwarf mistletoe was observed in nineteen of the 27 stands (63%) and it may be present in some of the others. Disease severity was rated using the 6-class dwarf mistletoe rating (DMR) system (Hawksworth *et al*. 2002). Results show an incidence of light, moderate and severe larch dwarf mistletoe infection in the area. Larch dwarf mistletoe is a major problem in the Hanlon project area. Western larch is the most common host for larch dwarf mistletoe (Wicker and Leaphart 1976) but it can also occur on lodgepole pine, ponderosa pine and (with less frequency) on Engelmann spruce (Hawksworth *et al*. 2002).

The infected western larch trees in the Hanlon stands were most likely infected when they were saplings. Mathiasen (1998) found that young western larch trees can get infected before they reached 15 years old even though trees of that age represent a small target for dwarf mistletoe seed to land on. The reason why so much of the larch in the Hanlon area is infected with larch dwarf mistletoe relates to the long term fire history. Larch

dwarf mistletoe is indigenous to the area; it has probably been present to some extent as long as larch has been present. We do not know the date but more than 100 years ago large wildfires swept through the area. The fires killed large numbers of trees, including larch. Larch is the most fire tolerant of all conifer species in the area due to its thick bark and long lengths of branch-free boles, so some larch survived the fires. Undoubtedly some of the fire-surviving larch trees were infected with dwarf mistletoe. The larch trees produced larch seed that resulted in larch regeneration. The dwarf mistletoe plants produced seeds that infected the larch regeneration. Over a long period of time many of the mistletoe infected larch died from mistletoe. Other tree species, especially Douglas-fir and grand fir, developed in the understories. Over time the Douglas-firs and grand firs outcompeted the understory larch leaving remnant mistletoe infected overstory larch in the stands.

Negative impacts of dwarf mistletoe infections on western larch trees include premature tree mortality, reduced growth rates, and tree deformation, thus lowering timber quality (Beatty *et al*. 1997). This pathogen can reduce cone and seed production in infected western larch trees. In addition, Wicker and Leaphart (1976) have related the effect larch dwarf mistletoe has on highly flammable woody fuel in infested stands. They stated that infected branches tend to break during the winter months because snow and ice accumulates on witches' brooms. The accumulation of dead broomed branches around the bases of infected or killed western larch trees increases the amount of ground forest fuel.

Armillaria root disease is a major problem in the Hanlon project area. Western larch is tolerant to *A. ostoyae*. In our opinion, favoring western larch as crop trees will help to reduce damages that *A. ostoyae* is causing in the area. We recommend substantially increasing the amount of western larch. Larch can only be increased by exerting a strong degree of control of larch dwarf mistletoe. Following are two management scenarios for dealing with larch dwarf mistletoe.

1) No corrective actions. This alternative will not eliminate larch dwarf mistletoe from the stands. This pathogen will continue to intensify in infected trees. Over time the number of larch in the stands will slowly decline as the trees are killed by mistletoe and competition from other tree species. Western larch will be slowly replaced by more shade tolerant species that are not hosts of *A. laricis*. This scenario will not help deal with Armillaria root disease (Hadfield, J.S. personal communication).

2) Removal of infected mistletoe trees. This treatment involves the removal of all obviously infected western larch trees from the stands and planting larch seedlings. Larch trees that appear to be free of dwarf mistletoe infections could be left to provide larch seeds to help regenerate the stands with more larch. Leave-trees should be monitored because some of them may already be infected (latent infection) and could become a source of inoculum that could potentially infect planted or natural regenerated western larch seedlings. If those leave-trees develop symptoms of infection they should be removed at once. Smith (1966) demonstrated that large quantities of dwarf mistletoe seeds were disseminated up to 45 feet by dwarf mistletoe plants in a single residual infected larch tree.

White Pine Blister Rust

White pine blister rust, *Cronartium ribicola*, is an introduced pathogen that has been present in the Hanlon area since the late 1920's. Native North America five-needle pines, including western white pine and whitebark pine, had little natural resistance to this pathogen. All western white pine stands in Washington State have been exposed to white pine blister rust for at least 70 years.

We found eight stands with white pine blister rust. Infected trees included mature western white pines, poles, and saplings. Symptoms that were observed on infected trees included: 1) typical brown-dying flagging branches, 2) sunken stem cankers which were often associated with heavy streaming pitching and 3) swellings on branches.

Fortunately, some western white pine trees have shown some natural resistance to white pine blister rust. Rust-resistant seed sources have been developed and are generally available for reforestation. A note of caution is warranted in that the "rust-resistant" trees are not totally resistant to blister rust infection. The genetically tested and improved trees would be better described as "less susceptible to infection and to being killed". Many so-called rust resistant white pines have become infected and in some areas many have died. Nevertheless, rust resistant pines, even though they are not completely resistant to infection, should be planted to increase the amount of western white pines in the Hanlon area.

White pine blister rust has killed large numbers of western white pines and that undoubtedly is the case in the Hanlon stands. The white pine stands in the Hanlon area have been exposed to blister rust for almost 80 years, yet there are still significant numbers of naturally regenerated white pines present. It is reasonable to conclude that many of the surviving white pines have some degree of resistance or tolerance to white pine blister rust.

Western white pine, like western larch, is more resistant to Armillaria root disease, than Douglas-fir and grand fir. The ability of western white pine to tolerate root diseases can be used as a tool to manage Armillaria root disease. We recommend the amount of western white pines in the Hanlon area be substantially increased because of its tolerance of Armillaria root disease. White pine blister rust needs to be managed if white pine is to be increased.

Management options:

1.) Planting resistant trees. The Colville National Forest has access to rust resistant white pine seeds and thus plantable seedlings. The rust resistant seedlings could be planted in any location that has supported growth of western white pines. It would be especially desirable to plant white pines in areas with significant amounts of Armillaria root disease.

2) Pruning. Lethal blister rust infections are most common on the lower parts of western white pines because conditions are more favorable for the fungus to cause infection. Most lethal blister rust infections are within 4 feet of the ground. Schnepf and Schwandt (2006) reported that pruning the lower branches of young trees greatly reduces the risk of infection. They reported that pruning lower branches on naturally seeded young western white pines decreased blister rust mortality almost 50 percent in comparison to non-pruned western white pine trees. It is common practice in northern Idaho to do lower crown pruning in plantations of rust resistant white pines.

   For this treatment to be effective, it should be done while the trees are rather small and young. Approximately 80 percent of the lethal blister rust infections take place within the first 20 years of the lives of western white pines. Schenepf and Schwandt (2006) recommended pruning young trees when they are 10 feet tall and that the removing of branches should be done to one-half of tree height. They also advised not to prune branches with rust cankers within four inches of the bole. White pines less than 10 feet tall can have major gains from lower crown pruning. The Colville National Forest has pruned thousands of acres of white pine stands with trees 6 feet to 15 feet tall.

3) White pine seed-trees. White pines that have good form and are apparently free of blister rust infections could be left to produce tree seeds for natural regeneration. Many of the healthy looking trees probably have some degree of resistance or tolerance to blister rust infection.

   The Hanlon project area is badly affected by Armillaria root disease. In our opinion, the management option of favoring "poor Armillaria host species" would be the most effective treatment. Western white pine is tolerant of Armillaria root disease. The developing of a management approach that will favor western white pine, western larch and ponderosa pine is highly recommended.

Western Gall Rust

Western gall rust was observed in the assessed area. Four stands had small amounts of infection on lodgepole pine trees. Although ponderosa pine is considered a host tree, we did not see western rust gall on any ponderosa pines. We found conspicuous galls, a visual diagnostic feature of this disease, on branches of young trees. We also found galls on branches of mature trees but they were less frequent.

Trees with galls on the main stem are often deformed and can be broken at the gall. Trees with main-stem galls are unsuitable for timber utilization. Tree mortality occurs mostly on young trees infected with main-stem galls.

Infection susceptibility of lodgepole pines is under genetic influence. Trees with large numbers of galls should not be used for seed collection. If any pre-commercial thinning is contemplated, pines with large numbers of galls should be cut and not retained as crop trees.

The Hanlon project area is badly infected with Armillaria root disease. Lodgepole pine is more tolerant to this disease than grand fir and Douglas-fir. Maintaining a presence of lodgepole, western larch and white pine trees will help to reduce damages caused by *Armillaria ostoyae*.

Heart Rots

Five species of stem decay fungi were recorded in the assessed stands. All of these diseases were recognized by the presence of fungal fruiting bodies, in this case conks, on down trees and in some cases standing host trees.

Filip *et al*. (1983) reported that spores of the Indian paint fungus, a heartwood rot, infect small diameter exposed branchlet stubs. After spore germination, the fungus enters a dormant period (by mean of resting spores) and can remain in that stage for 50 years or more. This dormant period may be broken by disturbance created by mechanical injuries, frost crack, and anything that would allow air to contact the interior of a tree. Once the infection has been activated, decay of the heartwood commences. Suppressed grand firs in the understory that are 40 or more years old are at the highest risk of having dormant infections.

Filip (2001) listed a series of recommendations aiming to minimize tree injuries during stand activities. Minimizing tree injuries that remove bark and expose wood to infection is the most effective approach to reducing losses to stem decay fungi. In addition, grand firs that have been suppressed for 40 or more years are most likely to have dormant Indian paint fungus infections and make poor crop trees.

We do not believe that the Hanlon project area stands have a major heart rot problem. However, in any future treatments for these stands care should be taken to minimize wounding of trees since that sets the stage for wood decay.

Douglas-fir Dwarf Mistletoe

This is not a major problem in the Hanlon project area. We found few trees in two stands separated by another apparently non-infected stand. The stands were light to moderately infected with Douglas-fir dwarf mistletoe.

Douglas-fir dwarf mistletoe can cause severe deformities, growth loss and mortality in infected trees. The presence and sizes of witches' brooms can influence the amount of forest fuel that could be present in a stand affecting the risk of wildfire spread.

Douglas-fir dwarf mistletoe is relatively uncommon in the Hanlon area and surrounding areas. The pathogen is potentially quite damaging to trees and stands. It is the most lethal of all the dwarf mistletoes that are present in eastern Washington. The limited distribution of Douglas-fir dwarf mistletoe in the Hanlon area may warrant

aggressive action to get rid of it or to greatly reduce its abundance in the infected stands. It is possible to cause an increase in numbers of trees infected if the stands are thinned and living, infected Douglas-firs are left. Dwarf mistletoe plants in the leave trees will produce an abundance of seeds to infect Douglas-fir regeneration that develops in the openings next to infected leave trees. If dwarf mistletoe infected Douglas-firs are to be left they should be clustered close together to avoid significant spread of the pathogen through the stands.

Mountain Pine Beetle in Lodgepole Pine

When a mountain pine beetle outbreak occurs in a lodgepole pine stand, the beetles preferentially attack the largest diameter trees. Over the course of an outbreak, 85% or more of the large diameter trees will be killed and progressively smaller proportions of the small diameter trees (Cole and Amman 1980). Thinning can reduce the proportion of a stand that will be killed by beetles, but stocking must be reduced to less than 80 square feet of basal area to be effective (Mitchell *et al.* 1983). A light thinning in small diameter stands may just hasten the development of 8-inch diameter trees without keeping densities below a beetle susceptibility threshold (Cochran and Barrett 1998). In the Hanlon area, many of the mature lodgepole pine stands have height to diameter ratios greater than 80. These tall, slender trees are not suitable leave trees for thinning, as they will bend over in wind or snow. Regeneration is a better option for lodgepole stands in this condition.

Bronze Birch Borer

The best way to manage this insect is to keep birch stands healthy. Leaving birches in partial cut units may increase the bronze birch borer population, since birch roots are easily damaged and weakened trees are easily attacked.

Fir Engravers

Fir engravers are bark beetles that attack true firs. Fir engraver activity is often associated with root disease. They are also attracted to trees under stress from drought, defoliation or other damage. Trees that are attacked may be killed outright, or they may survive with top kill. The best way to reduce damage by fir engravers is to manage for vigorous stands and to reduce the proportion of true fir.

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Excerpt from Hanlon Fire and Fuels Specialist Report
Proposed Post-harvest Treatments Table

Table A1.

Unit	Log_ sys	Rx	Acres	Residual Sp.	Size	Fuel Model	Rx Fire Proposed	Masticate Proposed	Grapple Pile Proposed	Potential Biomass Removal from Units	Remarks
1	G	HSL	124	Mixed	all	8/10	30	94		**X (<35% slope)**	
2	G	HSL	109	Mixed	all	8/10	40	69		**X (<35% slope)**	
3	G	HSL	23	Mixed	all	5/8/10	10	13		**X**	Landslide potential
4	G	HSL	19	DF, WL	12"+	5/8/10	14		5	**X**	
5	G	HTH	4	DF,GF,WL,RC	9"+	5/8/10			4	**X**	
6	G	HSL	62	WL,PP	11"+	5/8/10	50		12	**X**	
7	G	HTH	22	WL	11"+	5/8/10	22			**X**	
8	H	HTH	33	DF	12"+	5/8/10	33				
9	S	HTH	4	DF	12"+	5/8/10	4				
10	G	HTH	25	DF	12"+	5/8/10	25			**X**	
11	G	HSH/HTH	120	WL	12"+	8/10-25:75	90	30		**X**	
12	G	HSH/HTH	65	WL,PP	11"+	8/10	30	17	18	**X**	
13	G	HTH	63	DF,WL	11"+	5/8/10	30	33		**X**	
14	H	HTH	114	DF,WL	9"+	5/8/10	114				
15	S	HTH	18	DF	14"+	5/8	18				
16	G	HSL	27	PP,WL,DF	15"+	5/8/10	27			**X**	
17	G	HTH	81	DF, WL,PP	12"+	5/8/10	60		21	**X**	
18	H	HSL	63	DF,WL	10"+	5/8/10	50		13		
19	G	HSL	149	DF	9"+	5/8/10	110		39	**X**	
20	G	HTH/HSH	107	DF,WL,GF,RC	9"+	5/8/10	25		82	**X**	
21	G	HSL	61	WL,DF	9"+	5/8/10	15		46	**X**	
22	G	HSL	83	DF,WL	11"+	5/8/9	60		23	**X**	
23	G	HSH/HTH	31	LP	7"+	8/10		31		**X**	
24	G	HSH/HTH	36	LP clumps	8"+	8/10	25		11	**X**	
25	G	HSL	38	WL	10"+	8/10	30	8		**X**	
26	G	HTH/HOR	29	WL,ES,DF	10"+	8/10-25:75	15	14		**X**	
27	G	HTH/HOR	35	WL	10"+	8/10	15	20		**X**	
28	G	HTH/HOR	14	DF,WL	9"+	5/8/10	4	10		**X**	
29	G	HTH	27	DF,PP	11"+	5/8/10	20		7	**X**	
30	G	HTH	132	DF,WL	11"+	5/8/10	120		12	**X**	
31	G	HTH	52	DF,WL	11"+	5/8/10	40		12	**X**	

Unit	Log_ sys	Rx	Acres	Residual Sp.	Size	Fuel Model	Rx Fire Proposed	Masticate Proposed	Grapple Pile Proposed	Potential Biomass Removal from Units	Remarks
32	G	HSH/HTH	34	WL	10"+	8/10-25:75	17	17		**X**	High compaction (DC)
33	G	HSL	45	DF,WL,PP	12"+	5/8/10	15	15	15	**X**	
34	G	HSL	29	DF,PP,WL	11"+	5/8/9	22		7	**X**	
35	G	HTH/HSH	62	DF,PP	13"+	5/8/9	31	15	16	**X**	
37	G	HSH/HTH	61	LP clumps	7"+	5/8/10	45		16	**X**	
38	G	HSH/HTH	44	DF,WL	10"+	5/8/10	22		22	**X**	
39	G	HSL	17	DF,WL,LP clumps	7"+	5/8/10	10		7	**X**	
40	G	HSH	15	WL,DF,PB	9"+	5/8/10			15	**X**	
41	G	HTH/HSH	175	DF,WL	10"+	5/8/10	59	58	58	**X**	
42	G	HSH/HTH	44	WL,DF	12"+	5/8/10	30		14	**X**	
43	G	HTH	110	DF	14"+	5/8/10	110			**X**	
44	G	HTH/HSH	19	WL,DF	12"+	5/8/10	15		4	**X**	
45	G	HTH	9	DF,PP	15"+	5/9	9			**X**	
46	S	HTH	38	DF	14"+	5/8/10	20		18		
47	S	HTH	35	DF,PP	15"+	5/8/10	35				
48	G	HTH/HSH	17	DF,WL	12"+	8/10		17		**X**	
49	G	HSH	5	LP clumps	6"+	8/10		5		**X**	house borders unit
50	G	HTH	28	DF	13"+	5/8/10	20		8	**X**	cabin is in unit
51	G	HSL	26	DF,WL	12"+	5/8/10	10		16	**X**	
52	G	HSH/HTH	54	mixed	9"+	8/10	30	24		**X**	
53	G	HSH/HTH	25	DF,WL	15"+	8/10	15		10	**X**	
56	H	HTH	62	Mixed	12"+	5/8/10	50	12			Landslide potential
57	G	HSL	78	DF	11"+	5/8/10	30	24	24	**X**	High compaction
58	G	HTH	135	RC,WH,DF	12"+	8/10-25:75		80	55	**X**	Yard tops, GP trails
59	G	HTH	44	RC,WH,DF	12"+	5/8/10	22		22	**X**	Landslide potential
60	G	HTH	117	RC,WH,DF	12"+	8/10-25:75		70	47	**X**	Yard tops, GP trails
61	G	HSH	8	WL	10"+	8/10			8	**X**	
62	G	HSL	15	WL,ES,WP,DF	10"+	8/10-25:75		15		**X**	
63	G	HTH	40	WL,DF	8"+	8/10-25:75		30	10	**X**	
64	G	HTH/HSH	139	WL,RC,DF	9"+	5/8/10		90	49	**X**	
65	G	HSL	22	DF,WL	10"+	8/10		10	12	**X**	
66	G	HTH	42	WL,RC	9"+	8/10	15	12	15	**X**	
67	G	HSL	42	DF,WL	10"+	5/8/10	15	12	15	**X**	
68	G	HTH	9	DF,WL	10"+	8/10		4	5	**X**	
69	G	HSH/HTH	67	WL,LP clumps	11"+	8/10	30	18	19	**X**	

Unit	Log_ sys	Rx	Acres	Residual Sp.	Size	Fuel Model	Rx Fire Proposed	Masticate Proposed	Grapple Pile Proposed	Potential Biomass Removal from Units	Remarks
70	G	HTH/HSH	11	WL,DF	12"+	8/10		11		**X**	
70	G	HTH/HSH	7	WL,DF	12"+	8/10		7		**X**	
71	G	HTH/HSH	25	WL,LP clumps	11"+	8/10		25		**X**	
72	G	HSL	22	DF,WL,GF	11"+	8/10-25:75		15	7	**X**	
73	G	HTH/HSH	129	DF,WL	10"+	5/8/10	40		89	**X**	
74	G	HSL	8	mixed	13"+	8/10-75:25		8		**X**	
75	G	HTH	34	DF	12"+	5/8/10	15	9	10	**X**	
76	G	HTH	44	Mixed	8"+	5/8/10	15	14	15	**X**	
77	G	HTH	37	Mixed	8"+	5/8/10	15		22	**X**	High compaction
78	G	HSH/HTH	71	DF,WL	10"+	5/8/10	40	15	16	**X**	
79	G	HSH/HTH	15	WL,DF,PP	12"+	5/8/10	10		5	**X**	
80	G	HSL	6	WL	11"+	5/8/10			6	**X**	
80	G	HSL	30	WL	11"+	5/8/10	30			**X**	
81	G	HSH	24	WL	11"+	8/10-75:25	20		4	**X**	
82	G	HSH	14	WL	11"+	8/10-75:25	10		4	**X**	
83	G	HSH/HTH	60	DF,WL	12"+	5/8/10	50		10	**X**	
84	G	HTH/HSH	57	Mixed	9"+	8/10		28	29	**X**	High compaction
85	G	HTH/HSH	9	WL	9"+	8/10			9	**X**	
86	G	HTH	8	DF	9"+	8/10			8	**X**	
87	G	HTH	9	DF,GF	9"+	8/10			9	**X**	
88	G	HTH	16	RC,WH,DF,PP	11"+	8/10			16	**X**	
89	G	HTH	24	RC,WH,DF	11"+	8/10-75:25			24	**X**	
90	G	HTH	13	RC,WH,DF	11"+	8/10	8		5	**X**	
90	G	HTH	20	RC,WH,DF	11"+	8/10			20	**X**	
91	G	HSH/HTH	52	WL,DF	12"+	5/8/10	30	22		**X**	
92	G	HTH	22	DF	14"+	5/8/10	22			**X**	
93	H	HSH	41	DF,WL,PP	14"+	8/10-25:75	20	11	10		
94	H	HSH/HTH	70	DF,WL,PP	14"+	8/10	40		30		Landslide potential
95	H	HTH/HSH	106	DF,WL,GF,WH,RC	12"+	5/8/10	70		36		Landslide potential
96	G	HTH	48	WL,DF,GF	12"+	5/8/10	25	10	13	**X**	Landslide potential
97	G	HSL	79	DF,WL	12"+	5/8/10	60		19	**X**	
100	G	PCT/HCU	14	Mixed	6"+	8/10		14		**X**	
101	G	PCT/HCU	40	Mixed	6"+	8/10		40		**X**	
			4647				**2323**	**1096**	**1228**		

10/5/2009

Hanlon Regeneration Units
Collaboration Agreements between NEWFC[3] and Forest Service

Sideboards for all units:

For those no-cut or overstory removal (OSR) areas that are being used to reduce regeneration acres in any unit, the no-cut area will be a minimum of ½ acre in size.

Strips or corridors separating shelterwood areas need to be a minimum of 200' wide.

FR 1935 (existing) – wildlife requirement to retain existing regeneration pockets along the road is required even for those units along segments that are proposed for decommissioning with this project

Areas of shelterwood harvest require an average of 20 TPA (minimum) of overstory trees to be retained.

Where a maximum shelterwood size is stated, it reflects the actual acres being treated with a shelterwood harvest; OSR[4] or no-cut areas over ½-acre that are GPS'd can be subtracted from the overall unit acres.

The area listed for shelterwood harvest for each unit is total acres and may be a sum of multiple shelterwood pockets within the unit.

Acres are approximate based on field knowledge of the Interdisciplinary Team members and photo interpretation.

Unit #	Original Acres[5]	Proposed Vegetation Screening[6]	Layout requirements as agreed-to with NEWFC[7]	Final Acres[8]	Comments
11	66	Adjacent to Cty Rd 3503; would retain pockets of existing regeneration along road to provide screening	As this unit is proposed (with leave area and vegetative screening along West Branch road) and shown on most recent map by Forest Service, this unit meets the grid guidelines. Western side of the unit would have an area larger than 15 acres, but it meets intent of the guidelines. Unit will have leave pockets scattered through unit to protect residual trees.	40	Need to include leave strip as flagged by Nikcole & put in regeneration retention pockets along Cty Rd 3503 (see 2009_0803_draft_unit11_map.pdf)

[3] NEWFC = Northeast Washington Forestry Coalition
[4] OSR = overstory removal
[5] Acres originally proposed by the Forest Service IDT for shelterwood harvest
[6] Information listed in this column was from 8/29/09, and reflects layout direction based on grizzly bear habitat management guidelines.
[7] Agreements from September 2009 meetings with Jeff Juel, Maurice Williamson, John Buehler & IDT members.
[8] Acres proposed for shelterwood harvest following collaboration meetings.

Unit #	Original Acres[5]	Proposed Vegetation Screening[6]	Layout requirements as agreed-to with NEWFC[7]	Final Acres[8]	Comments
12	45	Adjacent to Cty Rd 3503; would retain pockets of existing regeneration along road to provide screening	Unit is split by a wildlife travel corridor; would need some vegetative screening along West Branch road for wildlife; unit will have leave (no-cut) pockets (3/4 to 1-acre blocks) scattered through unit to protect residual trees. Some areas would be slightly larger than 15 acres, but it meets intent of the guidelines[9].	38	Travel corridor will be a minimum of 400' wide.
20	34	Shelterwood harvest is proposed for small pockets located within a thinning unit. No vegetative screening required.	Small patches meet intent of guidelines (less than 15 acres). Larger patch (21 acres) would include lodgepole pine leave pockets ¼-acre and larger in additional to individual leave trees. Some areas would be slightly larger than 15 acres, but it meets intent of the guidelines.	32	Estimated size – three small patches total 13 acres; one patch at 19 acres (21-acre pocket minus no-cut areas). Large patch is more than 400' from other patches.
23	15	Adjacent to Cty Rd 3503; would retain pockets of existing regeneration to provide screening along road	Actual shelterwood area would be approximately 15 acres. No changes needed.	15	Long, narrow strip of lodgepole pine. Estimated unit size is 21 acres (includes both thinning & shelterwood areas). Need to retain regeneration pockets along Cty Rd 3503 where it is present.
24	29	Not adjacent to a road; no vegetative screening required.	Placement of pine marten corridor on western edge brings down the regeneration patch size to about 23 acres.	19	need to locate several ¾ to 1-1/2 acre size no-cut pockets to protect residual trees and reduce size of regeneration area to ≤ 19 acres (see map)
32	30	Adjacent to FR 1935115 (Hanlon cut-off road); would retain pockets of existing regeneration along road to provide screening	Unit would be divided into 15-acre pieces or travel corridor would be located along western edge of unit to break it up. Unit will have leave pockets scattered through unit to protect residual trees.	25	Would also leave vegetative screening adjacent to meadow (south edge of unit).
37	47	Portion along FR 1935000 would retain pockets of existing regeneration to provide screening.	Portion of unit along the western edge is non-regeneration (screening for grizzly bear). The 2 east-west strips are draws which would have OSR-like prescription or thinning (non-regeneration). The largest patch (south end) about 19 acres.	31	Logging system, topography & mixed species strips (thinning or OSR areas) break up regeneration pocket into three patches (19, 8 & 5 acres). OSR along east side of the road would provide grizzly bear screening and break up the 19-acre piece. Residual trees would be left in mix of clumps (no-cut pockets) and individual trees. (See map).

[9] "Guidelines" references the draft regeneration guidelines developed by the NEWFC.

Unit #	Original Acres[5]	Proposed Vegetation Screening[6]	Layout requirements as agreed-to with NEWFC[7]	Final Acres[8]	Comments
38	33	Adjacent to FR 1935115 (northwest part of unit); would retain pockets of existing regeneration along road to provide screening	A portion of the unit (from the southern plantation to the south boundary of the unit) would be changed from shelterwood to overstory removal to split the unit into smaller units. Unit will have leave pockets scattered through unit to protect residual trees.	28	OSR area would split shelterwood treatments into two separate areas.
40	14	Adjacent to FR 1935115 (Hanlon cut-off road); would retain pockets of existing regeneration along road to provide screening	Unit is adjacent to shelterwood portion of unit 41. Riparian buffer could reduce eastern edge of both units. Locating two no-cut strips or overstory removal areas would reduce unit size to within acceptable guidelines for both units 40 & 41. Unit will have leave pockets scattered through unit to protect residual trees and vegetative screening along FR1935115.	12	Unit size is approx. 14 acres. Other than along road, there is lack of suitable leave trees in unit. Need to keep total shelterwood area to less than 17 acres (continuous acres across boundaries for units 40 & 41)
41	20	Adjacent to FR 1935115 (Hanlon cut-off road); would retain pockets of existing regeneration along road to provide screening	Long, narrow strip of lodgepole pine to be removed.	17	Shelterwood part of this unit is adjacent to unit 40. Will leave no-cut strips or OSR pockets to break up shelterwood areas.
42	36	Adjacent to FR 1935; would retain pockets of existing regeneration along road to provide screening	The 400-ft wide no-cut zone on the eastern edge is for marten corridor, reducing patch size to 23 acres. Within that, 3-5 one-acre clumps (or some combination to equal 3-5 acres) reduces to approx. 20 acres. The clumps will be shaped and located with the prevailing winds in mind, also considering skidding logistics.	21	This unit would also have small patch at ~3 acres). Remaining regeneration harvest area is very heavy to lodgepole; leave trees would be clumped for protection. (see map)
52	50	Adjacent to FR 1935; would retain pockets of existing regeneration along road to provide screening	Wildlife biologist prefers relocated north-south pine marten corridor, to be implemented on eastern edge in riparian zone since they're favored by martens. Based on field work, "HSL" patch (selection harvest) to be implemented, will reduce regeneration patch to irregularly shaped patch 15-20 acres.	18	The regeneration part of the unit would now be 15-20 acres. Pockets of regeneration would be retained along both sides of the Middle Branch LeClerc road for wildlife screening (lodgepole overstory would be removed), which would also break up the area proposed for regeneration. A mix of clumps and individual trees (depending on species available to retain – lodgepole would need no-cut pockets; other species could be left as individual trees) would be retained to meet a minimum of 20 trees per acre. (see map)

Unit #	Original Acres[5]	Proposed Vegetation Screening[6]	Layout requirements as agreed-to with NEWFC[7]	Final Acres[8]	Comments
53	21	Adjacent to Cty Rd 3503; would retain pockets of existing regeneration along road to provide screening	Retained trees will be mix of desirable species such as western larch and ponderosa pine. Unit will have leave pockets scattered through unit to protect residual trees. Part of unit is thinning. Size will be reduced by riparian buffer and vegetative screening along county road.	18	Final unit size should be ≤ 18 acres.
69/71	61	Not adjacent to a road; no vegetative screening required.	"Thin" patch breaks up unit 69 with 13-acre patch northern end. Applying a 200-foot wide OSR in hemlock area at south end of unit 69 separates off unit 71, leaving the largest patch still at about 26 acres. At least five 1-acre patches will also be implemented, bringing total largest regen patch acreage to about 20.	43	See map. Commercial thin (HTH) would separate a 13-acre regen piece at the north end of unit 69. There is a heavy western hemlock understory in unit 71 (~ 10 acres) plus an adjacent ~5-7 acres in unit 69. The understory is about 30-40 years old and has some potential to respond to release. Within lodgepole areas FS will need no-cut pockets to protect residual trees (¼+ acre size pockets). Place OSR strip so bottom (#71) would be ~10 acres (shelterwood). OSR strip ~200' or more wide would be placed at south end of unit 69 (adjacent to unit 71). This would leave the top piece in unit 69 at ~25-26 acres. At least 5 one-acre pockets (or some combination to equal 5 acres) as no-cut areas oriented for slope & logging systems would be left in unit 69.
70	6	Not adjacent to a road; no vegetative screening required.	Two small pockets of shelterwood – one at 2 acres and one at 4 acres.	6	No changes from original proposal are needed.
78	48	Along FR 1935; would retain pockets of existing regeneration along road to provide screening	One travel corridor goes east-west through unit and splits into two separate units. A second corridor will be located along the northwest edge of unit (along the stream). Unit includes some overstory removal as well as some vegetative screening along FR 1935000. Unit will have leave pockets scattered through unit to protect residual trees.	33	Unit was originally proposed at 48 acres. Individual shelterwood pieces of this unit should be ≤ 20 acres.

Unit #	Original Acres[5]	Proposed Vegetation Screening[6]	Layout requirements as agreed-to with NEWFC[7]	Final Acres[8]	Comments
79	11	Adjacent to FR 1935; would retain pockets of existing regeneration along road to provide screening	Unit includes some vegetative screening along FR 1935000. Unit will have leave pockets scattered through unit to protect residual trees.	10	Screening within this unit would be protected until adjacent section of FR 1935 is decommissioned.
81	22	Along new location for FR 1935	Travel corridor proposed along east edge of unit would reduce acres (by approx. 5 acres). Unit will have leave pockets scattered through unit to protect residual trees.	16	HSH area to be ≤ 18 acres.
82	11	Along new location for FR 1935	Travel corridor proposed along east edge of unit would reduce acres. Unit will have leave pockets scattered through unit to protect residual trees.	9	
83	38	Along new location for FR 1935	Travel corridor proposed along east edge of unit would reduce acres (by approx. 5 acres). Area below road (in east part of unit) would retain trees (either no-cut or thinning [if suitable trees are present]) and split unit into smaller acreage. Unit will have leave pockets scattered through unit to protect residual trees.	28	HSH areas need to be ≤ 20 acres.
91	28	Not adjacent to an open road; no vegetative screening required.	Shelterwood would be divided near section corner (NE corner section 5) (place no-cut or thinning piece from section corner southwest through unit). Unit will have leave pockets scattered through unit to protect residual trees.	21	No-cut or OSR strip needs to be ≥ 200' wide.
93	41	Not adjacent to an open road; no vegetative screening required.	Unit would be split into east and west portions with center strip left as no-cut or overstory removal (if suitable trees are present) to separate into smaller units. Unit will have leave pockets scattered through unit to protect residual trees.	33	Regeneration area mixed with commercial thinning area. Shelterwood parts need to be split in half; HSH areas need to be ≤ 20 acres.
94	37	Not adjacent to an open road; no vegetative screening required.	Leave block shown cuts off NW arm, leaving largest patch at 29 acres. An east-west thinning patch roughly in the middle will break up the 29 acres into two, with the final location to be determined by Tom Link (district silviculturist).	27	See map. Place OSR or no cut strip at SW corner of private which separates the unit into two regeneration pockets (large piece = 29 acres; small piece = 4 acres). The leave strip would be a minimum of two tree lengths in width (~200' or wider). Other areas of residual lodgepole (needed to meet wildlife and other requirements) would be left in no-cut pockets scattered through the regeneration part of the unit.

Unit #	Original Acres[5]	Proposed Vegetation Screening[6]	Layout requirements as agreed-to with NEWFC[7]	Final Acres[8]	Comments
95	45	Not adjacent to an open road; no vegetative screening required.	Travel corridor at north end removes ~4 acres and separates a small piece of the shelterwood. Unit includes a rocky, brush opening near the south end of unit. Design of thin east-west strips through shelterwood piece of unit would break up area into smaller units. Leave areas would need to be at least two tree lengths in width (~200 feet wide). Unit will have leave pockets scattered through unit to protect residual trees.	32	This is a long, narrow, irregular-shaped patch. A no-cut area will be placed in the unit to reduce patch size. Unit has potential for improving forage opportunity on big game winter range