CHAPTER 3 – ENVIRONMENTAL CONSEQUENCES

This chapter presents information on the physical, biological, social, and economic environments of the affected project area, and the potential direct, indirect and cumulative effects to those environments due to the implementation of the alternatives. These effects are the scientific and analytic basis for the comparison of alternatives.

Each resource area discloses the direct, indirect and cumulative effects for that resource area. The National Environmental Policy Act defines these as:

- **Direct**: Effects which are caused by the action and occur at the same time and place
- **Indirect**: Effects which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable
- **Cumulative**: Impacts that result from the incremental impact of an action, when added to other past, present, and reasonably foreseeable further actions, regardless of what agency or person undertakes such other actions

The Environmental Assessment (EA) herby incorporates by reference the project record (40 CFR 1502.21). The project record contains specialist reports, biological evaluations, and other technical documentation used to support the analysis and conclusions in this EA. Specialist reports were completed for fire/fuels, vegetation resources, soils, hydrology, fisheries, wildlife, botany, invasive plants, recreation, and heritage resources. Separate biological evaluations and/or biological assessments were completed for botanical species, aquatic species, and terrestrial wildlife species as part of the consultation process with the National Marine Fisheries Service (NMFS) and the U.S. Fish & Wildlife Service (FWS). Full versions of these reports are available in the project record, located at the Hood River Ranger District office in Mt. Hood/Parkdale, Oregon.

Each of the specialist reports and biological evaluations conduct an analysis of cumulative effects resulting from this project. Table 3-1 lists the projects that the IDT considered in their analysis. Each report details the specific projects that were analyzed for cumulative effects.

Table 3-1: List of Projects Considered in Cumulative Effects Analysis

Past Activities
Past timber harvests
Past road building in planning area
Private land harvesting activities on Sections 31 and 36
Harvesting within The Dalles Watershed area
Firewood cutting activities
Pre-commercial thinning
Culvert replacements on Mill Creek road (1711-630 Road) and on North Fork Mill Creek (located approximately 0.5 miles downstream of Forest boundary)
Hazard tree removal along roads
Illegal trail construction in Gibson Prairie area
Present Activities
Additional non-motorized trail construction proposal from Mill Creek Collaborative Group
Hood River County trails project proposal (non-motorized and motorized) to north of project area

Present Activities Continued . . .
Long Prairie Grazing Allotment
The Dalles Watershed Fuelbreak
Pre-commercial thinning
Bonneville Power Administration maintenance, including herbicide treatments
Special Forest Products (e.g., firewood cutting, mushroom picking)
Ongoing incidental road maintenance
Ongoing trail maintenance
Future Activities
Off-highway vehicle (OHV) Travel Management Environmental Impact Statement – Gibson Prairie OHV Area proposal
Site-specific invasive plant treatments
Warming huts on Surveyor's Ridge
Surveyor's Ridge Trail grant proposal for trail reconstruction
Hazard tree removal along roads
Future aquatic restoration projects

Setting the Stage

Since the North Fork Mill Creek Restoration Opportunities project is being prepared under the Healthy Forests Restoration Act, and is within the Wildland Urban Interface, the No Action Alternative is not required to be developed. Understanding what would occur should no action be taken, however, is as important to gaining an understanding of the effects of the Proposed Action and Alternative 2, as well as to helping the readers and the decision maker understand why this project fits the purpose of the Health Forests Restoration Act to:

> *…reduce the risk to communities,…and other at-risk Federal land through…implementing hazardous fuels reduction projects…and…protect, restore, and enhance forest ecosystem components…*

Both the Fire/Fuels (7/15/2008) and Silviculture (7/11/2008) Specialists Reports, by District Fuels Specialist, Leo Segovia and District Silviculturist, Kim Smolt respectively, give details on what is expected to occur over time without treatment. Both reports are summarized in this chapter.

Fire / Fuels Management

A more detailed fuels report is located in the project record, located at the Hood River Ranger District. The analysis and conclusions of the report are summarized below. Reference material is contained in the full specialists report.

Introduction

The North Fork Mill Creek Planning area lies within the Mill Creek watershed. This planning area encompasses approximately 6607 acres and is located in the northern portion of the Hood River Ranger District. Elevations range from 2200 to 4000 feet. The area is predominately Douglas fir, white fir, ponderosa pine, lodgepole pine, and western hemlock. Riparian areas are predominately Douglas-fir, western hemlock, and western red cedar. With an understory combination of maple, chinquapin, and rhododendron in the lower elevation in North Fork Mill Creek.

The Mill Creek Watershed Analysis was completed in 1994. Field reviews of the North Fork Mill Planning area have resulted in the determination that the fire/fuels report for the watershed analysis is inconsistent with the existing conditions on-the-ground. The watershed analysis attributes Native American influences on the vegetative condition. However, field reviews indicate little to no direct influence by Native Americans on the area. These Native American influences are found outside the planning area on the lower elevation areas of the watershed. In addition, the watershed analysis was completed based on fire groups rather than fire regimes. Fire regimes are the current national standard for assessing historical fire influences in the area, while fire groups were an early eastside attempt to map historical fire regimes.

Figure 3-1: 1937 Picture Mill Creek Look Out

Figure 3-2: 1992 picture Mill Creek Look Out

Existing Conditions

Historically, fires would have burned in this area every 35 to 200 years. Fire suppression activities in the past 100 years have not altered the historical development of the vegetation. However, the different land management practices such as timber harvest and the associated road development after 1855 have increased the risk in human caused fire. Both natural and human caused fires have changed the landscape and increased the risk of ignitions occurring.

Lighting strikes do occur in this planning area but are often accompanied by rain that puts many fire starts out. Fire suppression efforts have been used to put out small fires that were held over from lighting storms. In areas where high fuel loadings and ladder fuels are present extreme fire behavior would still occur as a result of an uncontrolled fire. This may pose a safety problem for fire suppression crews as well as the public.

The current road system provides adequate access for fire suppression. The North Fork Mill Creek Planning area had seven wildfires in the past ten years. The causes of ignition included: lighting, smoking, equipment, abandoned campfires and arson.

Fire history for the non-Forest Service ownership (Oregon Department of Forestry, Oregon Department of Fish and Wildlife, and private) near The Dalles Watershed Fuel Break planning area was not collected. Although several large fires have occurred in or near the watershed in the past 40 years, including Sheldon Ridge Fire in 2002 (12,500 acres), School Marm Fire (includes the Brown Creek fire) in 1967 (9,618 acres), and Dog River Fire in 1908 (unknown acres). These fires were generally wind driven from the west and were mixed to high severity events. Sheldon Ridge burned to the north of the watershed, School Marm burned from inside the watershed in an easterly direction, and the Dog River occurred in the Dog River drainage of the watershed (SW of the project area). The 2004 Dalles Watershed Analysis, Wasco County, references three other fires (> 10 acres) within the watershed near the Mill Creek Butte area, but no other data is given.

The planning area is roughly divided into four Fire Regimes: Fire Regime I 50 – 100 year mixed severity, Fire Regime IIIA 100 – 200 years mixed severity, Fire Regime III B 100 – 200 years stand replacing, and Fire Regime IIIC (see Table 3-2). Fire regime refers to the nature of fire occurring over long periods and the prominent immediate effects of fire that generally characterize an ecosystem. All four of these fire regimes areas consist of a full range of fuel loadings from light to heavy. These loadings are dependent on such factors as stand type, stand condition, fire history, and past management practices. Fire Regimes in the North Fork Mill Creek Planning area are all capable of sustaining a stand replacing wildfire. See Figure 3-3 for location of fire regimes.

Table 3-2: Fire Regime in the North Fork Mill Creek Planning Area

Fire Regime	Percent of Planning Area
Fire Regime I	47%
Fire Regime III A	14%
Fire Regime III B	39%
Fire Regime III C	14 acres not notable

Condition classes are a function of the degree of departure from historical fire regimes resulting in alterations of key ecosystem components such as species composition, structural stage, stand age, and canopy closure. One or more of the following activities may have caused this departure: fire exclusion, timber harvesting, grazing, introduction and establishment of invasive plant species, insects or disease (introduced or native), or other past management activities. The stands in the planning area composed of the three condition classes shown in Table 3-3, Table 3-4, and Figure 3-4.

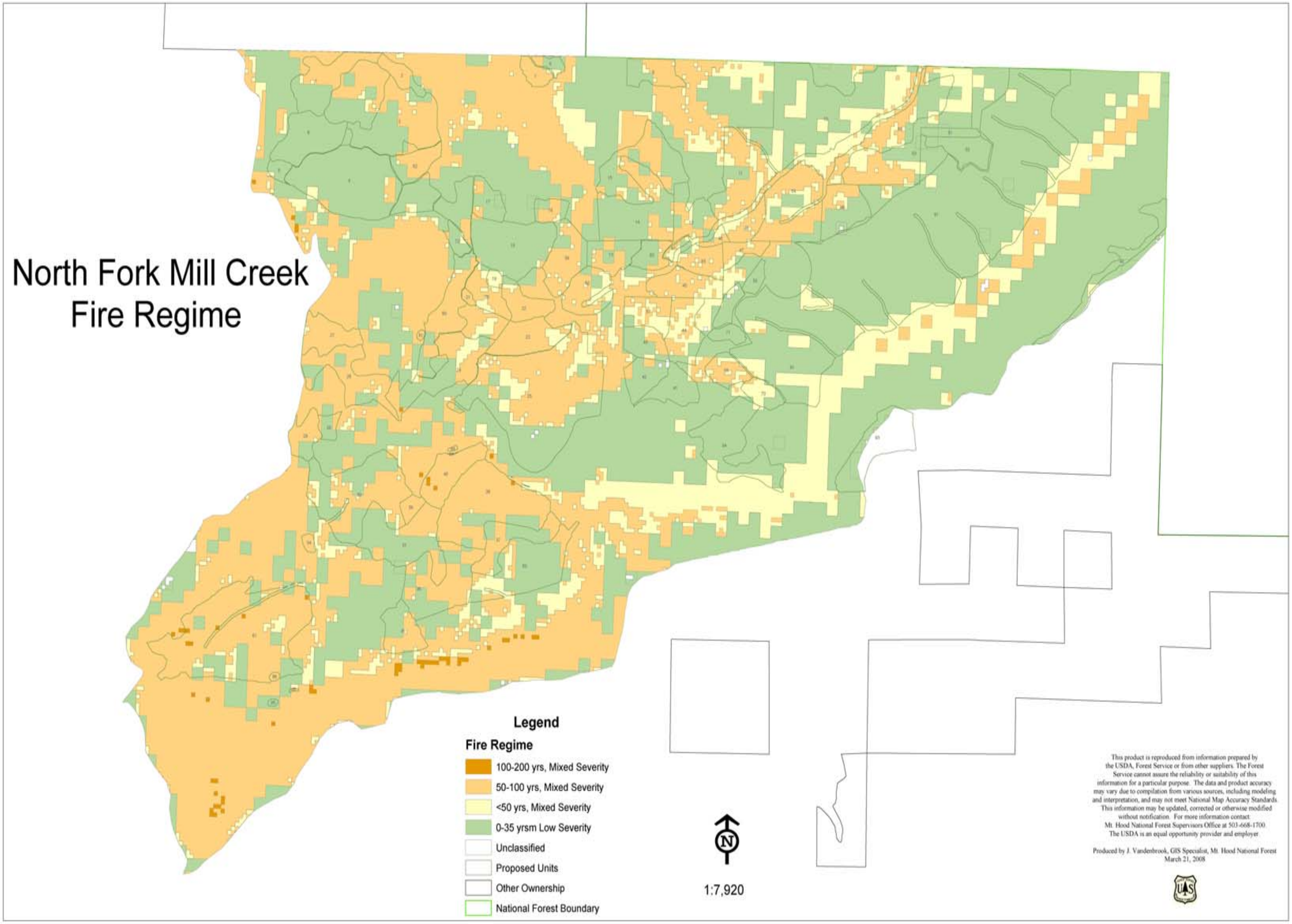

Figure 3-3: Fire Regime Map for Planning Area

Table 3-3: Fire Condition Classes in North Fork Mill Creek Planning Area

Condition Class	Attributes	Example Management Options
Condition Class 1	• Fire regimes are within or near an historical range. • The risk of losing key ecosystem components is low • Fire frequencies have departed from historical frequencies (either increased or decreased) by no more than one return interval. • Vegetation attributes (species composition and structure) are intact and functioning within an historical range.	Where appropriate, these areas can be maintained within the historical fire regime by treatments such as fire use.
Condition Class 2	• Fire regimes have been moderately altered from their historical range. • The risk of losing key ecosystem components has increased to moderate. • Fire frequencies have departed (either increased or decreased) from historical frequencies by more than one return interval. This change results in moderate changes to one or more of the following: fire size, frequency, intensity, severity, or landscape patterns. • Vegetation attributes have been moderately altered from their historic ranges.	Where appropriate, these areas may need moderate levels of restoration treatments, such as fire use and hand or mechanical treatments, to be restored to the historical fire regime.
Condition Class 3	• Fire regimes have been significantly altered from their historical range. • The risk of losing key ecosystem components is high. • Fire frequencies have departed (either increased or decreased) by multiple return intervals. This change results in dramatic changes to one or more of the following: fire size, frequency, intensity, severity, or landscape patterns. • Vegetation attributes have been significantly altered from their historic ranges.	Where appropriate, these areas need high levels of restoration treatments, such as hand or mechanical treatments. These treatments may be necessary before fire is used to restore the historical fire regime.

Table 3-4: Condition Class by percentage in the North Fork Mill Creek Planning Area

Condition Class	Percentage in Planning Area
Condition Class 1	48%
Condition Class 2	9%
Condition Class 3	43%

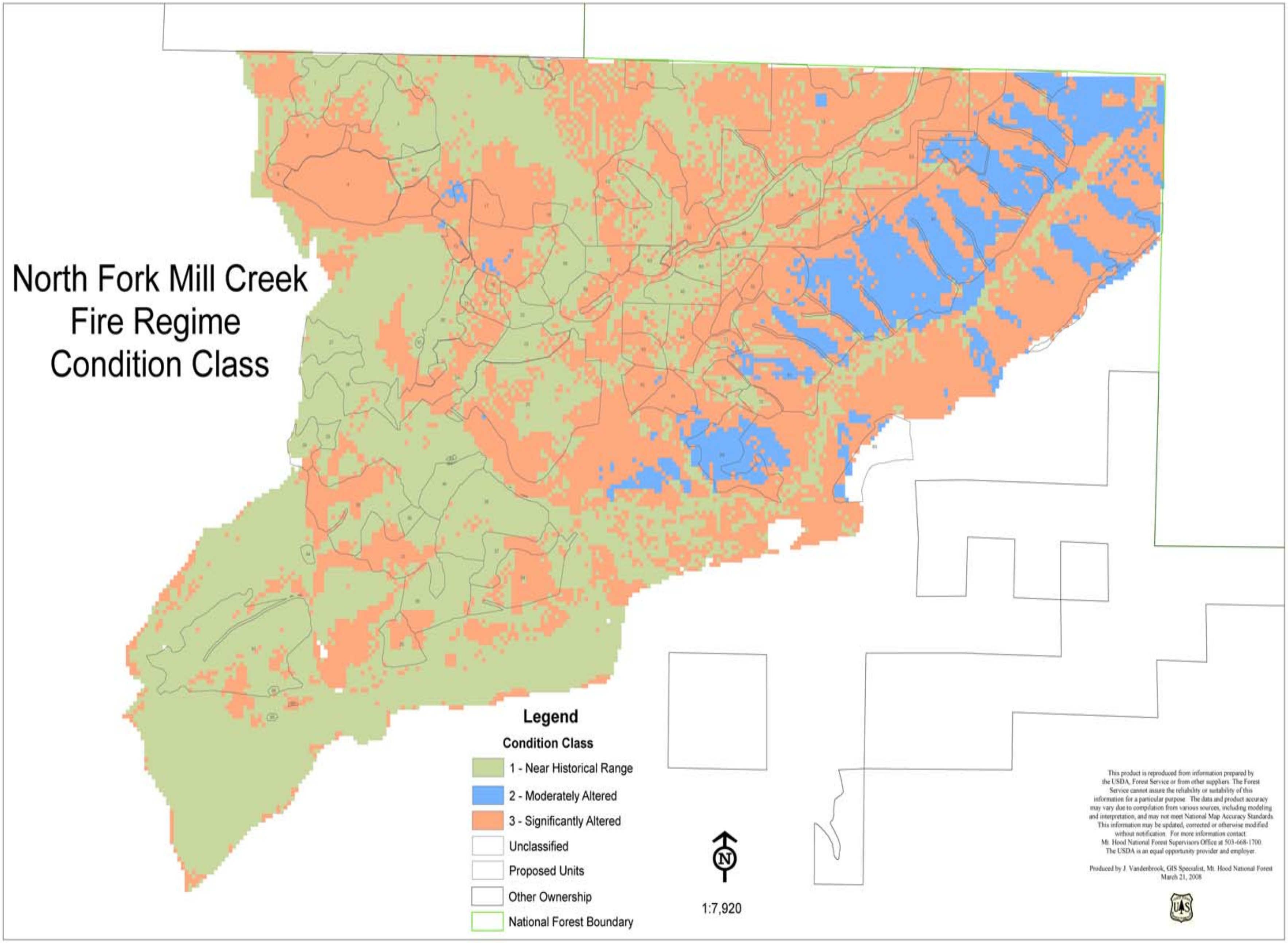

Figure 3-4: Condition Class Map for Planning Area

Cottonwood/Aspen Enhancement

Aspen are present in four areas in the North Fork Mill Creek Planning area (Figure 3-5), primarily found in moist areas along stream corridors. Aspen (Populus tremuloides) provide many ecological benefits including: protection of watersheds from erosion, protection against rapid wildfire advance, increased biological diversity in the species-rich grass-forb understory, wood fiber, wildlife habitat, forage for domestic livestock and native ungulates, recreational sites, aesthetic considerations (e.g., fall leaf colors), and more water yield than conifers (Bartos and Campbell 1998a). Decline of aspen stands is attributed to natural succession (e.g., invasion of conifers) (Harniss 1981), fire suppression (Jones and Debyle 1985), and over browsing by domestic livestock and native ungulates (Kay 1990). Western aspen, which reproduce primarily by suckering form lateral roots, often need disturbance to stimulate the suckering response (Schier 1981). Successful vegetative regeneration of aspen is dependent upon three key components: hormonal stimulation, growth environment, and protection of the resulting suckers. Each of these factors involves one or more of the silvical characteristics of aspen discussed above.

Any manipulation of aspen ecosystems has to satisfy all of these requirements to successfully regenerate the species. Manipulation techniques that are potentially available to perpetuate aspen stands include: Doing nothing, commercial harvest, prescribed fire, mechanical root stimulation, removal of vegetative competition, protection of regeneration from herbivory, and regenerating from seed. Choosing the appropriate technique for a given aspen stand depends upon its age, vigor, stocking, associated vegetation, accessibility, the abundance of other aspen in the landscape, and the importance ascribed to maintaining aspen at a particular location. None of the above techniques would be used in all situations.

Fire meets all the requirements of the aspen regeneration triangle. It stimulates suckering by killing overstory stems and by killing near-surface root segments and thereby interrupting the flow of auxin to surviving down stem root segments. Fire removes competing understory vegetation and conifer seedlings and it allows sunlight to reach the forest floor. The vegetation consumed by the fire provides a nutrient pulse for new suckers and the blackened surface warms soil in the root zone, further stimulating sucker growth (Hungerford 1988). In addition to stimulating aspen suckering, fire could also exert a large influence on soil properties in burned stands, depending on the intensity of the burn. Increases in plant available nutrients usually occur following fire because of the transfer of nutrients from the ash to soil (Schlesinger 1997). Fire is an important component in both establishing new stands of aspen and in assisting aspen in maintaining its position on the landscape (Jones and DeByle 1985). Conifers growing in the understory of aspen stands would eventually overtop the aspen canopy in the absence of fire or some other disturbance. In time aspen would disappear from that location on the landscape. If however, fire should consume both conifer and aspen overstory, the aspen root system would often survive.

Prescribed fire prescriptions in the North Fork Mill Creek Planning area would be developed to meet silivcultural objectives and to keep burn severity to a low and medium burn severity in and around moist areas in aspen stands found in the planning area. No hand lines would be constructed through the interior of any of the aspen stands. Hand lines in conjunction with wetlines would be utilized on the perimeter of the aspen stands as control lines to regulate prescribed fire spread. Historically sensitive aspen trees found in the planning area would be protected by pulling back debris from the base of leave trees. Reflective heat wrap would also be used in conjunction with pulling back of debris before ignition takes place. Fenced off enclosures would be recommend to aid aspen suckers becoming reestablished after prescribed fire. Enclosures would help reduce browsing pressure from deer, elk and livestock.

Figure 3-5: Historic Aspen Stand

Environmental Effects

Effective treatments to reduce fire hazard include treatments that lower existing fuel concentrations, lower future fuel concentrations, or decrease the ladder fuels (brush and small trees) which provide vertical connectivity into the crowns of the overstory trees. Commercial thinning, underburning, pruning, mowing, whip-felling, handpiling, and sapling thinning may be effective in reducing fire hazard.

The No Action alternative does not propose any projects in The North Fork Mill Creek Planning area and fire suppression would continue to occur.

Alternative 1 – Proposed Action would allow for a breaking up of continuous blocks of high fuel hazard areas. This breaking up of the high hazard areas would have an effect on a fire moving through the area as well as providing a safer area for suppression resources to either suppress new starts and in turn may alleviate some of the environmental damage and slow down the forward movement of the wildfire, thereby allowing for a higher success of suppression operations.

Alternative 2 would not allow for a breakup of continuous blocks of high fuel hazard areas. By not reducing the acres of the high hazard areas it would not reduce the effect on a fire moving through the area as well as providing a safer area for suppression resources to either suppress new starts. In turn it could not potentially alleviate some of the environmental damage and also slow down the forward movement of a wildfire fire, reducing the success of suppression operations.

Hand piling, pruning, burning, and underburning would reduce fuel loadings, fuel bed depth, and understory vegetation (ladder fuels). Mowing would reduce fuel bed depths and understory vegetation, but would not decrease fuel loadings. Underburning after the mowing would reduce the fuel loading and maintain manageable fuel conditions for future maintenance.

No Action Alternative – Direct and Indirect Effects

The No Action Alternative proposes no projects and fire suppression would continue to occur. In the short-term (one to five years), the fire hazard would remain constant, at a high risk. In the future, dead or dying trees would fall down increasing the fire hazard. Natural fuels (pine needles and other dead vegetation) would continue to accumulate. Natural processes of decay are not likely to remove the down and dead woody debris before the next fire cycle. As the available fuel increases, so would the potential for a large stand replacing wildfire event.

The risk of injury to the public and firefighters would increase as the fuel loadings and fire hazards increase. Larger, fast moving, higher intensity fires would put the public and firefighters at an increased risk to injury or death. Suppression costs would increase due to larger fires and the increased need for mechanized equipment and aircraft. Resource damage caused by fire suppression efforts would increase. There would be an increased threat of damage to the North Fork Mill Creek Planning Area.

When large amounts of dead and down debris increase and there is an increase in ladder fuels, a fire would burn very hot and exhibit extreme fire behavior. Such fire behavior could result in loss of productivity and biodiversity in the stands, surface soils could be severely damaged, and it could take many years to restore the ecosystem.

Overall, the North Fork Mill Creek Planning area would be left in its current condition. Air quality would remain unaffected, until a large fire event occurred. The Dalles and/or Hood River Valley would be impacted by such an event, with very high particulate matter imparted into the local air sheds, with potential health effects.

Proposed Action Alternative – Direct and Indirect Effects

Alternative1 would treat a total of 2885 acres, 1177 with mechanical thinning, 954 acres of thinning and burning, 26 acres of sapling thinning, 45 acres of aspen enhancement and 684 acres with prescribed burning only. This is about 42 percent of the 6607 acres of the planning area. This would reduce overall fuel loadings, thereby decreasing the Flame Length (FL) and Rate of Spread (ROS) in the event of a fire start in these areas, allowing suppression forces to safely and effectively contain and control a fire in the area of the Planning area

Thinning would reduce the ladder fuel component in stands that are overstocked, allowing for suppression forces to contain and control future fire starts more efficiently and safely, thus reducing the risk to private property.

Opening crown spacing to reduce the probability of a wildland fire transition from a surface fire to a crown fire has some trade offs. For example, thinning opens up stands to greater solar radiation and wind movement, resulting in warmer temperatures and drier fuels throughout the fire season. Also, activity fuels from thinning or pruning may result in increased fuel load, unless mitigated as an integral part of the treatment. These side effects of canopy fuel treatment must be considered when determining the overall effect of a treatment on potential fire behavior. Although opening the crown spacing could increase surface rates of spread, it also makes the fire easier to control and even under severe weather conditions an open stand is less likely to support a crown fire (Graham & McCaffery, 2003). Even though there is an increase in the rates of spread, flame lengths and fire line intensities are reduced to a level that could allow for initial attack by fire line personnel. When surface fires frequently burn, they tend to minimize surface and ladder fuel accumulations, which decreases the likelihood that crown fires would develop.

Low severity surface fires were relatively common (generally occurring every 4 to 25 years) in dry ponderosa pine and Douglas-fir forests prior to the 20th century (Agee 1993, Hann and others 1997). An appropriate fuel treatment would be a strategy of thinning (removing ladder fuels and decreasing tree crown density) followed by prescribed fire, piling and burning of fuels or other mechanical treatments that reduce surface fuel amounts. This approach would reduce canopy ladder and surface fuels, thereby reducing both fireline intensity and rates of spread severity and severity of potential wildfires (RMRS-GTR-120). Fuel models currently found in the North Fork Mill Creek planning are fuel models 2, 8, 9, and fuel model 10. Fuel models 9 and 10 are the predominant fuel models found in the planning area.

Thinning followed by slash treatment at the Haymen fire and Davis fire sites produced the most impressive results, with less than 80 percent canopy scorch while adjacent untreated areas were nearly completely consumed (Chong, Martinson, and Omi 2007). For example modifying a fuel model profile from a fuel model 10 (currently found in the North Fork Mill Creek planning area) to a fuel model 8 would alter rates of spread and flame lengths to a more manageable condition. This would allow land managers to conduct prescribed burns with less difficulty, less smoke and less risk of the fire escaping. For comparison purposes, Fire Behavior runs were done using Behave Plus 4.0.0. Tables 3-5 to 3-10 illustrates the differences in rate of spread, flame length and probability of mortality; and Figures 3-6 and 3-7 shows an example of fuel models.

Table 3-5: Fuel Model 8 Rate of Spread

Surface Rate of Spread (maximum) (ch/h)					
Mid flame wind speed	**10 % slope steepness**	**20 % slope steepness**	**30 % slope steepness**	**40 % slope steepness**	**50 % slope steepness**
2.0	1.1	1.2	1.5	1.8	2.3
4.0	2.3	2.4	2.7	3.0	3.5
6.0	3.9	4.0	4.3	4.6	5.1
8.0	5.7	5.8	6.1	6.4	6.9
10.0	7.8	7.9	8.2	8.5	9.0
12.0	10.0	10.0	10.0	10.0	10.0
14.0	10.0	10.0	10.0	10.0	10.0
16.0	10.0	10.0	10.0	10.0	10.0
18.0	10.0	10.0	10.0	10.0	10.0
20.0	10.0	10.0	10.0	10.0	10.0

Rate of Spread: A three person engine crew could build fire hand line12 ch/h with hand tools.

Table 3-6: Fuel Model 8 Flame Lengths

Flame Length (ft)					
Mid flame wind speed	**10 % slope steepness**	**20 % slope steepness**	**30 % slope steepness**	**40 % slope steepness**	**50 % slope steepness**
2.0	0.9	1.0	1.1	1.2	1.3
4.0	1.3	1.3	1.4	1.5	1.6
6.0	1.7	1.7	1.7	1.8	1.9
8.0	2.0	2.0	2.0	2.1	2.2
10.0	2.3	2.3	2.3	2.4	2.4
12.0	2.6	2.6	2.6	2.6	2.6
14.0	2.6	2.6	2.6	2.6	2.6
16.0	2.6	2.6	2.6	2.6	2.6
18.0	2.6	2.6	2.6	2.6	2.6
20.0	2.6	2.6	2.6	2.6	2.6

Flame Length: Four foot flame lengths are the limit fire line personal could safely and efficiently construct hand lines near a fire with hand tools.

Table 3-7: Fuel Model 8 Probability of Mortality

Probability of Morality (%)					
Mid flame wind speed	**10 % slope steepness**	**20 % slope steepness**	**30 % slope steepness**	**40 % slope steepness**	**50 % slope steepness**
2.0	7 %	7 %	7 %	7 %	7 %
4.0	7 %	7 %	7 %	7 %	7 %
6.0	7 %	7 %	7 %	7 %	7 %
8.0	7 %	7 %	7 %	7 %	7 %
10.0	7 %	7 %	7 %	7 %	7 %
12.0	7 %	7 %	7 %	7 %	7 %
14.0	7 %	7 %	7 %	7 %	7 %
16.0	7 %	7 %	7 %	7 %	7 %
18.0	7 %	7 %	7 %	7 %	7 %
20.0	7 %	7 %	7 %	7 %	7 %

Probability of Mortality is the likelihood that a tree will be killed by a fire.

Figure 3-6: Example of a Fuel Model 8

Table 3-8: Fuel Model 10 Rate of Spread

Surface Rate of Spread (maximum) (ch/h)					
Mid flame wind speed	**10 slope steepness**	**20 slope steepness**	**30 slope steepness**	**40 slope steepness**	**50 slope steepness**
2.0	3.8	4.3	5.2	6.4	8.0
4.0	8.2	8.7	9.6	10.8	12.4
6.0	13.7	14.2	15.1	16.3	17.9
8.0	20.0	20.6	21.4	22.7	24.3
10.0	27.1	27.7	28.5	29.8	31.3
12.0	34.9	35.4	36.3	37.5	39.1
14.0	43.2	43.7	44.6	45.8	47.4
16.0	52.0	52.6	53.4	54.7	56.2
18.0	62.4	61.9	62.8	64.0	65.6
20.0	71.2	71.7	72.6	73.8	75.4

Rate of Spread: A three person engine crew could build fire hand line12 chains per hour with hand tools. The areas highlighted in yellow are outside the capability of a three person engine for handline production.

Table 3-9: Fuel Model 10 Flame Lengths

Flame Length (ft)					
Mid flame wind speed	**10 slope steepness**	**20 slope steepness**	**30 slope steepness**	**40 slope steepness**	**50 slope steepness**
2.0	3.8	4.1	4.4	4.9	5.4
4.0	5.5	5.6	5.9	6.2	6.6
6.0	6.9	7.1	7.2	7.5	7.8
8.0	8.3	8.4	8.5	8.7	9.0
10.0	9.5	9.6	9.7	9.9	10.2
12.0	10.7	10.7	10.9	11.0	11.2
14.0	11.8	11.8	11.9	12.1	12.3
16.0	12.8	12.9	13.0	13.1	13.3
18.0	13.8	13.9	14.0	14.1	14.3
20.0	14.8	14.9	14.9	15.1	15.2

Fuel Model 10 Flame Length: Four foot flame lengths are the limit fire line personal could safely and efficiently construct hand lines near a fire with hand tools. The areas highlighted in yellow are over four foot flame lengths, and are too intense for direct attack by fire line personal.

Table 3-10: Fuel Model 10 Probability of Mortality

Probability of Mortality (%)					
Mid flame wind speed	**10 % slope steepness**	**20 % slope steepness**	**30 % slope steepness**	**40 % slope steepness**	**50 % slope steepness**
2.0	8 %	9 %	11 %	16 %	25 %
4.0	19 %	22 %	27 %	37 %	51 %
6.0	41 %	45 %	5 %	61 %	72 %
8.0	62 %	66 %	71 %	77 %	82 %
10.0	76 %	78 %	81 %	84 %	88 %
12.0	84 %	85 %	86 %	88 %	90 %
14.0	88 %	88 %	89 %	91 %	92 %
16.0	90 %	90 %	91 %	92 %	93 %
18.0	92 %	92 %	92 %	93 %	93 %
20.0	92 %	93 %	93 %	93 %	94 %

Figure 3-7: Example of a Fuel Model 10

Prescribe burning would have a two to three day impact on local airshed/air quality. This would include underburning and burning of handpiles. Units would be burned under conditions that minimize impacts to protected and sensitive areas, and would move smoke away from populated areas in the least amount of time

Fuels Treatments
Commercial timber, Aspen enhancement and harvest Natural fuels (litter, brush, and trees) would be treated in Alternative 1. Treatment methods would be hand piling, pile burning, underburning, mowing and harvesting. The treatments would be used over a large area to reduce the fuel loadings and modify the fuel profiles of the planning area.

Commercial Timber harvest and sapling thinning
Treatment of any residual surface left over from timber harvest would be machine piled and burned. Underburning could also be used to treat any residual fuel left on harvested units. Surface fuels would be reduced to 15 tons per acre.

Aspen Enhancement
Thinning and underburning of aspen stands in the planning area would promote regeneration. Fire would stimulate suckering by removing overstory stems and stimulating root segment near the surface. Underburning would also remove competing understory vegetation and conifer seedlings and allow sunlight to reach the forest floor.

Hand Piling
The piling of understory brush, small trees, and down dead woody material by hand crews, into piles of woody debris that may be later burned or utilized. Chainsaws and hand tools would be used to cut the material to aid in the piling operation. The piles would be burned during the fall season.

Effects: Ladder fuels are reduced as a result of the piling of brush and small trees. The fuel loading is reduced by the piling of the down dead woody material. The piles are burned in the fall season. Effects of this treatment on the stand are possible damage to residual trees, vegetation or soil when the pile is burned. Scorch of residual trees could occur if the pile is located too close to the dripline of residual trees.

Pile Burning
Burning the created landing and/or hand piles. The hand piles would contain woody material from brush, small trees, and other dead woody material found on the surface. The landing piles would contain the woody material (limbs, needles, bark and portions of the trunk) removed from trees during the harvesting procedure. Landing piles are much larger than the hand piles. This disposes of the piled fuel concentrations. The pile burning would occur in the fall season. A burn plan would be written which outlines the parameters under which the burning would occur.

When possible, utilization of piles would be encouraged rather then burning. Utilization is very dependent on existing market conditions. In past years, firewood has been salvaged from landing material on several timber sales. Also, landing piles could be utilized by the public to cut fire wood for local home use. After salvage operations, there is a small amount of clean up remaining, which consists of burning the residual piles.

Effects: Burning the pile eliminates the high concentrations (fuel loading) of woody material when the pile was created. Soil moistures and conditions (wet, frozen or dry) would have a strong influence on the effects of the fire on the soil. Soil microorganisms could be killed in areas of severely burned soil. Areas directly beneath and immediately adjacent to the burning piles would be affected. This damage would occur in the areas of large piles that maintain longer durations of heat. The effects of burning piles on the soil could be minimized by limiting the size of the piles and the amount of moisture in the soil. Pile burning is normally accomplished in the late fall after adequate moisture, either rain or snow, is present to prevent the spread of the piles. This timing would also limit the effects on the soil. Localized reductions in organic matter, loss of soil productivity in the immediate area and reduced water infiltration could result. Local, short-term effects on air quality would occur. These effects would include increases in carbon dioxide, carbon and particulates in the airshed. Cumulative effects of multiple burns in the same geographic area could contribute to a decrease in the air quality. Scorching of tree crowns is possible where landing piles are located close to residual leave trees. This scorching could result in tree mortality or reduced vigor. Trees killed by scorch could be left as future snags for wildlife benefits if not felled for public safety.

Escaped fires resulting from unexpected weather may occur and cause damage to the surrounding vegetation. Piles would need to be monitored and extinguished if weather conditions show that damage from escape would occur.

Mowing/Mastication
The treatment consists of mowing the understory of brush, small trees, and other vegetation. A mowing attachment is towed behind a dozer or tractor, or attached to the head of an excavator. The vegetation is chopped into small pieces and left on the surface.

Effects: Ladder fuels are reduced by mowing. Effects of this treatment on units are possible damage to residual trees due to scraping while the machine is maneuvering through units.

Underburning

Underburning is the use of prescribed fire underneath existing or residual trees to treat natural and /or created fuels such as, dead woody material, needle litter and dead brush. The majority of the units in the project area would require thinning and/or mowing before underburning could be done safely and effectively. Underburning unit boundaries would be coordinated with individuals from archaeology, silviculture, fire management and the Tribes. In most of the units needing to be underburned, the burning would be completed one to four years after the original hand piling or mowing. Most brush and some young trees are consumed or killed during this treatment. The underburning is conducted in the spring and fall seasons. A burn plan would be written which outlines the parameters under which the burning would occur.

Effects: The treatment reduces the total fuel accumulation and fuel ladders. The effects on trees vary by species, size and bark thickness. Ponderosa pine is a fire tolerant species that has evolved with fire and is able to withstand low to moderate intensity fires. Other tree species such as Douglas-fir and grand fir are less fire tolerant then ponderosa pines and are susceptible to more damage and higher mortality rates, particularly in the smaller size classes. Some trees would die due to crown scorch, ladder fuels carrying the fires through the tree crown, and large fuel accumulations around the tree base could cause cambium damage. Root damage and tree mortality could occur if soil moistures are too high or residual heat created by large fuel accumulations occurs. During any burning operation, a possibility exists that a burn may escape control and become a wildfire. All firelines would be completed by hand, mechanical equipment, or small all-terrain vehicles (ATV) pulling a fireline plow. Firelines should be rehabilitated after burning if there is a possibility of resource damage.

The effects of underburning on the soil and litter layer are dependent on the intensity of the burn. If soil temperatures are too hot, detrimental soil conditions could occur. To limit soil impacts and to meet other management objectives, these underburns would need to be of a low to moderate intensity. The duff or litter layer should not be reduced by more than 50 percent. Additionally, the fire would release nutrients stored in the litter and slash and allow these nutrients to become available for the remaining stand. These nutrients are especially valuable to the establishment of new growth after a fire. Burn plans should specify fuel amounts consumed in each size class.

Seedlings, saplings, brush and grasses would be consumed or killed during the underburning. Sprouting of the grasses and brush may occur if soil moistures and seed sources are receptive. This sprouting would create browse for foraging animals. Seeds and saplings may need to be fire lined for protection, for future stocking levels to be met (see silviculture prescriptions). Large dead, down and woody debris materials could be consumed during burning. Some of the large down may be consumed, but due to the nature of the fuel reduction, and consultation with the Eastside Wildlife Biologist, this is acceptable as the scale of the area treated is small compared to the entire landscape of the planning area.

Fire’s effect on bitterbrush varies widely and is difficult to predict. Generally, fire would kill the tops of the plants. It is documented that bitterbrush would resprout after fire and that it would regenerate from seed either cached in the ground or from seeding in, from adjacent stands. However the success of resprouting varies greatly often depending on site specific qualities and we could not currently predict a successful response from resprouting. Additionally, younger plants seem to resprout better then older ones. Underburning in bitterbrush plant communities should be monitored to determine when second entry underburning should occur. The historic fire return intervals of 15 years were too frequent to allow bitterbrush to survive in any quantity across the landscape.

Local, short-term effects on air quality would occur. These effects would include increases in carbon dioxide, carbon and particulates (PM 2.5 & 10 microns) in the airshed. Cumulative effects of multiple burns in the same geographic area could contribute to a decrease in the air quality.

Fireline Construction
In the units to be underburned, firelines would need to be constructed to serve as control lines during burning operations. Existing roads or skid trails would be utilized as firelines where practical. The firelines would be constructed either with hand crews with hand tools, with a small plow pulled by an ATV, or with another form of mechanized equipment (if needed due to fuels or topography). Firelines would be constructed to minimum standards needed to control the burns. Normally a 4 to 6 foot clearing with a 1 to 1.5 foot wide mineral soil line would be sufficient. The clearing would be cleared of all downed woody fuels, no duff, grasses or other ground cover would need to be removed. Brush may need to be cut out if line locations could not avoid them.

Effects: The mineral soil line has the potential to channel water which could cause erosion. The construction of water bars in the firelines would serve to limit erosion problems. Water bars would be constructed on all slopes greater than 10 percent. The erosion potential would decrease over time as normal needle cast and other litter starts to cover up the firelines. This process would start within one year and the lines should be completely covered in three to five years.

Combined fuel treatments
In some instances a combination of treatments would occur in the same unit, such as mowing/mastication, thinning, piling, pile burning, and underburning. Underburning would occur at least one year, and possible several years after other treatments (hand pile, pile burn, thinning, and/or mastication).

All prescribed burning would occur under the guidance of a site specific burn plan that would be developed for each burn area prior to ignition. The burn plan includes the weather and fire behavior prescriptions, resource needs, contingency plans, mitigations, smoke management requirements, lighting techniques, risk assessment, hazard analysis, and site specific resource objectives. Burn plans are written in accordance with the current 5140 directive (FM-5140), and must meet all required elements prior to approval of the plan by the Forest Supervisor.

Alternative 2 – Direct and Indirect Effects
Alternative 2 would treat approximately 1277 acres, 68 acres with mechanical thinning, 537 acres of thinning and burning, 25 acres of sapling thinning, 47 acres of aspen enhancement and 610 acres with prescribed burning only. This is about 19 percent of the planning area. This alternative would not allow for a breakup of continuous blocks of high fuel hazard areas. By not reducing the acres of the high hazard areas it would not reduce the effect on a fire moving through the area as well as providing a safer area for suppression resources to either suppress new starts. In turn it could not alleviate some of the environmental damage and also slow down the forward movement of a wildfire fire, reducing the success of suppression operations.

The impacts from reducing the fuel loadings to specific fuel models, and the impacts from the various fuel treatments are the same as described above for Alternative 1.

Summary of Effects for Alternatives 1 and 2
Fuel treatments would have a direct effect on canopy base height and crown bulk density. Commercial

and non-commercial fuel treatments would raise the average canopy base height by thinning from below and reduce horizontal canopy continuity. Underburning would also scorch the lower live limbs and help raise canopy base height. Where currently the treatment units have a general height of 1 to 8 feet to the base of the average lower canopy, there would be an increase to around 15 to 20 feet. This would also have an effect of reducing the overall crown bulk density. By increasing average canopy base heights, surface fires would have a greater tendency to stay on the ground and not ignite larger tree canopies. Horizontal canopy bulk crown density would be reduced, thus reducing crown fire sustainability.

Fire spreads by burning through surface fuels and by spotting. Spotting is greatly enhanced when torching and crowning loft fire brands in the convection column. These fire brands could cause spot fires over ½ mile away from the main fire. Fires that spread by spotting are much more difficult to contain than fires spreading through the surface fuels.

The proposed reduction of canopy, ladder and surface fuels would greatly reduce the potential for long range spotting from the treatment units. A passive or active crown fire burning towards a treated area may spot into it or burn on the surface and in the crowns as it reaches it, but fire would drop to the surface upon entering the treated area and intensities would be reduced allowing suppression resources a better opportunity at containment in all but the most extreme conditions.

In terms of historic conditions the main difference between the two alternatives is the number of acres within the planning area that are moved from a condition class 2 or 3 to a condition class 1. As described previously, condition class 1 (CC1) stands are at or near their historical range of conditions. Condition class 2 (CC2) are areas that have missed at least one fire return interval and are considered in a moderately altered condition from the historical range in attributes such as vegetation species composition and structure. Condition Class 3 (CC3) are areas where fire frequencies have departed by multiple return intervals and vegetation attributes are considered to be in a significantly altered condition. Management actions that can effect a change in condition class are those that remove fuels and include (but are not limited to) mechanical thinning which removes fuels from the site, piling of fuels and burning.

The emphasis of the proposed mechanical thinning treatments under Alternative 2 to focus on those stands which were less than 80 years old and were areas that had some level of regeneration (clearcut, shelterwood, seedtree) harvest prescribed in the past. Generally, these stands would be classified as either a CC1 and CC2 and also include areas that would meet the definition of CC3. For Alternative 2 the area prescribed for mechanical treatment (thinning, thinning plus burning, and aspen/cottonwood enhancement) is approximately 667 acres. In addition, around 610 acres are identified for prescribed burning treatments. These areas are located in the easternmost portion of the planning area and are currently classified as either CC2 or CC3. The CC2 areas are generally those grassy meadow areas with conifer encroachment from the adjoining stringers of timber located in the draws and riparian areas. The timbered stringers would generally be classified as CC3. Proposed treatment in these areas include pretreatment by hand of understory vegetation followed with prescribed fire to reduce fuel loadings. Post treatment condition is expected to be a CC1 in the grassy areas and the timbered stringers would be moving towards a CC2. In order to protect other resource values (water quality and wildlife habitat), treatments in the timbered stringers need to be lighter than what probably would have occurred naturally if fire had burned through the area. Overall, this alternative would result in moving, or maintaining, 1277 acres (19%) in a state that has fuel loadings and vegetation attributes more indicative of historic conditions.

For Alternative 1 (the proposed action) the stands proposed for treatment are not only the 667 acres of stands less than 80 years old, but also an additional 1525 acres of stands that are over 80 years old. These stands range in classification from Condition Class 1 through Condition Class 3 Proposed thinning and fuels treatments (burning, piling, mastication) in these stands would move those areas into a state more indicative of Condition Class 1 or Condition Class 2. The area proposed for prescribed burning (610 acres) is the same as for Alternative 2. Overall, this alternative would result in moving, or maintaining, 2802 acres (42% of the area) in a state that has fuel loadings and vegetation attributes more indicative of historic conditions.

- No Action alternative does not propose any projects in The North Fork Mill Creek Planning area and fire suppression would continue to occur.

- Alternative 1 – Proposed Action would allow for a breaking up of continuous blocks of high fuel hazard areas. This breaking up of the high hazard areas would have an effect on a fire moving through the area as well as providing a safer area for suppression resources to either suppress new starts in turn may alleviate some of the environmental damage and also slow down the forward movement of the wildfire, allowing for a higher success of suppression operations.

- Alternative 2 would not allow for a breakup of continuous blocks of high fuel hazard areas. By not reducing the acres of the high hazard areas it would not reduce the effect on a fire moving through the area as well as providing a safer area for suppression resources to either suppress new starts. In turn, it may not alleviate some of the environmental damage and also slow down the forward movement of a wildfire fire, reducing the success of suppression operations.

Old growth left in the Planning area would benefit from reduced potential mortality from the effects of fire. The other characteristics of old growth would be sustainable through time if future repeated maintenance fire is used every 15-30 years.

Treatments of underburning would be done over two entries around 5 years apart to reduce surface fuels while maintaining visual objectives. To achieve the level of surface fuel reduction needed, prescribed fire intensities could have the potential to heavily scorch and/or torch individual and small groups of trees. These effects could be lessened by utilizing a lower intensity initial underburn that would consume a good portion of the fine fuels while avoiding stark changes in visual quality.

Roads would be utilized as much as possible for underburn perimeters to lessen the need to construct firelines. Approximately 3 miles of hand fireline would need to be constructed by handcrews for the underburning proposed. Handlines would be constructed using hand tools or with a small plow pulled by an ATV leaving 12 to 18 inches wide of bare ground that would create a barrier to surface fire spread. Fires create potential for erosion and waterbars would be constructed on firelines as described in the soils section. Water bars used during burning would be angled into the burn area to catch any burning material that rolls down the fireline to direct it back into the fire. After underburns are declared out, the waterbars would be angled away from the burn area to direct water flow out of the burn to prevent erosion in the ash.

Future fire suppression costs have the potential to be reduced within the next 15 to 25 years because of anticipated reduction in future fire intensity. These reduced intensities would give more options to fire suppression managers and resources during suppression actions.

The road decommissioning/closures, trail construction, and culvert removal/replacement components of

Alternatives 1 and 2 do not have any impact on fuels.

Cumulative Effects for All Alternatives

Cumulative effects examine the effects of the alternatives taken in combination with past, present and reasonably foreseeable actions. The cumulative effects analysis includes the area bordered on the south by The Dalles Watershed Fuelbreak Project as well as the Billy Bob Hazardous Fuels Reduction project and past harvest activities.

No Action Alternative. Under the No Action Alternative, impacts to the current fuels profile in the projects area would be negligible in the short-term and moderate to high in the long-term. The No Action Alternative implies continuance of current conditions and current management and exacerbation of the currently overstocked fuels conditions. Ignitions would continue to occur. Under the No Action Alternative, fuel conditions would continue to move to a dense high dead to live ratio situation. Resistance to control would increase while the ability to provide for firefighter and public safety would continue to decrease. Ignitions can be anticipated to move both on to and out off The North Fork Mill Creek Project Area in the absence of human made or natural barrier to fire.

Alternative 1. The North Fork Mill Creek Planning area under Alternative 1 would benefit from by commercial harvesting, thinning, aspen enhancement and underburning 2885 acres out of 6600 acres in the planning area. Because Alternative 1 treats a substantial portion of the landscape, the vegetation would move towards conditions that would have occurred under a natural disturbance regime. This would lower flame lengths, reduce fire spread and lower the probability of tree mortality in the event of a wildfire, leading to more successful suppression efforts. Aerial delivered retardant or water would be more effective in lighter fuels and a more open canopy, making it safer for firefighters to successfully anchor and contain wildfires before damaging private and state lands.

Past actions affecting the project area under this alternative are past timber harvesting and insect infected trees. Additional past, connected reasonable foreseeable future actions that could affect the fuels profile include fuels reduction projects, including The Dalles Watershed Fuelsbreak and Billy Bob Fuels Hazardous Fuels Reduction project.

Alternative 1 – Proposed Action would enhance the effectiveness of the neighboring fuels reduction projects by reducing the likelihood of an intense wildfire starting in either The Dalles Watershed or in the North Fork Mill drainage in treated areas. This would be done by breaking up continuous blocks of high fuel hazard areas. There is a possibility of smoke intrusion in the communities of the Hood River Valley, Moiser, The Dalles, Dufur, and areas within the Columbia River Gorge National Scenic Area. All prescribed burning would be scheduled in conjunction with the State of Oregon to comply with the Oregon Smoke Implementation Plan (FW-040) and to minimize the adverse effects on air quality. Burning prescriptions would be developed to minimize the potential for adverse effects. Implementation of these measures would ensure compliance with the Clean Air Act. See the Air Quality/Smoke Management section for more details.

Alternative 2. The North Fork Mill Creek Planning area under Alternative 2 would benefit from by thinning, aspen enhancement and underburning 1277 acres out of 6600 acres in the planning area. This treatment is less than 20 percent of the North Fork Mill Creek Planning area. Wildland fire behavior would be altered in treated stands. Much of the existing condition would be maintained. Fuel levels would remain high until an uncontrolled wildfire occurred. Wildfires not immediately controlled could be expected to be stand replacing events due to high fuel levels. This alternative would continue to perpetuate the current condition of vegetation in the North Fork Mill Creek Planning area which has been influenced by past fire suppression activities.

Past actions affecting the project areas under this alternative are past timber harvesting and insect infected trees. Additional past, connected reasonable foreseeable future actions that could affect the fuels profile include fuels reduction projects, including The Dalles Watershed Fuelbreak and Billy Bob Hazardous Fuels Reduction project. Alternative 2 would not be as effective as Alternative 1. Alternative 2 would not allow for a breakup of continuous fuels blocks of high hazard areas. There would still be the a possibility of smoke intrusion in the communities of the Hood River Valley, Moiser, The Dalles, Dufur, and areas within the Columbia River Gorge National Scenic Area . All prescribed burning would be scheduled in conjunction with the State of Oregon to comply with the Oregon Smoke Implementation Plan (FW-040) and to minimize the adverse effects on air quality. Burning prescriptions would be developed to minimize the potential for adverse effects. Implementation of these measures would ensure compliance with the Clean Air Act. See the Air Quality/Smoke Management section for more details.

Air Quality / Smoke Management

Existing Conditions

Air quality is of particular concern on the Mt. Hood National Forest Airsheds. Airshed is defined as a geographical area that, because of topography, meteorology, and climate, share the same air (Boutcher 94; MHFP, Glossary-1). Portions of the Mt. Hood Wilderness are federally designated as a Class I Airshed (MHFP, FW-046, and FW-047). The Mt. Hood Wilderness is six miles Southwest of the North Fork Mill Creek Planning area. The Badger Creek Wilderness, a Class II Airshed is nine miles south of The North Fork Mill Creek Planning area. The city of the Dalles is a state receptor site is 12 miles Northwest of the planning area. Management activities shall comply with all applicable air quality laws and regulations, including the Clean Air Act and the Oregon State Implementation Plan (MHFP, FW-040). Also, in compliance with the Clean Air Act, the Forest Service is operating under the Oregon Administrative Rule OAR 629-43-043. The Forest Service is complying and would continue to comply with the requirements of the OSMP (Oregon Smoke Management Plan), which is administered by the Oregon Department of Forestry.

Smoke management is defined as: The management of fuel treatments from forest activities so that there is no or reduced effect to local areas surrounding the project. This primarily deals with impacts to people or air quality.

The effects of smoke management from activity created fuels on the surrounding area are described below and the procedures and guidelines followed when utilizing prescribed fire as a management tool. All Forestwide Standards and Guidelines for Air Quality FW-039 thru FW-053 (LRMP-MTF, 4:51-52) would be followed to minimize problems of Forest burns affecting air quality in local communities. All prescribed burning activities would comply with Forest Service Manual direction (FSM 5100, Chapter 5140)

Currently, and in the future, all planned ignitions are and would be conducted according to the Operational Guidance for the Oregon Smoke Management Program (OSMP). The Operational Guidance contains the direction for meeting the terms of the OSMP. The Environmental Protection Agency has approved the OSMP as meeting the requirements of the Clean Air Act, as amended. The OSMP, which is administered by the Oregon State Forester, regulates the amount of forestry related burning that could be done at any one time. The amount of burning that could occur on any one day depends upon the specific type of burning, the tons of material to be burned, and the atmospheric conditions available to promote mixing and transportation of smoke away from sensitive areas. For each activity requiring prescribed fire, the Forest Service requires a written, site-specific prescribed burning plan approved by the appropriate Line Officer. The purpose of the plan is to ensure that resource management objectives are clearly defined and that the site, environment, or human health is not harmed. The plan contains a risk assessment to quantify the chance of fire escaping and develops a contingency plan for actions taken to prevent escape and, if it does, quickly contain the escape. The plan would be implemented to minimize the possibility of any prescribed burn affecting Class I or other "smoke sensitive" areas in accordance with the OSMP.

The size class distribution for wood smoke particles is such that 82 percent of the particles range between 0.01 and .099 microns, 10 percent range between 1.0 and 4.99 microns, and 8 percent range between 5.0 and 15.0 microns. The most efficient particle size for scattering light (and thus reducing visibility) ranges between 0.3 and 0.7 microns. The majority (82 percent) of particulate emissions from wood combustion are in the size range that reduces visibility.

The PM (Particulate Matter) 10 (microns) and PM 2.5 (microns) have been established as primary air quality parameters because of potential adverse human health effects. These small particulates could be inhaled and cause respiratory problems, especially in smoke sensitive portions of the population, such as the young, elderly, or those predisposed to respiratory ailments. Coarse particles could accumulate in the respiratory system and aggravate health problems such as asthma. Fine particles, which penetrate deeply into the lungs, are more likely than coarse particles to contribute to the health effects associated with hospital admissions.

Smoke sensitive areas near the North Fork Mill Creek planning area also include: the communities of the Hood River Valley, Moiser, The Dalles, Dufur, and areas within the Columbia River Gorge National Scenic Area. Burning would only be conducted when actual and predicted atmospheric conditions would minimize the possibility of smoke affecting these areas.

Because of preventative measures and compliance with OSMP, there would be no long-term effects from prescribed burning or smoke from the proposed activities.

To avoid impacting smoke sensitive areas, units would be burned when smoke management forecasts predict mixing heights and transport winds that would carry smoke away from or over these areas. If intrusions occur, no additional areas that could contribute to the intrusion would be ignited and extinguishing burning material may be necessary. Signs would be posted on roads that are near burning operations when visibility could be affected, for public safety if visibility on State or Federal Highways is reduced to less than 750 feet, traffic flaggers and pilot cars would be required.

Smoke management concerns may require that some stands that have proposed underburning be treated by hand and/or machine piling. Pile burning could be accomplished during the passage of weather fronts that move smoke out of the area very quickly, whereas underburning requires very specific environmental condition to implement.

Environmental Effects

Direct and Indirect Effects

The direct effect of prescribed smoke for each action alternative would be directly related to the volume of timber to be removed. The direct effects of prescribed burning smoke are reduced visibility and increased level of small diameter particulates specifically PM 2.5 and PM 10, of concern for human health reason.

The indirect effects of prescribed burning smoke produced as a result of the implementation of one of the action alternatives would be directly related to the amount of timber volume to be removed. Indirect effects are limited to the air quality degradation, as a result of PM 2.5 and PM 10 particulates, and increased haze. PM 2.5 and PM 10 levels would rapidly disperse as they are carried by local and general winds.

Cumulative Effects

The cumulative effects on air quality of prescribed burning smoke, produced as a result of implementation of one of the alternatives, would result in an incremental decrease in air quality as PM 2.5 and PM 10 particles from this source combine with other particles produced both by the implementation of other aspects of this project, as well as other local and regional sources located upwind. Prescribed burning of logging slash, on other federal, state or private lands, would also contribute particulates, as would agricultural burning. Particulates from industrial and automotive sources also contribute to regional particulate loading. Other vehicle traffic agricultural and industrial sources within the planning area would also contribute to the cumulative particulate loading. It is not possible to predict the amount of particulates contributed by these sources.

Vegetation Resources

A more detailed vegetation resource/silviculture report is located in the project record, located at the Hood River Ranger District. The analysis and conclusions of the report are summarized below. Reference material is contained in the full specialists report.

Existing Conditions

Information on the vegetative conditions of the larger landscape within which North Fork Mill Creek Restoration Project lies is provided largely by an analysis conducted in the recent past by the Mt. Hood National Forest: the Mill Creek Watershed Assessment. Refer to the Silvicultural Report in the project record for maps with the boundaries of the landscape area.

The Mill Creek Watershed Assessment characterizes resource conditions at their respective scales, identifies issues, discusses trends and changes in conditions over time, defines desired conditions, and identifies possible management opportunities to be pursued at the project planning level. Only the elements from these analyses most pertinent to the proposal are discussed in this section. For the complete analysis of vegetation conditions and ecological processes at the landscape scale, refer to the Mill Creek Watershed Assessment (http://www.fs.fed.us/r6/mthood/documents/Watershed_Analyses/Mill_Creek_WA.pdf). The Silvicultural Report for the project provides an additional summary of this landscape information as related to the project. The previous landscape analysis provides the landscape context for the analysis of vegetation at the North Fork Mill Creek project level.

The analysis area is 6607 acres. The analysis area boundary for disclosing effects at this more site-specific level is the North Fork Mill Creek watershed, as well as parts of Neal and Mosier Creek headwaters, where stands were evaluated for possible treatment actions. The Silvicultural Report provides detailed documentation of individual stand conditions and the selection process. Information sources included stand records and field surveys conducted in the 1980s and 1990s, as well as field reviews conducted in the year 2007 (on file at the Hood River Ranger District in Mt.Hood/Parkdale, Oregon).

Landscape Scale
The Mill Creek Watershed Analysis describes the landscape of the east slope of Mt. Hood. Two dominant vegetative zones are included in the North Fork Mill Creek watershed. Dry grand fir, lodgepole pine and white pine are predominant in the west half of the drainage. The eastern half of the drainage on National Forest System (NFS) lands features open, grass covered slopes and forests of hot, dry ponderosa pine, with Oregon white oak dominating the lower elevations and drier sites.

Typically, across this landscape the fir and Douglas-fir dominated forests are dense single or multi-storied stands. The drier sites where ponderosa pine is more common may be less densely stocked, and are typically in a multi-storied condition. Douglas-fir is often a major component in the mid and lower canopies except on the driest sites, where ponderosa pine is prevalent, along with Oregon white oak. The lodgepole pine stands at mid to upper elevations in this landscape are often mixed with other species (Douglas-fir, grand fir) and most commonly form dense, single-storied canopies.

The analyses completed at the larger landscape scale (refer Mill Creek Watershed Assessment) noted that there have been some definite changes in the nature and condition of the vegetation across the landscape from historical conditions (the period prior to Euro-American occupation). Most of these changes reflect the consequences of 100 or so years of fire exclusion and suppression in combination with European settling of the area and timber harvest beginning in the earliest years of the 20th century. The first substantiated contact of Euro-Americans with the Native groups that occupied the Columbia River valley occurred during the Lewis and Clark Expedition in 1805. However, it wasn't until the mid 1800s that settlement of the valley by non-Indians really took off, primarily because of the discovery of gold. The lumber industry began its development in the area in the 1850s, although the Hudson Bay Company had constructed the first sawmill on Mill Creek in the 1820s. By the end of the 1800's, much of the timber was being cut from public lands at what was perceived as an alarming rate. This led to the establishment in 1893 of the Cascade Forest Reserve as part of a regional plan to preserve the forests of the western United States. The Mt. Hood National Forest contains the northern portion of the original reserve.

An increase in the amount of Douglas-fir forest type has occurred, with a correlating decrease in ponderosa pine and western larch dominated forest. However, the more notable changes have occurred in the structure classes and patterns of vegetation across this landscape. Increased tree densities, higher proportion of multistoried stands, reduction in amount of young, seedling/sapling forest (especially in the ponderosa pine and Douglas-fir types), and more continuous coverage of forest canopies across the landscape are the major elements that have changed. In many areas, the forest conditions are outside the historical ranges, influencing the normal functioning of ecological processes across the landscape (MacCleery 1998). The nature and effect of these changes are discussed more thoroughly in the assessments referenced above and under the section on "Influence of major ecological processes and disturbances" later in this section.

The lower slopes of the Cascade Range (where the project lies) have a relatively high natural level of forest fragmentation. This inherent level of fragmentation is the result of a diverse topography and dissected slopes, with abrupt changes from one site and vegetation type to another. In historical times, this would result in fires of a wide variety of sizes, frequencies, and intensities. Fires in the stands on the dry southerly aspects tended to be more frequent and often burned onto the northerly aspects. There they would either die out quickly, due to the more moist fuel conditions, or they might burn at a low to moderate intensity through portions of the area. Under certain conditions, the fire would move into tree crowns and be carried quickly along due to the dense canopy on these northerly slopes, resulting in a stand-replacing fire.

Under this natural disturbance regime, a fairly fine-grained landscape mosaic of different forest patches would be created, and a predictable and repeated pattern of vegetation tended to develop in the foothills of Mt. Hood. Semi-open ponderosa pine forests dominated the warm, dry southerly aspects, with somewhat more dense single or multi-storied ponderosa pine/Douglas-fir forests (sometimes mixed with lodgepole pine) on the cooler, moister northerly aspects. Older overstory trees of ponderosa pine and Douglas-fir would often exist in both of these areas.

Currently, the landscape exhibits a different pattern of forest cover and structure types than it has historically because of fire suppression, past logging, and the natural succession of the forest (USDA 2004). The average patch size has decreased and the number of patches has increased. Crown closure has increased. Stands once differentiated by stocking levels, canopy levels, and crown closure have become structurally more similar and continuous across the landscape. These changes have affected the normal functioning of ecological processes, such as fire, insects, and disease relationships (refer to discussions under later sections of this section).

Site-Specific or Project Area Scale

All proposed treatments in the project occur within the upper end of the North Fork Mill Creek watershed and the headwaters of Mosier and Neal Creeks. Douglas-fir dominated forests growing on warm, dry grand fir habitats cover the upper slopes of the drainages. These forests are of concern because of the dramatic change in condition that these areas have experienced over the past 100 years. There is an estimated total of 3980 acres of this Douglas-fir and grand fir forest type in the upper reaches of Mill Creek. Near the National Forest boundary in the northeast corner of the project area, the hot, dry pine-oak and Douglas-fir type covers 2625 acres.

Tree density within these Douglas-fir stands is relatively high compared to what most commonly existed historically on these sites (refer also to discussion in Chapter 3, Fire/Fuels Management). It is important to understand that this dense Douglas-fir forest type is not in itself a condition that was never experienced in the past. There were pockets of forest on similar sites across the historical landscape that by chance escaped one or more fires and developed the dense canopy and/or multi-storied conditions similar to those that are seen in the project area today. Historically, fires burning relatively frequently in forests dominated by thick-barked tree species would have created mortality mainly to understory trees, reducing competition for the residual western larch and ponderosa pine. Seed beds were created for regeneration in openings for the establishment of new cohorts (Oliver & Ryker 1990)

However, because of fire suppression and exclusion across the entire Mt. Hood Forest over the last century (particularly the lower and moderate intensity “thinning” types of fire), these dense Douglas-fir- dominated forests have developed over far more area than historically occurred. This has resulted in increased fuels and risk of larger scale, high severity fire, with the associated threat to resource and human values.

Accentuating the effects of fire suppression has been the logging that occurred beginning in the 1850s in much of the Douglas-fir forest type in Mill Creek. Prior to this, there appears to have been numerous mature, overstory ponderosa pine and western larch in these stands, and probably some overstory Douglas-fir as well. From evidence of the stumps that remain, it is estimated that from 30 to perhaps 60 trees per acre of these mature and older trees existed on these sites. Most of these larger pine trees were removed by logging, sometime between 1850 and 1940. The understory seedling and sapling Douglas-fir and grand fir that occupied the site at that time, along with new regeneration that occurred after logging, has grown into the dense, mature stands of fir that exist on the sites today. Table 3-11 presents stand size class distribution within the project area boundary.

Table 3-11: Stand Size Class Distribution

Stand size class	Acres	Percentage of area
Grassland	310	4
Seedling/sapling	970	15
Pole/immature/multi-story	2060	31
Mature/overmature	3260	49

One half of the analysis area contains stands of mature to overmature (large diameter) trees. Further, an additional 280 acres are multi-story stands with large legacy trees (see Figure 3-8). Even though there were larger pine removed over the last century or so, there is no shortage of large diameter trees of the various species in the watershed. Individual legacy ponderosa pines have become surrounded by grand fir ingrowth and many show signs of drought stress (flat tops and fading crowns) from being out competed by the aggressive water-using specie.

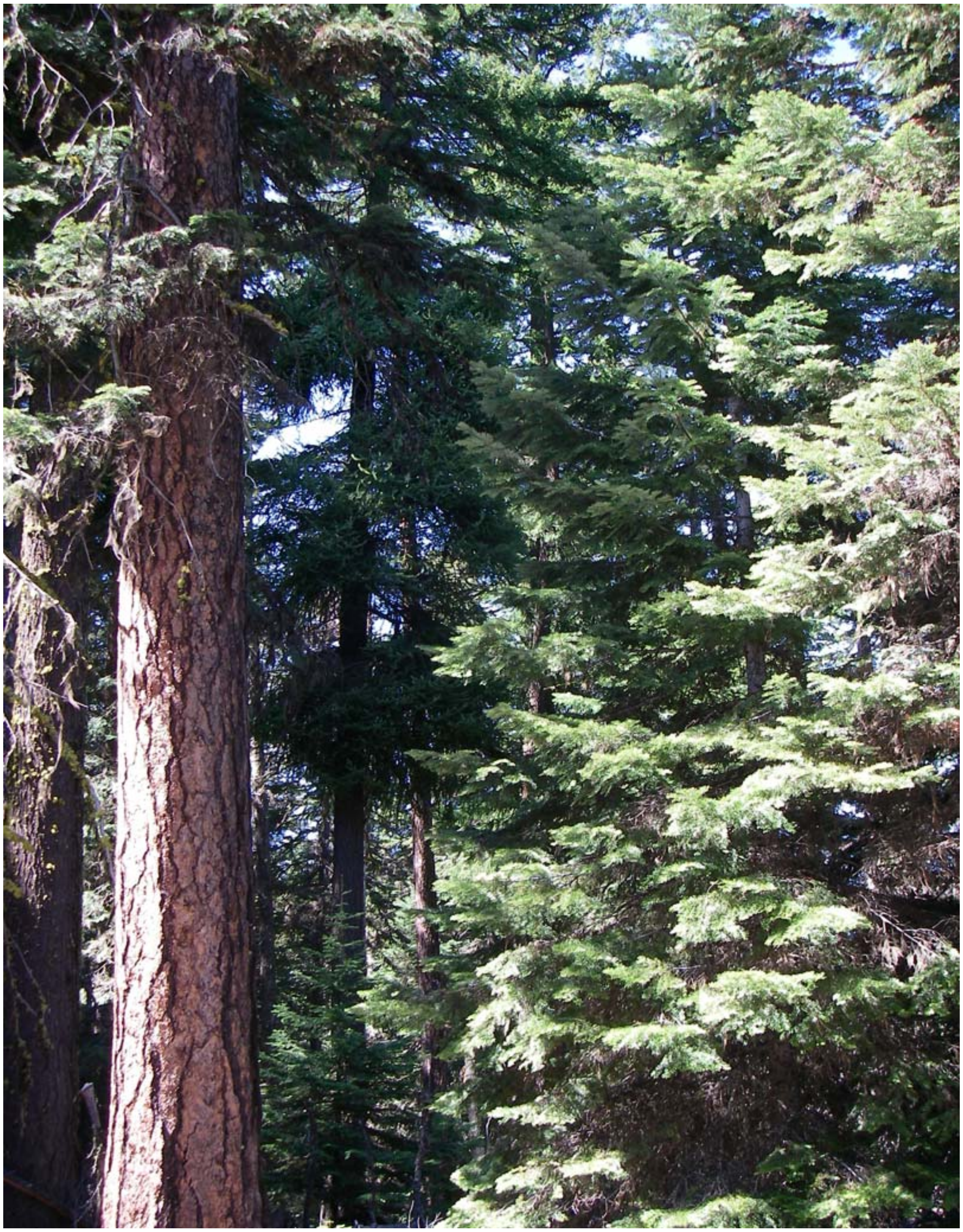

Figure 3-8: Dense multi-storied stand.

Table 3-12: Existing Site and Vegetative Condition of Proposed Treatment Stands within North Fork Mill Creek Restoration Project Area.

Stand Group	Forest Type: Vegetation Composition	Forest Structure; Density, Size & Age Classes	Vegetation Condition	Other
A1	Dry Grand Fir Type. GF, DF, WH, WRC, LP, minor amounts PP, WL. Undergrowth low shrubs and grass (ninebark, mountain maple, pinegrass), shrubs suppressed and decadent. Very few understory seedling or sapling trees; moss mat across portions of area.	Dense single and two storied forest, from 300-500+ tpa overall, with main canopy composed mostly of DF trees in 8-16" dbh range. These trees are typically 70-110 years old. Remnant groups and scattered individual old overstory DF and PP (+-200 years, up to 28" dbh, normally < 5 tpa but some areas at higher density). Very few snags; low to moderate amount downed wood.	Generally healthy, no serious insect or disease.	Occasional, scattered stumps indicate where larger overstory PP were removed 30-50+ years ago. Light downed fuels. Generally east and north facing slopes.
A2	Dry Grand Fir Type. GF, DF, WH, WRC LP, minor amounts PP, WL. Undergrowth low shrubs and grass (ninebark, mountain maple, pinegrass), shrubs suppressed and decadent. Short-lived GF seedling or sapling trees in gaps created by root disease.	Dense single and two storied forest, from 300-500+ tpa overall, with main canopy composed mostly of DF trees in 8-16" dbh range. These trees are typically 70-110 years old. Remnant groups and scattered individual old overstory DF and PP (+-200 years, up to 28" dbh, normally < 5 tpa but some areas at higher density). Many snags; moderate to high amount downed wood.	Dwarf mistletoe in DF, heaviest infection in older trees. Root rot pockets common, infecting grand fir and Douglas-fir. Poor health and form in this group.	Shallow, rocky soils in parts of area, especially along ridgelines. Some stands with evidence of partial cutting many decades ago (over 60 years), removing much of the overstory PP and WL. Heavy downed fuels from root rot mortality. Generally east and north facing slopes.
A2B	As above, with better representation of PP and WL.	As above	As above.	Generally south and west facing slopes. Proposed for underburning.
B1B	Hot, Dry Pine-Oak and Douglas-fir Type. Composed mainly of PP and DF with GF encroachment.	Dense second growth stands 40-80 years, 10-18" dbh.	Generally healthy, no serious insect or disease.	Proposed for underburning

Stand Group	Forest Type: Vegetation Composition	Forest Structure; Density, Size & Age Classes	Vegetation Condition	Other
B2	Hot, Dry Pine-Oak and Douglas-fir Type. Composed mainly of PP and DF with GF encroachment.	Dense single and two storied forest, from 300-500+ tpa overall, with main canopy composed mostly of DF trees in 9-16" dbh range. These trees are typically 70-110 years old. Remnant groups and scattered individual old overstory DF and PP (+-200 years, up to 28" dbh, normally < 5 tpa but some areas at higher density). Many snags; moderate to high amount downed wood.	Dwarf mistletoe in DF, heaviest infection in older trees. Root rot pockets common, infecting grand fir and Douglas-fir. Poor health and form in this group. Overstocked for this vegetation type.	Generally east and north facing slopes
B2B	As above	As above.	As above.	Generally south and west facing slopes. Proposed for underburning.
C	Dry Grand Fir and Douglas-fir with inclusions of aspen and cottonwood.	Decadent *Populus* spp. Encroached upon by DF and GF.	Declining	Aspen and cottonwood stands have become decadent from lack of natural fire and are reproducing poorly.
D	DF, PP, GF. Shrub species include ocean spray, ceanothus, manzanita, chinkapin, maple	Sapling to immature (early seral) stands from regeneration harvest 15-30 years ago. 300-800 tpa. Tree diameters up to 9" dbh. Light retention overstory	Dwarf mistletoe infection in remnant overstory DF and PP. Brush providing competition in some stands.	
E	Hot Dry Pine Oak and Douglas-Fir Type. Bunchgrass meadow with individual PP/DF/OWO			

Abbreviations: PP = ponderosa pine; DF = Douglas-fir; LP = lodgepole pine; GF = grand fir; WL = western larch; WH = western hemlock; OWO = Oregon white oak; WRC = Western Red Cedar
dbh = diameter breast height; tpa = trees per acre
Acreages are derived from Geographic Information System data and are not exact.

Table 3-13: Summary of Stand Groups for Project Area

Stand Group	Proposed Action Acres (Logging System)	Proposed Action Units	Alternative Action Acres (Logging System)	Alternative Action Units
A1	154 (Tractor)	7, 8, 13, 27, 30, 62	34 (Tractor)	7, 8, 13
A2	973 (Tractor)	1, 2, 3, 4, 5, 6, 19, 20, 21, 22, 23, 31, 35, 36, 37, 38, 39, 40, 41, 42, 43, 58, 59, 60, 61	0	
	11 (Cable)	59C	0	
A2B	350 (Tractor)	16, 17, 18, 24, 25, 26, 28, 29	97 (Tractor)	16, 24, 26, 28
B1B	149 (Tractor)	14, 15, 49, 51, 52	114 (Tractor)	14, 15, 52
B2	91 (Tractor)	9, 44, 47, 57, 63	24 (Tractor)	47, 63
	20 (Cable)	41C	0	
B2B	425 (Tractor)	10, 11, 12, 45, 46, 48, 50, 53, 54, 55	296 (Tractor)	10, 11, 12, 45, 46, 48, 50, 53, 54, 55
	30 (Cable)	52C, 56C	30 (Cable)	52C, 56C
C	25	70, 71, 72	47	81, 82, 83, 84, 86, 87
D	47	81, 82, 83, 84, 86, 87	24	70, 71, 72
E	610	91, 92, 94	610	91, 92, 94
TOTALS	**2885**		**1276**	

Influence of major ecological processes and disturbances
Ecological processes and disturbances directly affect the diversity of plant and animal communities within an area over space and time. The better this interrelationship is understood, the better we will be able to assess the integrity and sustainability of our ecosystems and plan our actions to maintain healthy, properly functioning ecosystems into the future. Ecological processes and disturbances include nutrient and biomass cycling, forest succession (the change in vegetation over time), weather events (i.e., windstorms), insects, pathogens, fire, and human influences (i.e., timber harvest).

Over the last century, there have been broad changes in vegetative conditions in the Cascade Range, as summarized in the landscape analyses referenced earlier. The primary or most obvious disturbances or factors of change, influencing vegetation in the project area include fire, diseases, insects and timber harvest. For example, western larch, a productive species tolerant to insects and diseases, has been replaced by less productive, shade-tolerant species, where insects and diseases cause far more serious damage to the replacement forests. These replacement forests also tend to be overstocked with vertical structure; they are highly vulnerable to abnormally intense wildfires (Carlson et al. 1995). A brief discussion of insects, diseases, and timber harvesting follows below. A discussion of Fire/Fuels Management occurs in an earlier section of this chapter. For further information, refer to the Silvicultural Report in the project record.

Insects and diseases are natural elements of the ecosystem that can exert equal, if not greater, influence on forest development and conditions as fire. Most of these organisms have co-evolved with their host species over thousands of years. The balance between forests and their major pathogens is dynamic and fluctuates through time. In the past, with regular fire cycles, they probably existed most commonly at endemic levels (i.e., present in an area but causing low or moderate levels of mortality). However, population fluctuations were normal with epidemic conditions of some insects or diseases developing periodically and causing high levels of tree mortality over short periods (Harvey et al. 1995).

Dwarf mistletoe
The pathogen currently causing the most obvious affect on the forests in the Mill Creek area is dwarf mistletoe (*Arceuthobium spp.*) on Douglas-fir. It is also found in many of the western larch and ponderosa pine. Dwarf mistletoes are small, leafless, parasitic plants that extract water and nutrients from live conifer trees. They are generally host specific, occurring on one principal species. They cause decreased height and diameter growth, reduction in seed and cone crops, and direct tree mortality or predisposition to other pathogens or insects. Once the dwarf mistletoe has spread throughout the crown, it usually takes ten or more years for tree mortality to occur. There are western larch snags throughout much of the project area, with evidence that dwarf mistletoe was the cause of mortality.

There is increasing evidence that important interactions exist between dwarf mistletoe and animals (Hawksworth and Wiens 1996). Birds, porcupines, squirrels, and other animals eat seeds, shoots, and other parts of the plants. The dense branch masses (“witches brooms”) caused by dwarf mistletoe provide cover and nesting sites for some birds and mammals.

Historically, wildfires have been the most important single factor governing the distribution and abundance of dwarf mistletoes (Alexander and Hawksworth 1975 in Hawksworth and Wiens

1996; Conklin and Armstrong 2001). Fires are frequently effective in limiting dwarf mistletoe populations because trees usually return to burned sites much faster than the parasite does. In addition, heavily infested trees have highly flammable witches' brooms and lower live crowns, which may increase intensity of fire and tree (and associated mistletoe) mortality. In some situations, fire can increase, rather than decrease, abundance and distribution of mistletoe populations. Low and mixed severity, spotty fires may leave live, infected trees on the site that infest new tree regeneration. Without fire, dwarf mistletoe continues to infect the trees coming up underneath the overstory. The infected understory trees are unlikely to grow to a very large size to become "old growth" stands. The sugars and nutrients produced by the tree are diverted to the branch that has the dwarf mistletoe plant growing in it, allowing very little diameter or height growth for the tree. A tree with mistletoe brooms can provide nesting habitat for birds and small mammals, and they are very common on the eastside of the Mt. Hood National Forest. Douglas-fir trees with dwarf mistletoe generally provide excellent fuel in a crown fire, as well as ladder fuels for a ground fire to reach crowns. Dwarf mistletoe creates a special kind of "structure", but it alters the natural "functioning" of the tree. Thinning in an infected stand does little to slow the infection, because the understory is already infected. Management options are few in a stand infected with dwarf mistletoe.

The absence of fire and partial cutting in the early 1900s in the project area has contributed to Douglas-fir- dominated, dense, and often multi-canopied stand conditions, which are particularly favorable to dwarf mistletoe. Dwarf mistletoe spread rate is fastest in the multi-storied stands where mistletoe seeds from infected overstory trees "rain down" on susceptible understory trees. Seedlings and saplings growing under a heavily infected overstory are killed at an accelerated rate. They often die before reaching maturity or cone-bearing age.

In the project area, the severity of dwarf mistletoe infection is very high in older age classes of Douglas-fir as well as in western larch and ponderosa pine. Many of the older (150+ year) Douglas-fir in the stands within the project area are infected with dwarf mistletoe, most with 100 percent of the crown affected. Huge witches' brooms are common on these trees; some are already dead. Stands that were harvested in the past with moderate to light retention levels allowed increased sunlight to reach the trees and incipient levels of infection soon grew to heavy levels of infection. The degree of infection in the younger Douglas-fir trees (<120 years) varies across the project area, from very low levels in some stands to very high levels in others. Generally, where heavily infected Douglas-fir overstory exists, the infection level in the adjacent and understory trees is also high and would be expected to continue to increase as long as the source of infection exists.

Root disease

The dense, multi-canopied Douglas-fir and grand fir dominated forests in the area are perfect conditions for the proliferation of root disease. Most of the stands in the watershed have some level of root disease present, found most often in the Mill Creek drainage as laminated root rot (*Phellinus weirri*). Highly susceptible species include Douglas-fir, grand fir, mountain hemlock, and white fir. Species that are tolerant or resistant to laminated root rot include lodgepole pine, western white pine, ponderosa pine, and western red cedar (Goheen and Willhite 2006). These organisms can cause increased stress, severe reduction in tree growth, and direct or indirect mortality to trees. Trees infected with *P.weirii* are sometimes killed by bark beetles in combination with other root diseases. The Douglas-fir beetle and fir engraver are commonly associated with laminated root rot (Schowalter and Filip 1993 in Rippy et al. 2005). We recognize that root decay and stem decay are perfectly natural agents processing downed wood and creating a variety of structure in the forest. Though the organisms themselves are a natural and integral part of the ecosystem, the condition of the vegetation across the landscape and within individual stands is in many cases not natural. Once again, in the absence of fire, root decay has become very active, probably outside its range of natural variability in these stands. Fire does not eliminate root disease, but there is evidence that it slows it down, especially when its host is consumed. When there is an abundance of a susceptible species in a stand, root disease centers continue to grow. When there is a wide variety of species in a stand, including some less susceptible species, it may be slowed. These organisms now have far more of their favored habitat available to them (dense, multi-canopied Douglas-fir forest) and therefore may cause more severe effects to the forests than has typically occurred in the past. Stands previously entered for selection harvest had the larger trees removed, mostly Douglas-fir, ponderosa pine and larch. Not only were the less susceptible species removed, the cutting of Douglas-fir accelerated the spread of the root disease through the remnant stumps. Also see Forest Health Protection Site Report (Hildebrand and Hostetler 9/2007). Root disease pockets throughout the analysis area have created an abundance of downed wood and snags (see Figure 3-9).

Figure 3-9: Downed wood fuel concentrations from root disease mortality.

Timber harvesting has been a major contributor to the change in vegetative conditions that have occurred across the Mill Creek area. This impact has been more significant in some forest types, particularly the lower elevation ponderosa pine and drier Douglas-fir. Removal of the ponderosa pine in many of these forests, in combination with fire exclusion, has accelerated their development towards a multi-aged and multi-storied Douglas-fir condition. This, as described in other sections, has altered the normal functioning of ecosystem processes (Arno et al. 1995).

In the project area, records show about 1900 acres of the area proposed for management has previously been treated, during the period from 1973 to 1999 (see Table 3-14 below). The district does not have records of historical harvest between 1880 and 1970, only information from field observations.

Table 3-14: Acres by harvest type in North Fork Mill Creek project area.

Decade	Clearcut	Shelterwood	Thinning
1973-1979	17	11	720
1980-1989	295	373	93
1990-1999	27	39	327
2000-2008	0	0	0
Total	**339**	**423**	**1140**

Environmental Effects

The baseline condition against which changes to the vegetation will be measured is the current condition. Criteria used to determine effects on vegetation include: (1) total acres treated and acres treated within each affected forest type (particularly the dense Douglas-fir dominated forests); (2) changes in forest structure and composition; (3) how our actions compare to what conditions might have been historically (i.e. under a more natural disturbance regime, as discussed under "Fire Ecology" section in this Chapter); (4) effects on residual trees; and (5) effects on insect and disease processes and forest vulnerability to these elements.

This section only analyzes the impacts of the vegetation management treatment. It does not analyze the proposed trails, proposed culvert removals and replacements, seasonal and year-long road closures, or road decommissioning components of Alternatives 1 and 2 because there are no direct, indirect or cumulative effects to the vegetation from these projects.

Effects on Forest Types within the Project Area

<u>No Action Alternative</u>
No acres are treated under this alternative, and thus there are no direct or indirect effects to the vegetation. Existing conditions as described above under "Affected Environment" would be maintained. In the short-term, there would be no measurable direct or indirect change in the current condition of the area relative to insect and disease levels and vulnerability of the stands to infestations. The warm Douglas-fir sites, currently occupied by densely stocked Douglas-fir and grand fir stands, would experience the continuing spread of root disease and resultant mortality over the long-term, as well as continued and spreading infestation and mortality from dwarf mistletoe.

<u>Alternative 1 – The Proposed Action</u>
The proposed action would treat a total of approximately 2885 acres; 1177 with mechanical thinning, 954 acres of thinning and burning, 26 acres of sapling thinning, 45 acres of aspen enhancement and 684 acres with prescribed burning only. This equates to about 42 percent of the 6607 acre project area.

Most of the fuels reduction treatment proposed occurs within the Douglas-fir dominated forests of concern, located on the warm, dry/moist grand fir Douglas-fir habitat associations. About 1432 acres of this type would change from what is currently dense, mostly closed canopy forest to a semi-open condition. This represents 36 percent of the total acres of this forest type within the vegetation analysis area. About 27 acres of the aspen cottonwood enhancement fall within the dry grand fir type. Treatment would reduce the amount of grand fir on the small sites and encourage the regeneration of aspen and cottonwood. Approximately 742 acres of the hot, dry pine-oak and Douglas-fir would be thinned, or about 28 percent of the forest type in the analysis area.

Units 91, 92 and 94 in this alternative are low intensity underburns in open ponderosa pine/grass vegetation types. The treatments would result in little change in the current structure or species composition on these sites. A few trees per acre could be expected to be killed, and these would mainly be seedlings and saplings and thin-barked trees. An open forest with grass undergrowth would still remain after treatment.

<u>Alternative 2</u>
This alternative would treat a total of approximately 1277 acres; 68 with mechanical thinning, 537 acres of thinning and burning, 25 acres of sapling thinning, 47 acres of aspen and cottonwood enhancement, and 610 acres with prescribed burning only. This equates to about 13 percent of the project area.

A small representation of the fuels reduction treatment proposed occurs within the mixed conifer stands located on the warm, dry/moist grand fir Douglas-fir habitat associations. About 166 acres of this type would change from what is currently dense, mostly closed canopy forest to a semi-open condition. This represents four percent of the total acres of this forest type within the vegetation analysis area. Approximately 500 acres of the hot, dry pine-oak and Douglas-fir would be thinned, or about 19 percent of the forest type in the analysis area.

Units 91, 92 and 94 in this alternative are low intensity underburns in open ponderosa pine/grass vegetation types. The treatments would result in little change in the current structure or species composition on these sites. A few trees per acre could be expected to be killed, and these would mainly be seedlings and saplings and thin-barked trees. An open forest with grass undergrowth would still remain after treatment.

Effects on Forest Structure and Composition:

<u>Alternative 1 – Proposed Action</u>
Low intensity prescribed burn treatments (Units 91, 92 and 94). About 610 acres of land would be burned with a low intensity underburn. There would be a relatively minor change to the vegetation with this treatment. This burn would perpetuate the current condition of naturally open, grassy slopes, and scattered ponderosa pine trees of all sizes and ages. Most of these trees would survive the burn, though some of the smaller seedlings and saplings may be killed. The underburn would remove some of the needle and litter layer that has accumulated over many decades and stimulate growth of the grasses and forbs. The lower limbs of some trees may require pruning prior to burning to prevent torching and subsequent mortality.

Thinning treatments (all remaining units). This alternative would mechanically thin about 2151 acres of forest, including 23 acres of sapling stands. The stands being treated are either reforested stands ("plantations") from early regeneration harvest, or stands that were selectively harvested over many decades. In this treatment, selected trees of all sizes down to saplings (i.e., 3-inches or less in diameter) would be removed; the focus would be on leaving the most vigorous, larger diameter trees, and favoring ponderosa pine and western larch over Douglas-fir and grand fir. Thinning from below must retain some young trees of desired species if stands are to retain a healthy age structure. (Perry et al. 2004). This treatment would be followed by piling to reduce the amount of fine fuels and slash concentrations left after treatment. Stands thinned and then followed with underburning would see a slight reduction in the thin-barked grand fir component due to some mortality from the burn treatment. Overall, the average stand diameters would increase. Trees girdled to reduce the spread of dwarf mistletoe would provide a long-term snag and downed wood component. About 1800 acres of stands to be treated have a high incidence of root disease. Treating the rot pockets with patch cuts and replanting with species that are both root rot resistant and fire resistant would improve species diversity, move the stand composition toward historical conditions, while improving the resilience to fire and improving forest health. Western larch and ponderosa pine could be restored as long as openings are large enough to allow for full sunlight on young trees struggling to become established (Arno and Fischer 1995). Openings created in these root disease pockets will provide the conditions necessary for the highly shade intolerant larch to become established, especially if followed by some application of fire to reduce the brush competition and improve germination conditions. Restoration should strive for landscape heterogeneity to protect habitat and other environmental values (ibid.).

<u>Alternative 2</u>
Low intensity prescribed burn treatments (Units 91, 92 and 94). About 610 acres of land would be burned with a low intensity underburn. There would be a relatively minor change to the vegetation with this treatment. This burn would perpetuate the current condition of naturally open, grassy slopes, and scattered ponderosa pine trees of all sizes and ages. Most of these trees would survive the burn, though some of the smaller seedlings and saplings may be killed. The underburn would remove some of the needle and litter layer that has accumulated over many decades and stimulate growth of the grasses and forbs. The lower limbs of some trees may require pruning prior to burning to prevent torching and subsequent mortality.

Thinning treatments (all remaining units). This alternative would mechanically thin about 641 acres of forest, and thin another 23 acres of saplings either by hand or by mechanical means. The stands being treated are reforested stands ("plantations") from early regeneration harvest. In this treatment, selected trees of all sizes down to saplings (i.e., 3-inches or less in diameter) would be removed; the focus would be on leaving the most vigorous, larger diameter trees, and favoring ponderosa pine and western larch over Douglas-fir and grand fir. This treatment would be followed by piling to reduce the amount of fine fuels and slash concentrations left after treatment. Stands thinned and then followed with underburning would see a slight reduction in the thin-barked grand fir component due to some mortality from the burn treatment. Overall, the average stand diameters would increase (Lindh & Muir 2004). Trees girdled to reduce the spread of dwarf mistletoe would provide a long-term snag and downed wood component. Very few acres of land would be restored to the historical composition of western larch and ponderosa pine.

<u>Alternatives 1 and 2</u>
The most notable direct change to vegetation in treated areas would be a substantial reduction in tree densities. These acres of forestland would be reduced from the current 250-600+ trees per acre down to about 50-100 trees per acre. Currently dense, closed canopy stands would change to a semi-open condition, where most trees would be spaced such that their crowns would not be touching (boles about 30 feet apart) (see Figure 3-10). This would reduce competition among trees for moisture and light, improving growth and vigor in residual trees (Cochran and Seidel 1995; Williamson 1982). Substantially more sunlight would reach the forest floor, stimulating growth of understory grass, forb and shrub species. Future underburning would stimulate the growth of these grasses and shrubs even further.

Ecosystem processes are dynamic, not static; they do not necessarily undergo an ordered development toward a single endpoint, but instead more likely undergo rapid transitions between different metastable states toward multiple endpoints (Choi 2007).

Figure 3-10. Target canopy cover

Species composition would change slightly, with ponderosa pine increasing in proportion within those units where it currently exists. This is because ponderosa pine would be chosen over Douglas-fir as a leave tree whenever possible. However, because Douglas-fir is currently so overwhelmingly dominant in most stands, this increase in proportion of ponderosa pine would be quite small. If root disease pocket treatments are about an acre or more in size, then pine and larch may be planted there to improve species diversity and reduce the likelihood of mortality on that site from root disease (Rippy et al. 2005). Because root disease spreads from intertwined root systems, species susceptible to laminated root rot should not be left near or in root rot centers (O'Hara et al. 1992). Grand fir killed by root disease do not remain standing for very long due to the progression of stem decay, nor are they preferred snag habitat. Ponderosa pine, and especially western larch, needs full sunlight to thrive as seedlings and saplings (Schmidt and Shearer 1995; Oliver and Ryker 1990) and may be successfully restored to the forest in these small patches if cleared of competing vegetation and shade. The patch sizes created may only be marginally large enough to promote western larch (ibid).

Stand structures that are single storied and essentially even-aged, composed of 80-110 year old Douglas-fir, would remain so, only more open-canopied. Few to no old overstory trees would exist, because there were none in the original stand. Stands currently with a more multi-storied structure and a wide range in ages of trees would also be more open after treatment, but still in the multi-age/multi-canopied structure. These areas would appear park-like after treatment, with widely spaced trees and a relatively clean, green forest floor after a year or so. Carbon sequestration would increase in rapidly growing healthy trees, and the dead trees would no longer be emitting carbon. Reducing the canopy cover would stimulate growth in the herbaceous layer.

Aspen and Cottonwood Enhancement

Thinning and underburning the few aspen and cottonwood stands in the area would promote regeneration of these hardwoods. Fire would stimulate suckering by killing overstory stems and by killing near-surface root segments and thereby interrupting the flow of auxin to surviving down stem root segments. Fire removes competing understory vegetation and conifer seedlings, and allows sunlight to reach the forest floor. The vegetation consumed by the fire provides a nutrient pulse for new suckers and the blackened surface warms soil in the root zone, further stimulating sucker growth and the flow of cytokinin (Bartos 2001). Dense suckering over large burned areas can act as a deterrent to browsing animals. Protecting new aspen suckers from damage is an important consideration, regardless of the manipulation technique being used (Shepperd 2001).Small exclosures would keep cattle and native ungulates from browsing too heavily on the new suckers (Shirley and Erickson 2001). While the area proposed for treatment is not large, the aesthetic value attached to aspen could be meaningful for many people. Restoring remnant patches by reducing conifer ingrowth and encouraging reproduction may promote these areas as unique habitat niches for both animal and man (McCool 2001).

Comparison to Historical Conditions:

The character of the existing stands in the North Fork Mill project area are heavily influenced by past fire suppression and logging activity, as described earlier under "Affected Environment". The treatments are proposed to counteract this influence, reducing tree densities and altering forest conditions to be closer to an estimated historical condition. Reducing the risk of active crown fire may necessitate heavier thinning, depending on stand structure and the acceptable degree of risk (Perry et al 2004).

Thinning maintains the overwhelmingly Douglas-fir dominated forest, though density and structure are altered to a more desirable, sustainable condition. Some improvement of conditions would occur for ponderosa pine and western larch regeneration, survival, and growth by creating small openings, releasing existing pine, and applying periodic underburning. Over time, it is hoped that ponderosa pine and western larch may find some space to regenerate successfully within these treatment units, as both of these species are highly shade intolerant. Reducing understory ladder fuels and downed woody debris would lower the risk of crown fires. Periodic underburning would restore more natural processes to the site and the landscape, reintroducing fire with all its known and unknown benefits to these plant communities.

The prescribed burn treatments in both alternatives are an attempt to functionally replace wildland fire with prescribed fire. The forests in the project area are adapted to fire, of variable intensities and sizes (as described more thoroughly in Fire/Fuels Management section). The prescribed burns would result in effects similar to that of a "natural" wildland fire. The treatments are meant to simulate the important role fire has historically played in these ecosystems for recycling of nutrients and organic biomass, and regeneration or stimulation of the vegetation. However, the effect of a prescribed fire does not in all cases equate to that of a wildland fire, often due to season of burning. Prescribed fire is likely to be at lower intensity than a wildland fire on that site, primarily to reduce the risk of fire escape. Higher intensity fires may burn much of the duff and debris layer on the forest floor. Fires of different intensities favor different complements of plant species because of the variability in a plants tolerance and resistance to fire. These tradeoffs are sometimes necessary to ensure that the prescribed fire could remain under control, or to ensure that other management objectives are met (such as avoiding excessive loss of live trees during burning operations).

Effects on Residual Trees in Thinned Areas:
Residual trees would benefit from the increased availability of sunlight, nutrients and water. Low stocking levels would result in less volume production, but larger average tree sizes (O'Hara et al. 1995). According to Cochran and Seidel (1995), "Thinning commercially from below down to densities of 50 percent of normal is reasonable, and thinning even to lower densities may be proper where the object is to produce large diameter trees in a short time….. Mosaics of stands of dense, small-diameter trees and stands of large diameter trees with an open, park-like appearance maintained by underburning are possible within the same landscape."

There is an increased risk of blowdown, bending and breakage of the residual trees from snow loading. Trees that have grown for many decades in densely stocked conditions and are relatively small in diameter as a result (i.e. <9" diameter at breast height) are often more vulnerable to these effects if a thinning occurs and the surrounding "supporting" trees are removed. However, it is not expected that these effects would be significant in this area. Tree diameters would vary, but many, if not most, trees would be of large enough diameter and strength to withstand the effects of winds and snow.

Mechanized equipment would be used to fell and remove the trees in the commercially thinned units. There is some risk of damage to residual trees from these activities. However, residual tree spacing would be quite wide, allowing machinery to have adequate room to maneuver; and therefore, should be able to avoid any appreciable damage to residual trees. Abundant natural regeneration could be expected to establish following the initial entry and periodically re-treating the stands would be necessary to keep the seedlings from growing into ladder fuels. The remaining overstory trees are likely to live many decades, but they would eventually die and require replacement to maintain the desired forest structure. In the long-term, the need for reducing wildfire risk must be balanced with the need to maintain a healthy viable population of trees along with other resource considerations (Hunter et al. 2007).

Mechanical treatments in combination with prescribed fire have been shown to be the most effective in altering fire behaviour by increasing the wind speed necessary to initiate a crown fire, thus providing the most protection for residual trees post-treatment (Moghaddas and Stephens 2007). "Silvicultural treatments that target canopy bulk density, canopy base height, and canopy closure have the potential to reduce the development of all types of crown fires if surface fuels are relatively low or are concurrently treated." (Peterson et al. 2005)

The general objective is to reduce physical contact of tree canopies and fire spread through the canopy. During extreme fire weather, fire can spread through horizontal and vertical heat flux and spotting from embers, so relatively wide spacing of canopies is necessary to effectively reduce crown fire hazard. An example of a field-based rule is that the distance between adjacent tree crowns should be the average diameter of the crown of codominant trees in the stand.

Variable density thinning combines thinning from below and on other silvicultural thinning techniques by removing trees from some patches and leaving small stands of trees in other patches. This technique reduces fuel continuity within the canopy, thereby reducing crown fire hazard. For any target stem density, variable –density thinning generally increases spatial heterogeneity of trees and canopy structure. Surface and activity fuels must be removed (to less than 15 tons/acre) (ibid).

Insect and Disease Processes and Forest Vulnerability:

Dwarf mistletoe

A direct reduction in dwarf mistletoe populations would occur with treatments proposed under the alternatives, the only difference being the number of acres treated. . This would occur mostly because many of the trees parasitized by dwarf mistletoe would be removed from the site in the thinning treatment. There would still be several dwarf mistletoe-infected trees left throughout the area, because in some areas there would be no choice but to leave these trees in order to meet structure retention objectives. Rate of dwarf mistletoe spread through the stand would likely be decreased from present conditions because of the wide space between the trees, and the girdling of some of the infected overstory trees. Trees with light infections may quickly become heavily infected when the presently shaded and overcrowded tree is given increased access to sunlight, nutrients and water. Further, small openings such as those proposed would still allow 20 to 40 percent of the future growth in the larch to be affected by dwarf mistletoe due to spread from the perimeter (Carlson et al. 1995). Understory burning has been shown to reduce stand infection, mainly from crown scorch (Conklin and Armstrong 2001), but fire is most effective as a stand-replacing function when the regenerating stand has a chance to become well-established before being influenced by adjacent parasitized trees. It is recognized that trees girdled because of dwarf mistletoe infection may eventually become hazard trees. The structural benefit they provide in the long-term overrides the future maintenance cost for their felling or removing.

Root disease

Recommendations for the North Fork Mill area from the Region 6 Pathologist "include clearing the laminated root rot patches, or clearing a buffer around the patches. Clearings of sufficient size could be prepared and planted with ponderosa pine, rust-resistant western white pine, western larch, and western red cedar. Between patches of laminated root rot, thin (both commercial and pre-commercial) to 16' by 16' or greater, to help retard the spread of root disease." (FHP trip report 2007). The project design includes these actions. The pathologist also states that clearing all Douglas-fir and grand fir within 50 ft of infected stumps or root wads would stop the spread of laminated root rot. The effects of thinning and small patch openings would be to reduce root to root contact and promote the growth of species in the stands that are resistant or have an increased tolerance to root disease. Trees with improved vigor would be more resistant to root disease, as well as the commonly associated insects. Root disease would still remain abundant in the project area, but small patches of forest would be restored to include a component of historical species with resistance (Carlson et al. 1995).

Table 3-15 illustrates the difference in treatments between alternatives in how they would influence insect and disease conditions. Alternative 1 would work toward restoring healthy forest conditions on 884 acres of mixed conifer stands with a high incidence of root disease and/or dwarf mistletoe. Alternative 2 treats zero acres of this stand group. Alternative 1 would treat 234 more acres of hot, dry pine/oak and Douglas-fir stand group containing root disease and/or dwarf mistletoe than would Alternative 2.

Table 3-15: Acres treated by Stand Group

STAND Group	Alternative 1 Acres	Alternative 2 Acres
A1 –Dry grand fir, generally healthy	154	34
A2-Dry grand fir, insect and disease problems	884	0
A2B- Dry grand fir, insect and disease problems, proposed for underburning after thinning	350	97
B1B- Hot, dry pine/oak and Douglas-fir, generally healthy, proposed for underburning after thinning.	149	114
B2-Hot, dry pine/oak and Douglas-fir, insect and disease problems	129	24
B2B Hot, dry pine/oak and Douglas-fir, insect and disease problems, proposed for underburning after thinning.	455	326
C Aspen and Cottonwood Enhancement	47	47
D- Sapling thinning	24 (17 pine/oak, 7 grand fir)	24 (17 pine/oak, 7 grand fir)
E – Underburn w/o mechanical thin	610	610

Cumulative Effects on Vegetation

Discussions of the cumulative effects are limited to those past, present and reasonably foreseeable activities that have been determined to have a cumulative effect on the vegetative resource. Refer to Appendix B in the Silvicultural Report (project record) for evaluation of all possible activities that were originally considered in this cumulative effects analysis for vegetative conditions.

No Action Alternative

This alternative perpetuates the current condition of the vegetation in the North Fork Mill Creek project area, which has been heavily influenced by the past fire suppression and logging activities as described earlier. There is higher probability and increasing risk of mixed and uncharacteristically lethal fire (stand-replacing) in the western half of the analysis area under this alternative (see effects discussion under the section on “Fire and Fuels”). A future fire of this sort would result in dramatic changes to the vegetation condition, uncharacteristic of what the area historically experienced. The dense, continuous forest canopies in this area, with substantial fuel loadings and ladder fuels, would be susceptible to lethal crown fires, killing all trees over large areas of forestland.

Alternative 1 – Proposed Action

The total acreage treated by thinning or prescribed burning in the action alternative is 2885 acres. This is a fair amount of vegetative change when considered at the watershed scale, specifically the 6600 acre North Fork Mill Creek analysis area as described earlier. Because Alternative 1 treats a substantial portion of the dense Douglas-fir stands of concern, it improves overall landscape vegetation towards a condition that would have occurred under a natural disturbance regime. Insect and disease intensity across the landscape would be decreased, and may continue to decrease with the application of periodic prescribed burning or future fires managed for resource benefit. Treatments under this alternative may improve the ability of fire suppression forces to contain fires before they spread, by altering fire behavior. As described under Fire/Fuels Management section, future fires in the project area are likely to be low intensity and non-lethal, easier and safer to control. Fire behavior would be more within what the site historically experienced on most similar sites, which would help ensure that key ecosystem elements and processes are sustained. The potential for severe and undesirable impacts to the forest and site from a future high intensity fire would be reduced.

The acres of late seral and mature stand classes would remain very similar after treatment, due to the fact that stands would be thinned and would retain the majority of the large overstory trees.

Alternative 2

The total acreage treated by thinning or prescribed burning in Alternative 2 is approximately 1277 acres. This is less than 20 percent of the North Fork Mill Analysis Area. It also would treat four percent of the dry grand fir type in the analysis area, doing little to improve the deteriorating conditions in the drainage. Future fire behaviour would be altered in stands treated in the hot dry pine/oak and Douglas-fir stand groups by lowering fire intensity and flame lengths.

Much of the existing conditions as described above under “Affected Environment” would be maintained. In the short-term, there would be little measurable direct or indirect change in the current condition of the area relative to insect and disease levels and vulnerability of the mature and late seral stands to infestations. The untreated dry grand fir sites, currently occupied by densely stocked Douglas-fir and grand fir stands, would experience the continuing spread of root disease and resultant mortality over the long-term, as well as continued and spreading infestation and mortality from dwarf mistletoe. Fuel levels would remain high until a natural cleansing event occurs. Fires not immediately controlled could be expected to be stand-replacing events due to the fuel levels and species composition in the drainage.

This alternative perpetuates the current condition of the vegetation in the North Fork Mill Creek project area, which has been heavily influenced by the past fire suppression and logging activities as described earlier. There is higher probability and increasing risk of mixed and uncharacteristically lethal fire (stand-replacing) in the western half of the analysis area under this alternative. A future fire of this sort would result in dramatic changes to the vegetation condition, uncharacteristic of what the area historically experienced. The dense, continuous forest canopies in this area, with substantial fuel loadings and ladder fuels, would be susceptible to lethal crown fires, killing nearly all trees over large areas of forestland. This, of course, would have associated effects on forest structure and composition and other resources.

Transportation Systems

A more detailed transportation report is located in the project record, located at the Hood River Ranger District. The analysis and conclusions of the report are summarized below. Reference material is contained in the full specialists report.

Existing Conditions

In April 1981, the "Reduced Road Reconstruction Policy" was implemented on the Mt. Hood National Forest. (Copy available in project file.) The stated objective was to reduce the total cost of developing, maintaining and operating the transportation system. Also, the policy statement 7730.3 (b) Existing Road Reconstruction (1) Existing roads not meeting Forest Service Manual (FSM) requirements now or for future critical elements may be operated without reconstruction when the Forest Engineer determines the inadequacies can be mitigated (made less severe) by: (a) user scheduling (sale or public), (b) maintenance, and (c) adequate traffic devices that identify the hazards. Reconstruction and maintenance for timber sales was limited to the proportionate share of the total traffic on a road (Commensurate Share Policy).

For the structural design of the subgrade, base and surfacing the axel loading over the life of the timber sale (3 to 5 years) was used. The design used the Normal Season of Use generally from June 1st through October 31st. A term used during this time period was "All Weather Road" and the resulting design was intended to meet the conditions within the Normal Operating Season unless unusual conditions existed, such as higher moisture then was normal.

The Arterial and Collector roads that were reconstructed during this period of the "Reduced Road Reconstruction Policy" do not have a structural design capacity for soil moisture in the subgrade that is above optimum moisture for soil strength (ref. Standard Specifications for Transportation Materials and Method of Sampling and Testing: Tests T 90 and T99).

Roads are asphalt, gravel, and native surface. Road drainage consists of ditch to culverts or insloped or outsloped surface to draindips or berms. Roads in the Planning Area provide access for administrative, public, and commercial users. Some of the roads are used during winter for winter recreation.

Limited road maintenance dollars have resulted in a backlog of road maintenance. This has resulted in roads brushing in, drainages becoming non-functional, and road surfaces needing repair. Lack of maintenance negatively affects safety for the users, increased potential for damage and loss of road structure, and higher levels of sedimentation. Roads brushing in reduce visibility for safe driving. Failed drainages increase the road damage. Damaged road surfaces, such as pot holes, ruts, washboards, breached water bars and pavement cracking, can be obstacles to drivers and increase the rate of degradation of the road structure.

Table 3-16: National Forest System Roads that are within the project area.

Roads	Mile Post	Miles	Closed	Comments
1700000	6.53 to 8.66	2.13		Entering National Forest System
1700000	8.66 to 11.03	2.37		End Bituminous Surface Treatment – Begin Aggregate

Roads	Mile Post	Miles	Closed	Comments
1700012	0.00 to 0.10	0.10	0.10	
1700013	0.00 to 0.72	0.72	0.72	
1700660	0.00 to 2.35	2.35	0.00	
1700661	0.00 to 1.21	1.21	1.21	
1700662	0.00 to 3.04	3.04	3.04	
1700663	0.00 to 0.35	0.35	0.35	
1700664	0.00 to 0.22	0.22	0.22	
1700665	0.00 to 0.14	0.14	0.14	
1700720	0.00 to 0.40	0.40	0.40	
1700740	0.00 to 0.40	0.40	0.40	
1700780	0.00 to 0.09	0.09	0.00	
1710000	0.00 to 0.93	0.93	0.00	
1710620	0.00 to 0.00	0.13	0.13	
1710630	0.00 to 0.94	0.50	0.50	
1710631	0.00 to 0.40	0.40	0.40	
1710632	0.00 to 0.10	0.10	0.10	
1710640	0.62 to 1.28	0.66	0.00	Aggregate
1710640	1.28 to 1.90	0.62	0.00	Native
1710643	0.00 to 0.32	0.32	0.32	
1710644	0.00 to 0.61	0.61	0.00	
1710645	0.00 to 0.45	0.45	0.00	
1710690	0.00 to 0.40	0.40	0.40	
1710710	0.00 to 0.15	0.15	0.15	Road into Long Prairie
1711000	0.00 to 1.01	1.01	0.00	
1711000	1.01 to 4.05	3.04	0.00	
1711620	0.00 to 1.12	1.12	0.00	Aggregate
1711620	1.12 to 2.19	1.07	0.00	Native
1711621	0.00 to 1.68	1.68	0.00	
1711623	0.00 to 0.19	0.19	0.19	
1711624	0.00 to 0.92	0.92	0.92	Native
1711630	0.00 to 2.67	2.67	0.00	Native
1711640	0.00 to 0.40	0.40	0.40	
1711650	0.00 to 1.51	1.51	1.51	
1720193	0.00 to 2.30	2.30	0.00	
Total		**34.70**	**11.60**	

Summary of National Forest System Roads for Existing Conditions within Planning Area

- Total National Forest System (NFS) Classified Road = 34.7 miles
- Total NFS Classified Road that are Closed = 11.6 miles
- Total NFS Classified Road that are Open = 23.1 miles
- 10.3 square miles within the planning area
- 3.4 mile per square mile total road density for the planning area

- Open road density = 2.24 miles per square mile.
  This is less than the 2.5 miles of open road density of the Forest Plan Standards and Guideline (FW-208, Page Four-72) for this allocation.

Inventoried Winter Range

The Inventoried Winter Range is 2909 acres or 4.55 square miles. The open road density per square mile is 8.67 miles as shown in Tables 3-17 and 3-18 below. This is within the 2.0 miles of open road density of the Forest Plan Standards and Guideline (FW-208, Page Four-72) for this allocation.

Table 3-17: Acres of Inventoried Winter Ranger

Inventoried Winter Range	Acres
Normal Winter Range	702
Severe & Normal Winter Range	2207
Total	**2909**

Table 3-18: Roads within Inventoried Winter Range

Wear	Road #	Miles
Normal	1700662	0.35
Severe	1700662	1.06
Normal	1700665 *	0.00
Severe	1700665 *	0.00
Normal	1710640	0.14
Normal	1710644	0.58
Normal	1711000	0.72
Severe	1711000	1.37
Normal	1711621	0.49
Normal	1711630	0.51
Severe	1711630	2.09
Normal	1711650	0.58
Severe	1711650 *	0.00
Severe	1720192 **	0.00
Severe	1720193	0.77
Total		**8.67**

* = Closed Road
** = Road not within Project

Mt. Hood National Forest Plan B-10 Allocation Deer/Elk Winter Range

The Forest Plan B-10 Allocation Deer/Elk Winter Range is 2183 acres or 3.41 square miles. The open road density per square mile is 3.77 miles as shown in Tables 3-19 and 3-20 below. This is within the 1.5 miles of open road density of the Forest Plan Standards and Guideline (B10-036, Page Four-275) for this allocation.

Table 3-19: Acres of Deer/Elk Winter Range (B-10 Lands)

MHF Forest Plan Allocation	Acres
B10	1741
B10/B5	442
Total	**2183**

Table 3-20: Roads within Deer/Elk Winter Range (B-10 Lands)

Land Use Allocation	Road #	Miles
B10	1710640	0.212
B10	1711000	1.797
B10/B5	1711000	0.131
B10	1711630	0.819
B10/B5	1711630	1.021
B10	1711650 *	0.00
Total		**3.77**

* = Closed Road

Analysis Methodology and Assumptions

Roads were analyzed for three different seasons of haul: wet operation season, normal operating season and dry operating season. Given the existing conditions and life expectancy of roads, wet season haul would not protect the integrity of existing roads. A cost analysis to reconstruct main haul roads to withstand the wet operating season, or the normal operating season is economically prohibitive and beyond the financial capability of this project or any road maintenance or reconstruction funding source available. The roads were designed for hauling timber during the normal operating season, generally June through October (reference Mt. Hood December 18, 1989 extended season haul policy). The proposed action alternative was analyzed for the normal operating season haul. Soil moisture in the subgrade must be below its plastic limit to meet this design parameter.

Environmental Effects

No Action Alternative – Direct and Indirect Effects
Road use, access, reconstruction and maintenance would be reduced. Timber sales from the adjacent planning areas would continue. The road system would continue to deteriorate, increasing the backlog of maintenance and create higher reconstruction cost for future projects. The reduction of maintenance and reconstruction will have a negative effect on safety to the traffic, an increased negative impact to soil movement and water quality.

Proposed Action Alternative – Direct and Indirect Effects

<u>Log Haul Analysis</u>
Log Haul has the most critical effect on the transportation resource. The amount of moisture present in the subgrade or base course is a concern. Past commercial haul during wet conditions of the base and subgrade have weakened the structural capacity of aggregate surfaced as well as asphalt surfaced roads. Even with normal traffic, road damage is likely to occur. With heavy vehicles use on saturated base and subgrade, the damage would be accelerated. The haul route analysis is shown in Table 3-21.

Hauling during freeze/thaw conditions has damaged the surface and base materials. As frost penetrates the road prism, it pulls moisture up into the subgrade and base course material, saturating the subgrade. When the moisture in the subgrade and base course freezes, the ice expands, pushing soil and rock particles apart. This action reduces the compaction in the subgrade and base course, which in turn reduces the structural capacity of the road. During this freeze/thaw condition, moisture content normally reaches the saturated condition leaving the base and subgrade in a weakened condition. During this period, an 80,000 pound legal loaded truck will produce five times or more stress on the travelway than it would produce during optimum moisture conditions for the base and subgrade.

Plowing snow for winter haul eliminates insulation, which allows deeper frost penetration. Plowing also stores snow along the shoulders of the road. As the snow melts, the subgrade is saturated and prolongs the time it takes for the road to dry out in the spring. Snowplowing for use will accelerate damage caused from saturated soils and freeze/thaw. It will also set up a corridor for collecting and concentrating water during rain-on-snow events that could accelerate damage to the road and drainage structure.

The proposed action would involve log haul (See haul Route Analysis for details). Commercial haul would be prohibited when moisture is greater than the plastic limit in the subgrade and during freeze/thaw cycles, which would mitigate damage to road surfaces during the normal operating season.

The Commensurate Share Policy is used to determine maintenance and reconstruction responsibilities for any project that has commercial haul. Under this policy all competing users would be assessed their commensurate share of responsibility for maintenance and reconstruction. This policy would reduce the cumulative effects of commercial haul over a similar time frame. Timber sales from the adjacent planting areas would continue independent of this project. With the current mitigation measures and design features for the proposed action, there would be no unacceptable damage to Forest System Roads and no cumulative effects. Removing danger trees would increase safety for all users.

Table 3-21: Haul Route Analysis for Alternative 1

Road[1]	Miles	Brushing	Drainage[2]	Surface[3]	Blading[3]	Comments[4]
1700000 From MP 0.00 to 4.00	4.00	X	X	X	X	BST/AC
1700000 From MP 4.00 to 4.80	0.80	X	X	X	X	Agg
1700000 From MP 4.80 to 8.66	3.86	X	X	X	X	BST
1700000 From MP 8.66 to 11.03	2.37	X	X	X	X	Agg
1700013 From MP 0.00 to 0.70	0.72	X	X	X	X	Agg
1700660 From MP 0.00 to 2.34	2.34	X	X	X	X	Agg
1700661 From MP 0.00 to 1.21	1.21	X	X	X	X	Nat
1700663 From MP 0.00 to 0.35	0.35	X	X	X	X	Agg
1700664 From MP 0.00 to 0.22	0.22	X	X	X	X	Agg

Road[1]	Miles	Brushing	Drainage[2]	Surface[3]	Blading[3]	Comments[4]
1700720 From MP 0.00 to 0.40	0.40	X	X	X	X	Agg
1710000 From MP 0.00 to 0.93	0.93	X	X	X	X	National Forest Boundary Agg
1710000 From MP 0.93 to 2.30	1.37	X	X	X	X	Junction w/1710640 Agg
1710620 From MP 0.00 to 0.13	0.13	X	X	X	X	Nat
1710630 From MP 0.00 to 0.94	0.94	X	X	X	X	Nat
1710631 From MP 0.00 to 0.40	0.40	X	X	X	X	Nat
1710640 From MP 0.00 to 1.28	1.28	X	X	X	X	Agg
1710640 From MP 1.28 to 1.90	0.62	X	X	X	X	Nat.
1710644 From MP 0.00 to 0.61	0.61	X	X	X	X	Agg
1710690 From MP 0.00 to 0.40	0.40	X	X	X	X	Nat
1711000 From MP 0.00 to 1.01	1.01	X	X	X	X	Agg
1711000 From MP 1.01 to 4.05	3.04	X	X	X	X	Nat.
1711620 From MP 0.00 to 1.12	1.12	X	X	X	X	Agg
1711620 From MP 1.12 to 2.19	1.07	X	X	X	X	Nat.
1711621 From MP 0.00 to 1.68	1.68	X	X	X	X	Nat
1711623 From MP 0.00 to 0.19	0.19	X	X	X	X	Nat
1711624 From MP 0.00 to 0.92	0.92	X	X	X	X	Nat.
1711630 From MP 0.00 to 2.67	2.67	X	X	X	X	Nat. Decommission or fix
1711640 From MP 0.00 to 0.40	0.40	X	X	X	X	Nat
1711650 From MP 0.00 to 1.51	1.51	X	X	X	X	Nat
1720193 From MP 0.00 to 0.11	0.11	X	X	X	X	Nat
TOTAL MILES	**36.67**					

1 Roads are asphalt, gravel, and native surface.
2 Road drainage consists of ditch to culverts or insloped or outsloped surface to drain dips or berms.
3 Deep patching, patching and reconditioning of aggregate surface roads would use standard construction specifications. All work would be within the existing road structure.
4 Abbreviations: Asphalt Concrete = AC; Native Material = NAT; Crushed Aggregate = AGG; Bituminous Surface Treatment = BST

Only the road maintenance work needed for the haul route would be completed. All these maintenance activities would not be completed as part of this project. If road maintenance work is needed for log haul on a road proposed for decommissioning, the decommissioning would happen after the log haul is completed.

Road Density Analysis

Table 3-22 shows the road density of the proposed action, including the proposed road closures and decommissioning.

Table 3-22: National Forest System Roads that are within the project area with proposed road closures and decommissioning.

Roads	Mile Post	Miles	Closed	Comment
1700000	6.53 to 8.66	2.13	0.00	Entering NFL
1700000	8.66 to 11.03	2.37	0.00	End BST – Begin Agg.
1700012	0.00 to 0.10	0.10	0.10	
1700013	0.00 to 0.72	0.72	0.72	
1700660	0.00 to 2.35	2.35	2.35	
1700661	0.00 to 1.21	1.21	1.21	
1700662	0.00 to 3.04	3.04	3.04	
1700663	0.00 to 0.35	0.35	0.35	
1700664	0.00 to 0.22	0.22	0.22	
1700665	0.00 to 0.14	0.14	0.14	
1700720	0.00 to 0.40	0.40	0.40	
1700740	0.00 to 0.40	0.40	0.40	
1700780	0.00 to 0.09	0.09	0.00	
1710000	0.00 to 0.93	0.93	0.00	
1710640	0.62 to 1.28	0.66	0.66	Agg
1710640	1.28 to 1.90	0.62	0.62	Nat.
1710645	0.00 to 0.45	0.45	0.00	
1710710	0.00 to 0.15	0.15	0.15	Rd into Long Prairie
1711000	0.00 to 1.01	1.01	0.00	
1711000	1.01 to 4.05	3.04	0.00	
1711620	0.00 to 0.55	0.55	0.55	Agg
1711620	1.12 to 2.19	1.07	0.00	Nat
1711621	0.00 to 1.68	1.68	0.00	
1711623	0.00 to 0.19	0.19	0.19	Ck Distance
1711624	0.00 to 0.92	0.92	0.92	Nat
1711630	0.00 to 2.67	2.67	0.00	Nat
1720193	0.00 to 2.30	2.30	0.00	
Total		**29.76**	**12.02**	

Summary of National Forest System Roads for Alternative 1

- Total National Forest System (NFS) Classified Road = 29.7 miles
- Total NFS Classified Road that are Closed = 12.0 miles
- Total NFS Classified Road that are Open = 17.7 miles
- 10.3 square miles within the planning area
- 2.9 mile per square mile total road density within the planning area

- Open road density = 1.72 miles per square mile.
  This is less than the 2.5 miles of open road density of the Forest Plan Standards and Guideline (FW-208, Page Four-72) for this allocation.

Inventoried Winter Range

The Inventoried Winter Range is 2909 acres or 4.55 square miles. The open road density per square mile is 0.87 miles as shown in Tables 3-22 below. This is below the 2.0 miles of open road density of the Forest Plan Standards and Guideline (FW-208, Page Four-72) for this allocation.

Table 3-23: Roads in Inventoried Winter Range

Wear	Road #	Miles
Normal	1700662	0.350
Severe	1700662	1.058
Normal	1700665	0.00
Severe	1700665	0.00
Normal	1710640	0.143
Normal	1710644	0.580
Normal	1711000	0.000
Severe	1711000	0.000
Normal	1711621	0.489
Normal	1711630	0.000
Severe	1711630	0.000
Normal	1711650	0.581
Severe	1720193	0.774
Total		**3.98**

Mt. Hood National Forest Plan B-10 Allocation Deer/Elk Winter Range

The Forest Plan B-10 Allocation Deer/Elk Winter Range is 2183 acres or 3.41 square miles. The proposed action will result in no open roads (Table 3-23) during the seasonal closure that will exceed the 1.5 miles of open road density of the Forest Plan Standards and Guideline (B10-036, Page Four-275) for this allocation.

Table 3-24: Roads in Deer/Elk Winter Range (B10 Lands)

Land Use Allocation	Road #	Miles
B10	1710640	*0.000
B10	1711000	**0.000
B10/B5	1711000	**0.000
B10	1711630	**0.000
B10/B5	1711630	**0.000
B10	1711650	*0.000
Total		**0.000**

* = Closed Road
** = Seasonal Closure

Alternative 2 – Direct and Indirect Effects

Log Haul Analysis

The log haul route analysis was completed in the same manner as Alternative 1 and is summarized in Table 3-25.

Table 3-25: Haul Route Analysis for Alternative 2

Road[1]	Miles	Brushing	Drainage[2]	Surface[3]	Blading[3]	Comments[4]
1700000 0.00 to 4.00	4.00	X	X	X	X	BST/AC
1700000 4.00 to 4.80	0.80	X	X	X	X	Agg
1700000 4.80 to 8.66	3.86	X	X	X	X	BST
1700000 8.66 to 11.03	2.37	X	X	X	X	Agg
1700013 0.00 to 0.72	0.72	X	X	X	X	Agg
1700660 0.00 to 2.34	First 0.4	X	X	X	X	Agg
1710000 0.00 to 0.93	0.93	X	X	X	X	National Forest Boundary Agg
1710000 0.93 to 2.30	1.37	X	X	X	X	Jct w/1710640 Agg
1710640 0.00 to 1.28	1.28	X	X	X	X	Agg
1710640 1.28 to 1.90	0.62	X	X	X	X	Nat.
1710644 0.00 to 0.61	First 0.35	X	X	X	X	Agg
1711000 0.00 to 1.01	1.01	X	X	X	X	Agg
1711000 1.01 to 4.05	First 2.50	X	X	X	X	Nat.
1711620 0.00 to 1.12	1.12	X	X	X	X	Agg
1711620 1.12 to 2.19	1.07	X	X	X	X	Nat.
1711624 0.00 to 0.92	0.92	X	X	X	X	Nat.
1711630 0.00 to 2.67	2.67	X	X	X	X	Native surface; Decommission or fix
1711650 0.00 to 1.51	1.51	X	X	X	X	Nat
1720193 0.00 to 0.11	0.11	X	X	X	X	Nat
TOTAL MILES	**27.61**					

1 Roads are asphalt, gravel, and native surface.
2 Road drainage consists of ditch to culverts or insloped or outsloped surface to drain dips or berms.
3 Deep patching, patching and reconditioning of aggregate surface roads would use standard construction specifications. All work would be within the existing road structure.
4 Abbreviations: Asphalt Concrete = AC; Native Material = NAT; Crushed Aggregate = AGG; Bituminous Surface Treatment = BST

Similar to Alternative 1, only the road maintenance work needed for the haul route would be completed. All these maintenance activities would not be completed as part of this project. If road maintenance work is needed for log haul on a road proposed for decommissioning, the decommissioning would happen after the log haul is completed.

Alternative 2 uses the same National Forest System Road 1700000 as Alternative 1 for the primary access. The reduction of 1,524 acres treated will result in less commercial haul for Alternative 2. With the appropriate mitigation and maintenance requirements being required this reduction of commercial haul will not have significantly different effect from Alternative 1.

The reduction of 9.06 mile of Haul Roads for Alternative 2 is Maintenance Level 1 and 2 roads. Funding needed maintenance, restoration and decommissioning for Maintenance Level's 1 and 2 roads is difficult and unpredictable to obtain. This reduction in treated miles could have a negative impact for Alternative 2.

Comparison Between Alternatives

Table 3-26: Comparison of Existing Condition to Alternatives 1 – Proposed Action and Alternative 2

Item	Exiting Condition	Proposed Action Alternative 1	Alternative 2
Road Density in Planning Area	3.36 miles/sm total existing all roads	2.88 miles/sm total existing all roads	Same as Alternative 1
Open Road Density in Planning Area	2.24 miles/sm open road	1.72 miles/sm open road	Same as Alternative 1
Inventoried Winter Range	1.91 miles/sm open road	0.87 miles/sm open road	Same as Alternative 1
B-10 Allocation	1.11 miles/sm open road	0.00 miles/sm open road	Same as Alternative 1

Table 3-27: Comparison in Haul Route Analysis between Alternatives 1 and 2

Item	Alternative 1	Alternative 2	Difference from Alternative 1
Miles of National Forest System Roads for access	36.67	27.61	- 9.06
Acres Treated	2,800	1,276	- 1,524

Table 3-28: Road Comparison between Alternatives 1 and 2

Alternative 1		Alternative 2	
Road	**Miles**	**Road**	**Miles**
1700000 0.00 to 4.00	4.00	**1700000** 0.00 to 4.00	4.00
1700000 4.00 to 4.80	0.80	**1700000** 4.00 to 4.80	0.80
1700000 4.80 to 8.66	3.86	**1700000** 4.80 to 8.66	3.86
1700000 8.66 to 11.03	2.37	**1700000** 8.66 to 11.03	2.37
1700013 0.00 to 0.70	0.72	**1700013** 0.00 to 0.72	0.72
1700660 0.00 to 2.34	2.34	**1700660** 0.00 to 2.34	First 0.4
1700661 0.00 to 1.21	1.21	**1710000** 0.00 to 0.93	0.93
1700663 0.00 to 0.35	0.35	**1710000** 0.93 to 2.30	1.37
1700664 0.00 to 0.22	0.22	**1710640** 0.00 to 1.28	1.28
1700720 0.00 to 0.40	0.40	**1710640** 1.28 to 1.90	0.62
1710000 0.00 to 0.93	0.93	**1710644** 0.00 to 0.61	First 0.35
1710000 0.93 to 2.30	1.37	**1711000** 0.00 to 1.01	1.01
1710620 0.00 to 0.13	0.13	**1711000** 1.01 to 4.05	First 2.50
1710630 0.00 to 0.94	0.94	**1711620** 0.00 to 1.12	1.12
1710631 0.00 to 0.40	0.40	**1711620** 1.12 to 2.19	1.07
1710640 0.00 to 1.28	1.28	**1711624** 0.00 to 0.92	0.92
1710640 1.28 to 1.90	0.62	**1711630** 0.00 to 2.67	2.67
1710644 0.00 to 0.61	0.61	**1711650** 0.00 to 1.51	1.51
1710690 0.00 to 0.40	0.40	**1720193** 0.00 to 0.11	0.11
1711000 0.00 to 1.01	1.01	**TOTAL MILES**	**27.61**
1711000 1.01 to 4.05	3.04		
1711620 0.00 to 1.12	1.12		
1711620 1.12 to 2.19	1.07		

Alternative 1		Alternative 2	
Road	**Miles**	**Road**	**Miles**
1711621 0.00 to 1.68	1.68		
1711623 0.00 to 0.19	0.19		
1711624 0.00 to 0.92	0.92		
1711630 0.00 to 2.67	2.67		
1711640 0.00 to 0.40	0.40		
1711650 0.00 to 1.51	1.51		
1720193 0.00 to 0.11	0.11		
TOTAL MILES	**36.67**		

Soil Productivity

A more detailed soil productivity report is located in the project record, located at the Hood River Ranger District. The analysis and conclusions of the report are summarized below. Reference material is contained in the full specialists report.

Existing Conditions

Background and Introduction
The productivity and health of entire plant communities depend on the maintenance of healthy soils. Regional soil productivity protection standards were originally implemented in 1976, and have been revised several times since then (Pacific Northwest Region Monitoring and Evaluation Report, 2001). These standards are incorporated into the Mt. Hood Land and Resource Management Plan (Forest Plan) as part of the soil productivity chapter. Compared to some watersheds, soil distribution is relatively simple across the watersheds where this analysis area is located. Each type of soil is given a soil map unit (number) to show where they occur on a soil map. Then, each soil type is assessed for many risks and hazards called management ratings (e.g., erosion risk, compaction hazard, etc.), which for this report and analysis are located in the Soil Survey of The Dalles Watershed (High, 1989, unpublished survey). This planning area, directly north and adjacent to The Dalles Watershed, was remapped to expose more detail and match the numbering system used in The Dalles Watershed Soil Survey. As a result, it is useful as a starting point for site-specific planning such as this and is the survey that will be used in this analysis. Mapped at a scale of four inches to the mile, The Dalles Watershed Soil Survey is much more detailed than the Soil Resource Inventory (SRI, Howes, 1977), which covers the entire Mount Hood National Forest at one inch to the mile, and has been commonly used in other planning areas as a starting point for analysis.

Planning Area Characterization
The North Fork Mill planning area is approximately 6,600 acres, spanning an elevation range of 2,200 to 4,200 feet. Average annual precipitation ranges from 50 inches on the westside to 30 inches on the eastside, occurring mostly during the winter months. This planning area also contains the headwaters of Mosier and West Fork Neal Creeks.

Geology
This planning area has two distinctly different terrains. Each terrain has its own set of physical characteristics that are greatly influenced by the underlying geology and geologic history. The largest terrain unit encompasses the gently sloping ground in Neal Creek, Mosier Creek, and upper North Fork Mill Creek drainages. The rock units are relatively young lava flows and pyroclastic deposits. The lava flows formed a "cap rock", partially protecting this area from fluvial and glacial erosion. The product of this geologic history is a gently rolling upland with a low drainage density and almost no landslide hazard. The rocks have a low fracture density and as a result groundwater movement is slow. The upper surface of lava flows weather along their fracture planes to form large sub-rounded boulders. The elevations in this upper terrain unit are high enough to have supported small glaciers that only slightly modified the landscape. The low-angle slopes, poorly developed drainage system, thin glacial till deposits, and low permeability bedrock have all contributed to the development of numerous meadows in the area.

The second terrain unit is the steep-sided valley of lower North Fork Mill Creek. Older lava flows in this valley are highly fractured and more susceptible to erosion than the surrounding flatter area. Groundwater movement is rapid, drainage density is high, and many hillslope processes are active here. Many tributary channels to North Fork Mill Creek can experience debris flows that deliver material to the valley floor. These channels and their adjacent continuously steep hillslopes are identified as having a very high landslide hazard. Other steep hillslopes, not directly connected to the drainage system, are areas with a high landslide hazard.

Soil Types and Associated Landscapes

Soils across the planning area have been derived from glacially modified volcanic ash deposits ranging in depth from less than seven inches to greater than 20 inches. Due to the prevailing wind patterns, as Mount Hood would erupt, ash clouds would be carried downwind and deposited across the area. Subsequent winds, precipitation events, and landslides have altered, and continue to alter, the original depositional pattern by removing soil completely in some places exposing bedrock, and depositing it in others resulting in deep deposits. Despite the variability in soil depth, surface soil characteristics such as texture are fairly consistent across the proposed vegetation treatment areas and across the watersheds as a whole. The same holds true for the areas proposed for underburning treatments (prescribed fire).

Soil characteristics are quite different between the two basic landscapes or terrains as explained above within the planning area; gentle terrain in Neal, Mosier, and upper North Fork Mill Creek, and steep terrain in lower North Fork Mill Creek. The differences in soil development characteristics between the two landscapes are summarized in Table 3-29 and explained in detail below.

Table 3-29: Soil types on the Mt Hood National Forest within the planning area and useful ecological characteristics.

	North and West – Neal, Mosier, Upper North Fork Mill	*South and East – Lower North Fork Mill*
Soil types	13/14 → 1 → 5 → 6 → 10 → 4 → 7 → 8 → 3	
Soil characteristics	Glacial, Deeper, Lower rock content, Gentle slopes →	Steep, High rock content, Shallow
Vegetation	Cedar/W. Hemlock → Moist Grand fir → Dry Grand fir/Doug fir → Pond. Pine → Grassland	
Climate	Cooler, wetter →	Warmer, dryer
Organic matter	Average appx. 29 tons and six logs per acre →	Average 10 tons and one log per acre*
Fire frequency/type	Less frequent/stand replacing →	More frequent/underburn
Landslides	Very rare, usually small →	More frequent, larger

* From Managing Coarse Woody Debris in Forests of the Rocky Mountains (Graham et al., 1994)

Gentle terrain in Neal, Mosier, and upper North Fork Mill Creek:

Soils within this area are developing on gentle, glaciated terrain where slopes rarely exceed 30 percent. The primary activities proposed here are conifer thinning, sapling thinning, trail construction, road decommissioning, road closures, culvert removal/replacement, and aspen enhancement. Soil types occurring where activities are proposed include 1, 4, 5, 13 and 14 as described in the Soil Survey of The Dalles Watershed. Soils 1, 4, and 5 are deep, loamy, well-drained, productive soils that contain slightly higher gravel and rock content than described in the soil survey. The deep, loamy nature of the soils allows them to store adequate moisture for the growing season. Factors limiting growth here include cool temperatures and nutrient availability. Nutrients on these sites are stored in the duff layer, woody debris, and very thin light brown topsoil that is found just above the thin (an inch or less), nutrient poor bleached horizon.

Soils 13 and 14 are moist to wet, and support the aspen/cottonwood stands identified for enhancement in the proposed action. Soils here are silty with a dense clay pan that perches and stores water year round. These soils are nearly black with accumulated organic matter. However, productivity is somewhat limited by anaerobic conditions from the high water table, which confines the available rooting zone to the soil surface.

Steep terrain in lower North Fork Mill Creek:
Soils within this area are developing on very steep terrain where the average slope is approximately 50 percent. The primary activity proposed here is underburning (prescribed fire). Soil types occurring where activities are proposed include 3, 5, and 7. These soils differ from those occurring on the gentle ground in the following ways: they are generally not as deep due to eons of erosion on steep terrain; there are large patches that become droughty during the summer months because of aspect, high rock content, shallow depth and lack of precipitation; they have evolved under a more frequent fire regime, resulting in stands of large diameter fire resistant tree species that support more of a grass/forb understory where the canopy is not closed; and they store more nutrients in the mineral soil itself, rather than just a thin topsoil, duff, and old logs. These soils have a dark, well-structured surface horizon evident of high organic matter content referred to as a mollic horizon. They develop where perennial grasses and forbs dominate (or used to dominate) the understory. The decay of fine roots from grasses and forbs leads to an accumulation of organic matter in the topsoil. This area is a mosaic of vegetation types, where organic matter would come and go with natural wildfires; yet remain shady enough in pockets to deter the growth of an understory. Fire exclusion has brought about a domino effect of broad scale changes to vegetation species composition and structure, which has allowed fire sensitive species to encroach resulting in denser stands of trees, thus affecting soil properties. As more open stands close in, understories of grasses, forbs, and shrubs are shaded out, changing the soil development pathway from mollic to soils that typically develop under coniferous forest. Sites then begin to store their nutrients more in duff, coarse woody debris, and additional trees, rather than in the topsoil. This is not a desirable situation on this landscape because if fire occurs under these conditions it could result in an uncharacteristically severe loss of organic matter.

In addition, the non native species present on soil type 3 (dry meadow/grasslands) tend to be annual, weedy, shallow rooted species, such as cheatgrass, rather than the more desirable deep-rooted perennial bunchgrasses and forbs. As a result, erosion risk tends to increase. As topsoil is lost these sites tend to become less productive over time, further increasing the opportunity for invading non native plant species - overall a negative downward trend.

In the most productive forested areas on this landscape, soils were found to be sufficiently deep and loamy to support either dense stands of trees or more spaced out larger trees (sometimes both in the same stand). Factors limiting growth include hot summer temperatures and availability of water and nutrients.

Soil Analysis Methodology

In order to form a basis to predict impacts, the soil types have been divided into two main categories and further subdivided into a total of four general types based on slope steepness. The two main categories are soils that formed under a more frequent fire return frequency (based on vegetation types and surface soil characteristics) versus those under a more infrequent fire return frequency. Soils developed under more frequent fire returns tend to have a more developed, darker topsoil that 'stores and protects' site organic matter from loss during fire. Soils developed over time where fire is less frequent tend to be lighter in color and store nutrients above ground in the duff and woody material. These two types are further divided into soils on less than 30 percent slope and those on greater than 30 percent slope. A summary of soil mapping units and their associated management interpretations as adjusted by field observation is located in Table 3-30 below. Useful observations from the table include:

- All soils potentially impacted by machinery have a severe compaction hazard
- Erosion risks for soils on less than a 30 percent slope (those with C [0 to 15 percent] or D[16 to 30 percent] after the number) are rated from slight on undisturbed soils, to high on bare soils, and very high for bare compacted soils
- Erosion risks for soils on greater than a 30 percent (those with E after the number) slope are rated from slight on undisturbed soils to moderate for bare soils with high rock content, to very high for bare, fine textured soils

In the table, soil types written in *italics* are the ones where underburning is proposed, and soils shaded in green (gray if viewed in black and white) are the ones where vegetation manipulation is proposed. Soil types written in **bold** (13 and 14) are the aspen enhancement sites. The remaining soils with no highlights are mapped within the planning area, but have no actions proposed on them. See Figure 3-11 for a map of soil types.

Table 3-30: Summary of soil types in the analysis area and associated management interpretations adapted from The Dalles Watershed Soil Survey.

Soil Map Units	Compaction Hazard	Erosion Risk		
		Undisturbed	Bare Soil	Bare and Compacted Soil
More Frequent Fire <30% slope				
3C	Moderate	Slight	Moderate	High
3D	Moderate	Slight	High	Very High
5C	Severe	Slight	Moderate	Very High
5D	Severe	Slight	High	Very High
8C	Moderate	Slight	Moderate	High
More Frequent Fire >30% slope				
3E	N/A	Slight	Moderate	N/A
5E	N/A	Slight	High	N/A
7E	N/A	Slight	Very High	N/A
8E	N/A	Slight	Very High	N/A
Less Frequent Fire <30% slope				
1C	Severe	Slight	Moderate	High
4D	Severe	Slight	High	Very High
13C/14C	Extreme	Slight	Moderate	Very High
Less Frequent Fire >30% slope				
1E	N/A	Slight	Very High	N/A
4E	N/A	Slight	Very High	N/A
6E	N/A	Slight	Very High	N/A
10E	N/A	Slight	Very High	N/A

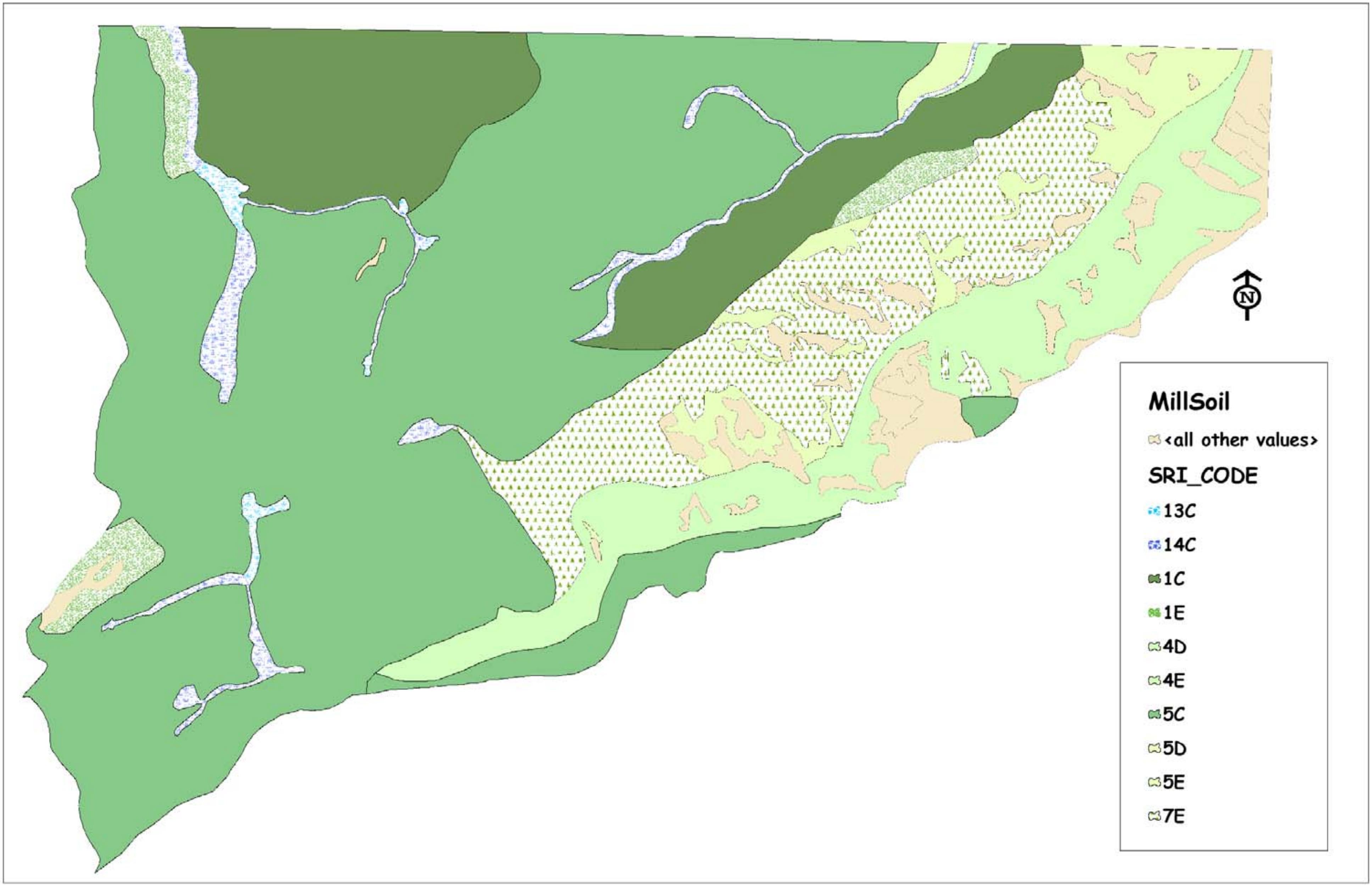

Figure 3-11: Soil map units in the North Fork Mill Planning Area are fairly simple in the solid greens, more complex and variable in the tans and stippled patterns. 'All other values' consists of smaller mapped units lumped together in lower North Fork Mill Creek Canyon

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Analysis Area, Applicable Standards and Guidelines, and Methodology
The analysis area for soil resources in this Environmental Assessment (EA) are the proposed treatment boundaries. A comparison of alternatives will be conducted using applicable Forest Plan standards and guidelines (Table 3-31) as the method of measure to answer the following questions:

> 'If the proposed ***actions*** are implemented, what measurable ***changes*** occur to the soil, and of the changes, which do we use in the analysis to describe the ***effect?*** What are the consequences of taking no action?'

In other words, what are the risks to the soil and related/associated values from projects in the action alternatives? Is it possible to reduce risks through mitigations measures or design criteria? What would happen if no action is taken? For this analysis and project types (vegetation management, underburning, trail construction, road decommissioning, road closures, and culvert removal/replacement), the following three measures will be used to assess impacts:

1. The risk of erosion and subsequent sedimentation of adjacent water bodies.

   Erosion Hazard: The possible impact of concern stemming directly from soil erosion is runoff from bare areas carrying sediment that affect watercourses. This hazard rating is based upon a particular soils' texture, slope, etc. under three differing circumstances – ***undisturbed; bare soil; and bare and compacted*** soil. Surface soils within each of the two landscape terrains will respond to disturbances in different ways, resulting in erosion hazard ratings appropriate for each.

2. The risk of detrimental soil conditions, such as heavy compaction and intense burning, that alter water movement through the soil and reduce site productivity.

   Detrimental Soil Condition: The Mount Hood National Forests standard of no more than 15 percent detrimental soil condition in an activity area following project completion will protect site productivity, maintain water movement through the soil, reduce erosion risks and associated sedimentation, and protect organic matter. All soils within the planned treatment areas have a moderate to severe compaction risk due to inherent soil properties.

3. The risk of altering the soil biological ecosystem because of insufficient amounts of down woody debris to feed the forest carbon and nutrient cycles in less frequent fire plant communities, or the burning of uncharacteristically high amount of organic matter in more frequent fire plant communities.

   Soil Biology (organic matter levels): Poorly functioning soil biological systems may lead to difficulties in revegetation efforts, or decline in existing desirable vegetation. In and of itself, soil biology is extremely difficult to evaluate because of infinitely complex interactions occurring between organisms and their soil habitats, including physical and chemical characteristics. It is assumed that soil biological systems will properly function given certain habitat components are present, such as non-compacted soils, appropriate levels of organic matter, and types of native vegetation under which the soil developed.

Management actions that displace, burn or compact soil or that remove groundcover are considered to result in a greater risk to soil productivity. The analysis will also consider restorative actions, mitigation measures and design criteria, and best management practices to minimize impacts. These actions would include landing use (some existing landings would be reused and some new landings would be created), skidding with ground based equipment (some would use existing skid trails and some areas would have new skid trails), the use of low impact (low ground pressure) harvester felling equipment, skyline lateral yarding and corridors, temporary road use (some roads are existing, some would be built on top of already disturbed ground and some would be on previously undisturbed ground), temporary road and landing obliteration, erosion control activities, and landing slash burning. Other components of Alternative 1 - Proposed Action and Alternative 2 would not have a meaningful or measurable affect on soil productivity.

Table 3-31: Summary of Forest Plan Soil Standards guiding the soils analysis. Full texts of these standards are on pages 4-49 and 4-50 of the Mt. Hood National Forest Land and Resource Management Plan.

<table>
<tr><th colspan="2">Summary of Forest Plan Soil Standards</th></tr>
<tr><td>FW – 025
(Page 4-49)</td><td>In the first year following surface disturbing activities, the percent effective groundcover by soil erosion hazard class should achieve at least the following levels:
<table>
<tr><th>Soil Erosion Hazard Class (risk)</th><th>Effective Groundcover</th></tr>
<tr><td>Slight to Moderate</td><td>60%</td></tr>
<tr><td>High</td><td>75%</td></tr>
<tr><td>Very High</td><td>85%</td></tr>
</table></td></tr>
<tr><td>FW – 022, 023
(Page 4-49)</td><td>The combined cumulative detrimental soil impacts occurring from both past and planned activities should not exceed 15% of an activity area (paraphrased).</td></tr>
<tr><td>FW – 032, 033, 034
(Page 4-50)</td><td>Favorable habitat conditions for soil organisms should be maintained for short and long-term soil productivity. At least 15 tons per acre should be maintained and evenly distributed across managed sites (paraphrased).</td></tr>
</table>

The methodology used to gather data needed for this effects analysis include field visits as well as previous field experience in this and adjacent watersheds, which include the Fivemile planning area to the south (1996), South Fork Mill watershed to the south (2006), Mill Creek Watershed Analysis (1997), and the 17 road fuel break on the west (2002). Professional observation and knowledge of how soils respond to the proposed types of management actions was used to predict impacts.

Assumptions and Design

- Damage on skid trails would not exceed 12-feet in width;
- Conceptual layout of logging system patterns have been designed to ensure less than 15 percent of the area is impacted (ground disturbance – detrimental soil condition) within each proposed treatment that uses ground-based equipment;

- Undisturbed soils meet the Forest Plan groundcover standards;
- Underburns would be low severity, with very little moderate and even less high severity in aerial extent;
- Ground impacts would take place during the normal operating season, when soil damage risk is lower than for the same activities occurring in winter;
- Recreation trails would be constructed and maintained to standards that reduce erosion hazards; and
- Road decommissioning and culvert removals/replacements would follow standard and proven procedures to ensure success with minimal impacts.

If a proposal to implement winter logging is presented, the following should be considered by the District Ranger if the ground is not frozen hard enough and/or insufficient snow depth to support the weight and movement of machinery in moist to wet soil conditions (these are based upon observations and monitoring of winter logging in Sportsman's Park on the Barlow Ranger District):

A. The proposal should be considered on a unit-by-unit basis using soil types in the area as a guide since some soils may be more prone to detrimental damage than others

B. Because the margin of difference between not detrimental and detrimental soil damage could be so slim under moist to wet soil conditions, monitoring of the logging activity may need to occur daily, or more, as agreed to by a sale administer and soil scientist

C. Equipment normally expected to traverse the forest, such as feller bunchers, track mounted shears, etc., should be restricted to skid trails once soil moistures are such that even one or two trips are causing detrimental soil damage out in the unit (i.e., not on landings or skid trails)

D. Due to higher PSI (pounds per square inch) than track mounted equipment, no rubber tired skidders should be used even on skid trails once soils become nearly saturated (approach their liquid limit)

Environmental Effects

Current and Predicted Changed Conditions Caused by Activities Described in Action Alternatives

<u>Soil Erosion Risk</u>

No active erosion from previous vegetation management was observed during the field reconnaissance for this project. All vegetation treatment areas (thinning, underburning, and aspen enhancement) are expected to meet the effective groundcover standard in aerial extent following ground disturbing activities. However, these activities (especially thinning) would result in the largest amount of exposed soil compared to the other actions that are proposed.

Trail construction and maintenance would result in bare, compacted soil, and thus would increase the risk of soil erosion. The highest risk areas are very short segments on steeper slopes near Mosier Creek and West Fork Neal Creek. The highest likelihood for sufficient soil movement to actually reach running water is in the first year or two after construction. Bridge installations at crossings would help minimize impacts that would occur on stream banks and within the stream channel. The remainder of trail construction is on gentle to nearly flat terrain, and while the erosion risk for bare and compacted soils is high, the actual movement of soil material would be within a very short timeframe and limited to very short distances.

Road decommissioning and culvert removals/replacements would follow standard and proven procedures to ensure success with minimal impact. Erosion risk would be very slightly lower due to a minimal increase in vegetated area. Overall watershed function is increased by these projects, explained in detail in the Water Quality Specialist report.

Detrimental Soil Conditions

The results of field surveys from the Mill Creek watershed are shown in Table 3-32 below. Areas examined showed existing detrimental damage, primarily on non-system roads and old skid trails.

Table 3-32: Summary of stands monitored with shovel probe transects in the North Fork Mill Planning Area.

Watershed	Acres	Silviculture Treatment*	Logging System	Fuel Treatment	Previous Entries	% Current Detrimental Soil Impacts
Mill Creek	12	Unknown	Ground	None	1	6
Mill Creek	12	Unknown	Ground	None	1	<1
Mill Creek	74	Unknown	Ground	None	1	4

* Stands appeared to have no particular silvicultural prescription other than to remove scattered trees within the area. No evidence to indicate fuels treatments occurred post-harvest.

The conceptual layout of logging system patterns for the proposed treatment areas have been designed to ensure less than 15 percent of the area is impacted (ground disturbance) within each individual stand that uses ground-based equipment. Since ground disturbance does not equate with detrimental soil condition, and design already has impact area below 15 percent, it is not expected that any of the proposed treatment areas would exceed the Forest Plan standard. Soils underlying skid trails nearest landings are most likely to incur detrimental damage because they receive the most trips with equipment. Further away from landings, soils are impacted less and less as fewer trips occur over them. The past several years of Forest Plan monitoring results indicate a clear trend in the reduction of detrimental impacts due to the use of lower ground impact machinery. Observations during monitoring indicate obvious detrimental impacts on main skid trails and landings that receive numerous trips with higher impact machinery (such as skidders) with much less impact on lateral trails and within the unit where harvester equipment typically works. As an example, a recently thinned area in the West Fork Hood River watershed was yarded with a large log loader. Random shovel probes occurring right behind the machine as it moved through the unit showed virtually no impact at all, and not even close to what would be considered detrimental.

Due to the nature in which they occur on the land, trail, road, and culvert projects are typically not evaluated against this standard. In other words, they are not at all like a timber sale unit, where amount of area meeting detrimental soil condition can be measured against a known, bounded project area.

Organic Matter Levels
It is likely organic matter would be reduced to levels below Forest Plan standards in the higher fire frequency areas within the thinning and underburning areas. Since the overarching goal is to reintroduce fire into an area where it should be naturally occurring, it is a trade-off to meet the purpose and need. Organic matter levels are expected to be met on the more northerly facing slopes where fire returns are a bit longer. Trail, road, and culvert projects should not change the current levels of organic matter.

No Action Alternative – Direct and Indirect Effects

Soil Erosion Risk
The risk of erosion within the analysis area would remain as it is because the amount of groundcover protecting the soil surface from erosional influences is prevalent. The expected effect is the landscape would respond and change proportionate to the severity of natural events, such as storms or wildfire. Uncharacteristically hot wildfire due to fuel build ups may occur, depending on many unpredictable factors such as field conditions during burning, etc. These effects would likely be localized, but some areas may experience a decrease in site productivity.

Detrimental Soil Conditions
It is assumed that damaged soils would continue to recover and change at an unknown rate as roots, animals, and other influences slowly break up existing compaction. The effect of soil recovery is a gradual increase in available soil (therefore nutrients and water) for all normally expected soil biological, chemical, and physical functions to occur.

Organic Matter Levels
Soil organic matter and corresponding soil functions would continue to occur as they are in a general sense. Similar to erosion risk, the expected effect is that the soils at landscape and site scales would respond and change proportionate to the severity of natural events such as storms or wildfire. In addition, organic matter decomposition is influenced substantially by temperature, moisture, and fire, thus the rate of decay and cycling would continue accordingly. The aspect of this alternative in terms of organic matter risk is the unpredictability of uncharacteristic wildfire severity in higher fire frequency stands that have experienced conifer encroachment. Recent observations of local wildfires (i.e. Ball Point on the Barlow Ranger District) that have occurred under these same conditions show high fire severity is possible in blocks of tens to hundreds of acres.

Alternative 1: Proposed Action – Direct and Indirect Effects

Soil Erosion Risk
For thinning treatments the soil erosion risk would increase with the proposed action because bare soil would be exposed during implementation. As amount of bare, bare/compacted soil increases, so does the risk of soil movement. Actual resource damage (erosion and/or sedimentation) depends on weather events that would provide the energy to move soil material

from one location to another. In order to diminish this risk while soils are exposed, certain erosion control techniques are practiced to reduce erosive energies. The effectiveness of these Best Management Practices (BMP), is discussed by Rashin et al. (2006) in a publication of the Journal of the American Water Resources Association. Comparing the proposed action to their application of studied BMP would indicate the proposed buffers, logging system criteria, etc. would substantially reduce the risk of resource damage should a storm event occur while the ground is exposed. For example, the study showed an assessment of surface erosion and sediment routing during the first two years following harvest indicated a 10 meter (approximately 30 feet) setback from ground disturbance can be expected to prevent sediment delivery to streams from about 95 percent of harvest related erosion features. The proposed action design uses setbacks from nearly double to 10 times that distance, in addition to directional felling, etc that would further reduce erosion features and disturbance. Therefore, by maintaining proper amounts of protective groundcover along with BMP design criteria, the risk of erosion and subsequent sediment delivery caused by the thinning treatments is extremely small.

Underburning treatments are occurring on the steepest landform in the planning area. The soils and vegetation here have evolved with fire, and therefore it is not expected to release measurable amounts of erosion. At most there could be some minor wind and/or water erosion on the surface soils, which is not expected to enter North Fork Mill Creek.

The aspen/cottonwood enhancement (ACE) areas would one of the highest risk projects that could produce localized sedimentation because the area of disturbance is directly adjacent to high water tables and small stream channels that are typically found emerging from these stands. These areas are also very flat, and provided that streambanks and small channels are protected, any exposed soil that could end up as sediment in the stream channel would be extremely small and would not move very far. Fortunately, the soils found here are nearly black with organic matter, which provides a great amount of resiliency to the forces of disturbance that expose soil to erosional forces.

Road associated projects also use BMP guides that have proven effective to minimize impacts.

Detrimental Soil Conditions

There would be an increase in the amount of detrimental soil damage within the thinning treatment areas caused by heavy equipment. This increase is not expected to exceed Forest Plan standards, and therefore no accompanying decrease in site productivity. The Changed Condition section above explains how logging systems are expected to impact the ground based treatment areas related to detrimental soil impacts.

There would likely be small isolated pockets of high burn severity in the underburning treatments. It is doubtful this would amount to more than 1 or 2 percent of the overall underburning area.

Trail construction, road decommissioning/closures, and culvert alteration projects would also cause minor amounts of detrimental soil conditions following implementation. However, the 15 percent standard is not used to measure these projects due to the lack of methodology to define the overall project area. These types of projects are typically viewed strictly in terms of erosion risk.

Organic Matter Levels
In thinning areas there would be substantial future organic matter left standing in addition to material on the ground, although it is likely localized acreage would be lower than Forest Plan standards for organic matter in the higher fire frequency areas within the thinning project on south and west facing slopes. When this occurs, it is not expected to be a substantial impact to nutrient cycling because these are ecosystems where fire typically moved through very quickly, thus retaining substantial organic matter reserves in the mineral topsoil due the way in which they have developed. The same conclusion applies for the underburning treatments.

Trail, road, and culvert projects are not expected to have a measurable effect on forest organic matter levels.

Alternative 2 – Direct and Indirect Effects

Soil Erosion Risk
This alternative proposal reduces the amount of acreage impacted from the vegetation treatments (thinning). All other actions and their associated predicted effects would be the same. Therefore, overall erosion risk in this alternative would be slightly less, simply due to less exposed ground.

Detrimental Soil Conditions
This alternative proposal reduces the amount of acreage impacted from the vegetation treatments (thinning). The lower amount of impact will be proportional to the amount of reduced treatment areas compared to the proposed action. Although there would be an increase in the amount of detrimental soil damage within the thinning treatment areas compared to no action, the increase is not expected to exceed Forest Plan standards, and therefore no accompanying decrease in site productivity. All other actions and their associated predicted effects would be the same.

Organic Matter Levels
Effects occurring on treated acres would be the same as Alternative 1, and effects on acres dropped from this alternative would be similar to the no action alternative.

Cumulative Effects
Analysis of soil impacts for this kind of project inherently incorporates cumulative effects on an activity area basis, since we are examining previous impacts plus expected. On a larger scale, there is unauthorized Off-highway vehicle (OHV) use occurring in Ramsey Creek south of the project area, which has resulted in obvious localized erosion and subsequent sediment input directly into the stream. The amount of sediment has not been measured. Efforts are undertaken to discourage the OHV use when it is observed in the field (placing logs, limbs, rocks in the trail, etc).

Table 3-33: Summary Table of Environmental Effects for Alternative 1 and 2.

Project		Erosion Risks on Project Site`	Erosion Risk Off-Site	Detrimental soil condition > 15%	Organic Matter Levels to Forest Plan Standard
Thinning*	**Alt 1**	Increased	May move short distances off site, but very unlikely to reach watercourses	Not likely to exceed 15%	Not likely to meet standard as currently written on some south and west slopes. Would likely meet on north and east
	Alt 2	Slight increase	Highly unlikely	Not likely to exceed 15%	Same as Alt 1, but on fewer acres
Sapling Thinning		None	None	No	No appreciable change – more small sized Organic Matter on the ground
Aspen Enhancement		Increased	Not likely to move off site	No	Yes
Underburning		Increased	Not likely to move off site	No	No
Trail Construction		Increased	Short-term (2 yrs) risk to enter watercourse crossings where steep side slopes occur above crossing	N/A	N/A
Road Decommissioning and Closures		Increased	Not likely to move off site	N/A	N/A
Culvert Projects		Increased	Short-term (less than 1 yr) – highly likely	N/A	N/A

* Alternative 2 impacts, or risk of impacts, would be proportionally less based on the acreage proposed as compared to the acreage in the proposed action alternative. All other project effects are the same.

Watershed Resources

A more detailed watershed resources report is located in the Water Quality Specialist Report in the project record, located at the Hood River Ranger District. The analysis and conclusions of the report are summarized below. Reference material is contained in the full specialists report.

Existing Conditions

Almost all of the North Fork Mill Restoration Project is located within portions of three 7th field sub-watersheds, 24B (West Fork Neal Creek), 21K (Mosier Creek) and 14A (North Fork Mill Creek). Nintythree acres or a little over 1 percent of the planning area is locted in 21A (Neal Creek 7th field sub-watershed). All of the above mentioned 7th field sub-watersheds are located within the Neal Creek, Upper Mosier Creek and North Fork Mill Creek 6th field watersheds. The 5th field watersheds include Hood River, Mosier Creek and Middle Columbia/Mill Creek. North Fork Mill Creek (14A) 7th field sub-watershed is part of the Mill/Fivemile/Eightmile Creeks Tier 1 Key Watershed as identified in the Northwest Forest Plan (NWFP). See Figure 3-12 for map of area.

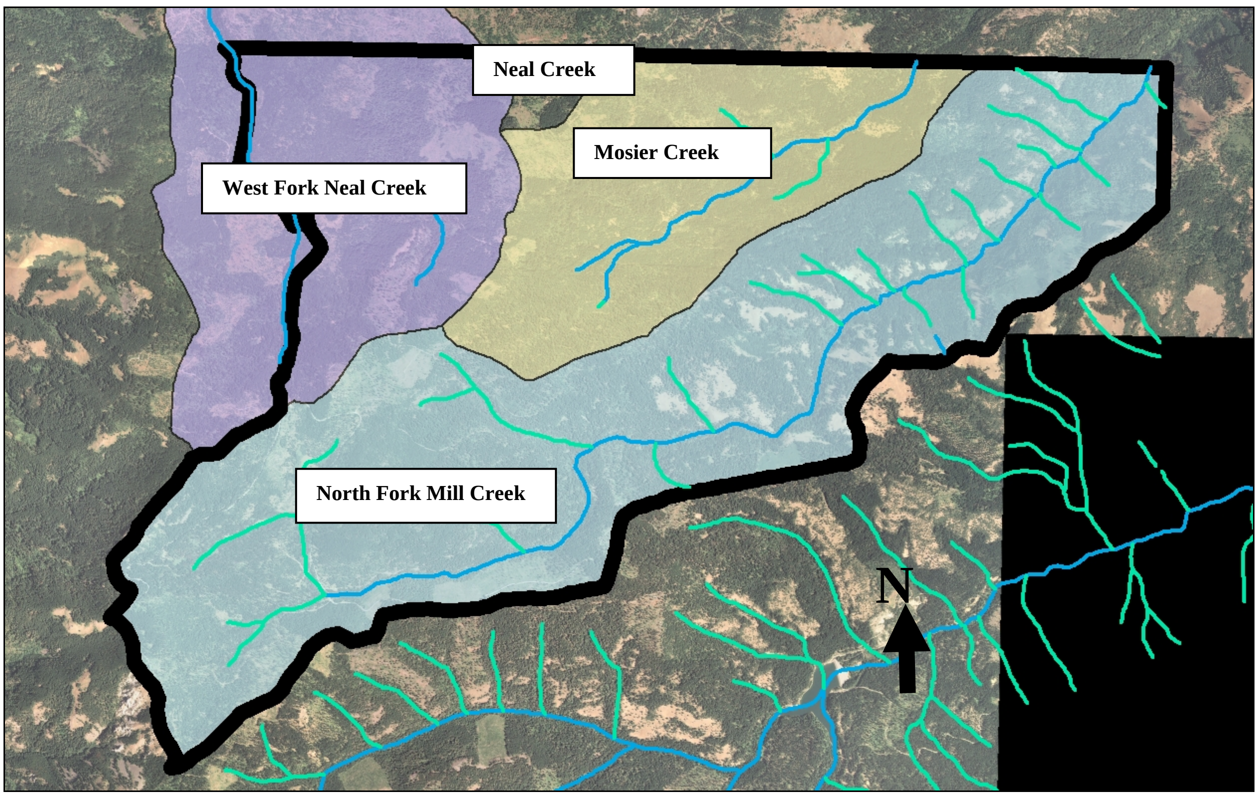

Figure 3-12: Map showing the location of the three major 7th field watersheds and the small portion of Neal Creek that are part of the North Fork Mill Planning Area. The planning area is outlined in black and is in the central portion of the map.

There are many streams, springs and wetlands located within these sub-watersheds. The primary streams include West Fork Neal Creek (24B), Mosier Creek (21K), and North Fork Mill Creek

(14A). There are approximately 90 miles of stream in the National Forest portion of these 7th field sub-watersheds in the following categories: 46 miles of perennial streams (flow year around) and 44 miles of intermittent streams (streams that dry up for part of the year).

Water Quality

Rivers, streams, and lakes within and downstream of the treatment areas are used for boating, fishing, swimming, and other water sports. Additionally, the Forest streams provide habitat and clean water for fish and other aquatic biota, each with specific water quality requirements. The Clean Water Act (CWA) protects water quality for all of these uses.

The CWA requires States to set water quality standards to support the beneficial uses of water. The Act also requires States to identify the status of all waters and prioritize water bodies whose water quality is limited or impaired. For Oregon, the Department of Environmental Quality (DEQ) develops water quality standards and lists water quality limited waters. In addition, Region 6 of the Forest Service has entered into a Memorandum of Agreement (MOA) with the Oregon State DEQ to acknowledge the Forest Service as the Designated Management Agency for implementation of the CWA on National Forest land. In an effort to support the CWA, the Forest conducts a variety of monitoring and inventory programs to determine status of meeting state water quality standards as well as other regulatory and agency requirements. In an average year, approximately 75 sites are monitored for water temperature throughout the Forest. In addition, other water quality monitoring occurs at various locations throughout the Forest depending on the year. This could be turbidity monitoring, instream sediment sampling, water chemical sampling, or surveys of physical stream conditions. Currently, approximately 25 miles of physical stream habitat is surveyed every year and to date approximately 1200 miles of stream have been surveyed. Some of the information collected during these surveys includes the number of pools and riffles, amount of large wood, riparian area condition and types, and numbers of fish and other aquatic organisms.

By direction of the CWA, where water quality is limited, DEQ develops Total Maximum Daily Load (TMDL) plans to improve water quality to support the beneficial uses of water. For water quality limited streams on National Forest System lands, the USDA Forest Service provides information, analysis, and site-specific planning efforts to support state processes to protect and restore water quality. Currently, Hood River Basin has a completed TMDL and the Miles Creek Basin is in the process of TMDL development. Once the TMDL plan is completed, streams would be removed from the 303(d) list and stream recovery would be achieved through an implementation plan. Following is a table (Table 3-34) displaying the 2004/2006 State of Oregon 303(d) list for streams that are in the planning area. The list only includes criteria that this project may have some effect on.

All listed segments that occur on National Forest land are either attaining the criteria or there is insufficient data for listing, except salmon and trout rearing and migration water temperatures on Mosier Creek.

Table 3-34: 2004/2006 State of Oregon 303(d) List for Streams in the Planning Area

Stream Name	River Mile	Parameter	Season	Criteria	Status
North Fork Mill Creek	0 to 3.8	Temperature	Year Around (Non-spawning)	Salmon and trout rearing and mitigation; 18.0 °C 7-day-average maximum.	Cat 5: Water quality limited, 303(d) list, TMDL needed.
	3.8 to 13.1	Temperature	Year Around (Non-spawning)	Core cold water habitat: 16.0 °C 7-day-average maximum.	Cat 2: Attaining some criteria/uses.
	0 to 123	Temperature	October 15-May 15	Salmon and steelhead spawning: 13.0 °C 7-day-average maximum.	Cat 2: Attaining some criteria/uses.
Mosier Creek	0 to 16.1	Sedimentation	Undefined	The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation or industry may not be allowed.	Insufficient data
	0 to 16.2	Temperature	Year Around (Non-spawning)	Salmon and trout rearing and mitigation; 18.0 °C 7-day-average maximum.	Cat 5: Water quality limited, 303(d) list, TMDL needed.
	0.4 to 1.2	Temperature	October 15-May 15	Salmon and steelhead spawning: 13.0 °C 7-day-average maximum.	Cat 2: Attaining some criteria/uses.
West Fork Neal Creek	0 to 9	Temperature	Summer	Rearing 17.8 °C	Attaining
	0 to 9	Sedimentation	Undefined	The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation or industry may not be allowed.	Insufficient data

Stream Temperature

Water temperature data has been collected by the Forest Service on the above mentioned stream systems for many years. Data has been collected on continuous temperature recording dataloggers in North Fork Mill Creek for the past 9 years and West Fork Neal Creek for the past 14 years (see Figure 3-13). Grab samples were also collected during stream surveys in North Fork Mill Creek and West Fork Neal Creek.

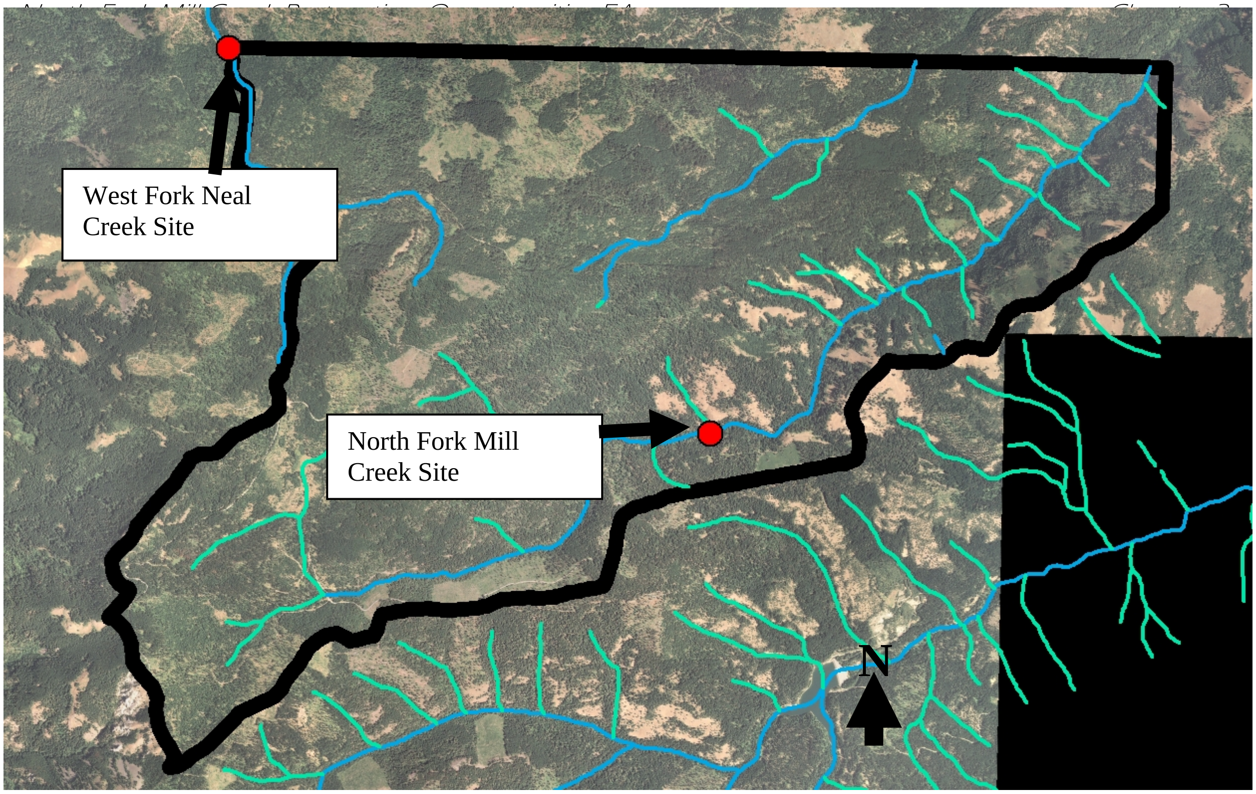

Figure 3-13: Water temperature monitoring sites in the North Fork Mill Restoration Project area. Monitoring sites are shown as red circles on the map and the North Fork Mill Project area is shown in black.

The highest 7-day average maximum stream temperatures (in °C) for the years deployed are shown in Table 3-35.

Table 3-35: 7-day Average Maximum Stream Temperatures (in °C)

Stream	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
N. Fk Mill Ck	ND	ND	ND	ND	ND	14.0	14.0	14.6	14.5	13.4	14.7	14.3	15.4	14.9
W. Fk Neal Ck	14.8	14.4	14.6	13.5	14.9	13.3	13.2	13.7	14.3	13.8	13.8	12.8	17.9	13.6

ND = Not Deployed for that Year at that Site

The section of North Fork Mill Creek from river mile 0 to river mile 3.8 is listed on the 2004/2006 State of Oregon 303(d) list of impaired water bodies for salmon and trout rearing and migration water temperatures that exceed a 7-day average maximum of 18.0°C. This section is located approximately 3 miles downstream of the National Forest boundary. As displayed in the table above, the highest 7-day average maximum stream temperatures for the site on National Forest land ranged from 13.4°C to 15.4°C for the nine years of deployment.

The section of Mosier Creek in the project area is also listed on the 2004/2006 State of Oregon 303(d) list of impaired water bodies for for salmon and trout rearing and migration water temperatures that exceed a 7-day average maximum of 18.0°C . As displayed in the table above, the Mosier Creek site has been below the 18.0°C standard every year that equipment has been deployed.

In summary, temperature standards are being met in all streams within the planning area. Continuos recording data loggers have been deployed in area streams since 1994, and standards have never been exceeded during that period of record.

Sediment and Stream Channel Condition

Both West Fork Neal and North Fork Mill Creeks have low channel gradient headwaters and steeper, more confined middle sections. The upper section of N. Fk Neal Creek (area around Long Prairie) is a "C4" Rosgen channel type that is actively downcutting. Rosgen (1996) identifed riparian vegetation as having a "very high" controlling influence on the stability of a C4 channel. He also identified this channel type as having a "very high" sensitivity to disturbance from increases in sediment.

Frequent trampled streambanks due to cattle use were identified on portions of West Fork Neal Creek during a 1993 stream survey, from river mile 6.45 to 8.8 (area within the Long Prairie Grazing Allotment). This was further verified during field visits conducted in the summer and fall of 2004 as part of the Long Prairie Grazing Allotment project. Numerous areas of bank trampling, fine sediment introduction, channel downcutting and riparian vegetation removal were noted and mapped along a 0.5 mile section of West Fork Neal Creek in the Long Praire area. A total of 27 areas of bank trampling and 23 stream cattle crossings or an average of 1 crossing or trampled bank every 50 feet of stream were identified. This represents approximately 1500 ft2 of concentrated disturbance in the 0.5 mile section of stream. This is a high use area for cattle due to the location of the main corral where the cows are turned out and gathered every year.

The upper reaches of North Fork Mill Creek (area around Gibson Prairie) are of similar channel type and similar general channel condition to those described for West Fork Neal Creek. North Fork Mill Creek is undergoing more severe channel downcutting around Gibson Prairie than W. Fk. Neal, due in part to the loss of riparian vegetation from grazing. The Mill Creek Watershed Analysis (Ch-III-Q3-1) noted degradation of Gibson Prairie due to cows keeping "riparian grasses short" and physically altering the stream banks. "The ephemeral streams within the meadow complex are actively downcutting which has resulted in a lowered water table, effectively draining the meadow." This was also verified during field visits during the summer of 2004. As a result of this damage, measures to reduce these impacts were identified in the Long Prairie Environmental Assessment and are in the process of being implemented. These include the construction of exclosure fences around impacted riparian areas, some of which are already in place. Since the allotment is currently not being used, the effectiveness of the fences are not known at this time.

Another potential source of coarse and fine sediment is roads. Sediment can wash off road surfaces into adjacent streams. Road density (miles of road per square mile of basin) can be used as a general indicator of potential problems associated with roads. Road densities within a sub-watershed that exceed 3.0 miles per square mile indicate areas that should be examined more closely for specific sediment related problems, although it is possible to have isolated areas of road instability even in areas of low road density. This value is based on professional judgement by local Forest Service hydrologists, fish biologists, and earth scientists. Table 3-36 total specified road densities for 7th field sub-watersheds within the planning area.

Table 3-36: Road Densities for 7th Field Sub-watersheds

Sub-watershed	Road Density (mi/mi^2)
West Fork Neal Creek-24B	4.0
Mosier Creek - 21K	3.2
North Fork MillCk - 14A	3.2

Stream surveys of West Fork Neal Creek noted an average of 27% fine substrate (silt/sand, organics) from river mile 0 to 2.0 (1993 ODFW survey) and river mile 2.3 to 8.8 (1999 USFS survey). This higher percentage of fine sediment in the channel may be due, in part, to cumulative sources such as bank trampling and channel incision in the Long Prairie area.

In summary, one of the major sources of anthropogenic sediment was identified and mitigated during the Long Prairie Grazing Allotment Environmental Assessment process. Numerous measures to reduce sediment input from grazing were proposed and are in the process of being implemented. These measures are expected to reduce sediment input from this activity. In addition, road density indicates that roads may also be a potential source of fine sediment to area streams.

Riparian Area Condition

Native riparian vegetation plays a key role in forming habitat for fish and other aquatic species. Roots help stabilize stream banks, preventing accelerated bank erosion and providing for the formation of undercut banks, important cover for juvenile and adult fish. Riparian areas with native vegetation could supply downed trees (large wood) to streams. In turn, downed trees in streams influence channel morphology characteristics such as longitudinal profile; pool size, depth, and frequency; channel pattern; and channel geometry. Turbulence created by large wood increases dissolved oxygen in the water needed by fish, invertebrates and other biota. The extent of the hyporheic zone adjacent to and under the stream surface is increased by large wood in streams.

Riparian forest canopy protects streams from solar radiation in summer, and could moderate minimum winter nighttime temperature, preventing the incidence of anchor ice or freeze-up in streams (Beschta, et al., 1987). Changes in water temperature regime could affect the survival and vigor of fish, and affect interspecies interactions (FEMAT, 1993).

Riparian areas are dynamic. Disturbance characteristics of uplands such as fire and windthrow, as well as disturbances associated with streams, such as channel migration, floods, sediment deposition by floods, and debris flows, shape riparian areas (FEMAT, 1993). The most likely anthropogenic modifications in the project area are past cattle grazing and timber harvest activity. As discussed in the "Stream Channel Condition and Sediment" section of this report, cattle have removed riparian vegetation in localized areas in the allotment. This is done by grazing as well as trampling and is most evident in high use areas such as Long Prairie and Gibson Prairie. Since the C4 channel type is very sensitive to riparian vegetation removal, this has caused some channel modification in the form of downcutting most noteably in upper North Fork Mill Creek.

In addition to riparian vegetation removed due to cattle activity, riparian vegetation has been removed by past timber harvest activity. An analysis of the percentage of Riparain Reserves that have been removed by timber harvest on National Forest land is displayed in Table 3-37. This gives a general idea about the current condition of the riparian area.

Table 3-37: Percentage of Riparain Reserves Removed by Timber Hharvest

Sub-watershed	% Riparian Reserve Harvested
West Fork NealCk-24B	4%
Mosier Ck - 21K	0%
North Fork MillCk - 14A	20%

North Fork Mill Creek (14A) has a Riparian Reserve harvest level of 20%. The other 7th fields have a very low harvest level. These created openings were pre-Northwest Forest plan, so very few large trees were left adjacent to streams. The Riparian Reserves are recovering as planted trees are growing and providing shade and other benefits to the aquatic system.

According to the Desired Future Condition of the Forest in the Mt. Hood National Forest Land and Resource Management Plan (LMRP, page Four-6), "…there will be little apparent change in Forestwide riparian areas…These areas will reflect relatively high vegetative and structural diversity most closely associated with mature and old growth stand conditions. Many individual areas, totaling roughly 10-15 percent …reflect early seral stage vegetation associated primarily with past timber harvest activities. Riparian areas for intermittent streams, seeps, and springs increasingly show a shift toward early seral stage vegetation…".

Effects Analysis & Methodology

The following effects analysis utilizes research, relevant monitoring, field data and modeling to provide a context, amount and duration of effects for each of the alternatives.

GIS analysis and additional modeling was completed for a variety of site conditions and parameters in the project area. The Aggregate Recovery Percentage (ARP) model was used to determine whether watersheds in the planning area would meet the LMRP standard as Special Emphasis Watersheds. The ARP model is a standard tool used by many Forest Service resource specialists throughout the Pacific Northwest. The model calculates the "hydrologic recovery" of a watershed, which is based on the amount of human caused vegetation disturbance. This disturbance usually results from timber harvest and road building. Mt. Hood National Forest resource specialists have adjusted the model to reflect hydrologic recovery in east-side Cascade Mountain forest stands, since the model was originally based on west-side timber stands (February 23, 1998 memo - Forest Plan Management Direction - Interpretation #8).

Some considerations about strengths and weaknesses associated with the analysis approach discussed above include the strength and weaknesses identified in Table 3-38.

Table 3-38: Strengths and Weaknesses in Water Quality Analysis

Method	Strength	Weakness
Aggregate Recovery Percentage (ARP) Model	Gives a good general idea about potential hydrologic recovery in a basin. Model works well when followed up with field data such as stream surveys.	Model utilizes a number of GIS results and a growth simulation model to determine recovery. These may differ somewhat from what is actually on the ground due to mapping inaccuracies and actual site conditions.
Water Erosion Prediction Project (Disturbed WEPP) model	Provided more site-specific erosion data for effects analysis. This led to a more accurate effects analysis.	Recent research indicates that the WEPP model tends to overestimate erosion amounts (Geren, 2006).
GIS Generated Site Data	Provided more site-specific data for effects analysis. This led to a more accurate effects analysis.	Since layers in GIS are updated as new, more accurate data becomes available, there may be some inaccuracies in current mapping. Accuracy depends on the level of field verification.
Effectiveness of Aquatic Mitigation Measures and Design Criteria	Effectiveness of various erosion control measures in reducing erosion is well documented. General effectiveness of buffers in reducing sediment and other impacts is well documented.	Effectiveness of various buffer widths on reduction of effects to surface water is not extensively documented in a wide variety of physical settings.

Environmental Effects

No Action Alternative – Direct and Indirect Effects

Stream Temperature

Stream temperatures would remain at current levels in the watershed due to no reduction in streamside shading. Primary shade zones (areas of riparian vegetation directly adjacent to streams) along perennial streams would continue to fill in with understory vegetation. Since these areas are already densely vegetated, it is not anticipated that this component would reduce stream temperatues any great degree within the project area.

These densely vegetated areas are more susceptible to high severity burns due to excess fuel loading from fire exclusion. In the event a wildfire burned in this watershed, riparian areas have the potential to burn hot in areas that have high fuel loading. Recent research by Tollefson and others (2004) on 33 burned watersheds in the central, western Cascades of Oregon indicates that fire severity in intense events may be similar between intermittent stream channels and adjacent upland areas. It had been thought that the riparian areas might burn with a lower severity due to the presence water and other fire resistant features. Research on the effects of wildfire on stream temperature is limited, but there is quite a bit of research on burning after clear-cut logging. In the central Oregon Cascades, clear-cut harvesting along a stream increased summertime maximum stream temperatures by 4° F. This same area was burned the following year and stream temperatures increased 14° F when compared to an undisturbed forest watershed (Levno and Rothacher 1969). In the central Oregon Coast Range, clear-cut harvesting along a stream increased maximum stream temperatures by 17° F; after a hot slash burn, an additional increase of 10° F was measured the following summer (Brown 1972). The above-mentioned studies indicate that riparian vegetation can experience a high severity burn that has the potential to increase water temperature.

Sediment
Sediment delivery to streams in the project area is expected to remain at current levels. Vegetation that impedes erosion and sediment delivery would be maintained. In the event a wildfire buned in this watershed, areas that have high fuel loading have the potential to experience high severity burns. These areas have the potential to have high sediment input to adjacent surface water through increased landsliding and surface erosion, and increased stream channel and bank erosion from increased runoff and sediment bulking from ash deposits. Sediment yields for the Wilson River watershed in Oregon were 252 tons per square mile per year or 5.7 times higher than for a comparable unburned watershed, after the 1933 Tillamook Fire. The number of days that the river experienced very high turbidity (sediment concentrations greater than 27 mg. per liter) increased from 18 to 102 days per year (Anderson 1976). It is not known to what extent salvage operations in the burned area contributed to this sediment increase. Increased sediment yields were found after a wildfire burned three relatively steep watersheds (average slopes of 50%) in the central Washington Cascades (Helvey 1980, Helvey et. al. 1985). An increased susceptibility to debris torrents was noted following the fire and was an important factor in causing incresed sediment yields.

While much of the sediment increase can occur within the first year after the fire (Agee 1993, Debano et. al. 1998), it may take many years for sediment levels to reach pre-fire levels depending on fire severity. DeBano et al. (1996) demonstrated that following a wildfire in ponderosa pine, sediment yields from a low severity fire recovered to normal levels after three years, but moderate and severely burned watersheds took 7 and 14 years, respectively. Robichaud and Brown (1999) reported first year erosion rates after a wildfire from 9 to 22 tons per acre decreasing by one to two orders of magnitude by the second year and to no sediment by the fourth in an unmanaged forest stand in eastern Oregon. Erosion rate reduction was due to recovery of natural vegetation. First year growing season shrubs, forbs and grasses accounted for 28 percent of the total ground cover whereas after the second growing season, total ground cover was 82 percent. In the event of a high severity burn, there could be severly impaired water quality due to high trubidity levels. It may take many years (5 – 10) for turbidity levels to decrease to background levels.

In summary, water quality parameters such as stream temperature and sediment are not expected to appreciably change in the project area. Current riparian areas are overstocked with shrubs and trees due primarily to fire exclusion creating ample stream shading. If a wildfire does occur in this project area, it would likely lead to seriously impared water quality conditions for quite some time. The overstocked riparian areas would encourage higher intensity fires due to high fuel loading that could lead to higher burn severities. As described above, these high severity burn areas have the potential for high turbidity and increased stream temperatures.

Proposed Action Alternative – Direct and Indirect Effects
Stream Temperature – Vegetation Treatments
This alternative proposes to treat approximately 238 acres of vegetation within Riparian Reserves. The thinning prescription for riparian areas is designed to "emphasize creating species diversity of riparian vegetation and thin dense understories to maintain survival of late-seral trees by creating a stand that is moving toward a natural, pre-fire exclusion structure and composition with high large woody debris recruitment potential." In addition, underburning "may take place in this area in order to restore plant species composition and structure that would occur under natural fire regimes" (North Fork Mill Riparian Area Prescription, available in the project record). Vegetation removal has the potential of increasing solar radiation to surface water, which in turn may increase water temperature. The following analysis utilizes tools contained within the "Sufficiency Analysis for Stream Temperature" (2004) document to identify necessary shade so that stream temperatures within treatment areas would not increase as a result of the proposed vegetation treatments. The previously mentioned document is the result of work between the Forest Service, Bureau of Land Management (BLM) and State of Oregon Department of Environmental Quality (DEQ) and identifies how to maintain sufficient stream shading while providing the opportunity to treat Riparian Reserve vegetation to improve stand condition. Vegetation treatments in the North Fork Mill Restoration Project would have the benefit of minimizing negative effects that may result from a catastrophic wildfire.

The concept of the sufficiency analysis is to maintain a primary shade zone next to the stream and identify a secondary shade zone that could be treated to reach Riparian Reserve Objectives. In order to maintain sufficient shade next to the stream, the primary shade zone is untreated. The size of this zone is dependant on the current height of the trees and the hill slope. This relationship is shown in the table below (Table 3-39).

Table 3-39: Primary Shade Zone

Height of Tree	Hill slope <30%	Hill slope 30% – 60%	Hill slope >60%
Trees < 20 feet	12 feet	14 feet	15 feet
Trees 20 to 60 feet	28 feet	33 feet	55 feet
Trees > 60 feet	50 feet	55 feet	60 feet

As an example, if the height of trees in the riparian area are predominately <20' tall, the primary shade zone would be 14 feet wide for an area that had 30% to 60% hill slopes next to the stream. Based on field observations in proposed treatment units, most of the hill slopes are between 30% and 60% and existing tree heights range from <20' to 60'+. Since the proposed treatment would include removal of trees greater than 60' tall in some cases, the primary shade zone was set at 60'. This area would be left untreated next to perennial streams to maintain current stream shading and temperatures.

In addition, vegetation treatments within the secondary shade zone (60' to 100'), would leave an average canopy closure of approximately 50% which would provide consistency with the Sufficiency Analysis. Due to project design that meets and exceeds the Sufficiency Analysis, there should be no increase in stream temperature resulting from implementation of this project.

This portion of the project may have an indirect positive effect on stream temperature because the riparian prescription is designed to stimlate growth in the post-treatment stand, which should provide shade faster to adjacent streams.

Stream Temperature – Recreation Trails
Approximately 0.6 miles of new trail constuction would occur in Riparian Reserves. Over 75% of this new construction in Riparian Reserves is located in the Gibson Prairie area. Three new stream crossings, one on West Fork Neal Creek, one on Mosier Creek and one on an unnamed tributary to North Fork Mill Creek would need to be constructed. Some vegetation would need to be removed to clear a trail for these crossings. Due to the narrow width needed for the trail (2’ to 3’ tread width, 6’ to 8’ clearing width), very little vegetation that currently provides shade is expected to be removed, so no increase of stream temperature is anticipated from this activity. This conclusion is based on professional judgement that includes examination of many stream/trail crossings throughout the National Forest system.

Stream Temperature – Road Decommissioning/Culvert Replacement
These sites are already disturbed and would not remove any vegetation that currently provides shade. Road decommissioning may have a slight indirect positive effect on stream temperature due to vegetation recovery within the Riparian Reserves. These areas would be allowed to revegetate and eventually should provide some additional shading to surface water. A total of 0.4 miles of road within Riparain Reserves are projected to be decommissioned.

Road closures would not influence steam temperature because existing vegetation currently providing stream shade would not be removed or modified

Sediment – Vegetation Treatments
Some ground distubing activites in this alternative have the potential to dislodge soil particles which in turn may increase erosion and sedimentation to surrounding surface water These activities include using roads, building temporary roads, landings, skid trails, yarding corridors, burn piles, as well as areas of underburning, snowplowing, road maintenance and road repair. In addition, trail construction and maintenance and culvert replacement also have the potential to deliver eroded soil to streams. A detailed discussion of soil erosion and delivery potential is contained in the Soil Productivity section of Chapter 3. According to the soils analysis, amounts of erosion and sediment delivery are expected to be small due to flat topography in portions of the planning area, maintaining protective groundcover, and implementation of BMP design criteria.

The ability of BMP to reduce erosion and sediment delivery is documented in a study referenced in the Soil Productivity section (Rashin et. al. 2006). In this study, the authors looked at 21 harvest sites that had a variety of treatments ranging from no buffers to buffers up to 66 meters (216.5 feet) wide. They found that “Of 157 individual erosion features determined to deliver sediment to streams during either the first or second year following timber harvest, 94 percent were located within 10 m (33 feet) of the stream. Conversely, 74 percent of the 248 erosion features with no evidence of sediment delivery were greater than 10 m from streams. The sediment routing survey results indicate that when erosion is initiated by ground disturbing activities within 10 m (slope distance) of a stream, delivery of sediment was more likely than not.”

Other studies also support the effectiveness of mitigating sediment delivery by maintaining a buffered area adjacent to surface water. Burroughs and King (1989) found that 80% of sediment reaching streams from roads in the first year after construction came from the fill slope of the road. They also found that transport distances and obstructions between the fill slopes and streams influenced the amount and likelihood of eroded material reaching these streams. Burroughs and King found that windrowed fill slopes, which would act very similar to unharvested Riparian Reserves in that there would be obstructions to flow, had an average travel distance of 3.8 feet for eroded material, and a maximum travel distance of 33 feet. Similar results were documented by Packer (1967). He found that "the most important factors that affect the distance that sediment moves are the spacing between down slope obstructions and an interaction between this spacing and the kind of obstruction". He found that logs, rocks, and trees or stumps were the second, third, and fourth most effective materials in reducing sediment movement distances below roads. Travel distances were similar to those reported by Burroughs and King.

Mitigation measures and design criteria that include undisturbed vegetative buffers of 60 feet along perennial streams and 30 feet along intermittent streams, keeping large mechanized equipment away from surface water, use of erosion control (e.g. erosion control blankets, straw wattles, waterbars etc.) where necessary, and lower impact road maintenance techniques (leaving vegetated buffer strips in ditchlines near streams) would substantially reduce the amount of sediment reaching the streams from this work. Burroughs and King (1989) reported that measures such as erosion control blankets alone could reduce sediment production by 80 to 90 percent. This in conjunction with other measures such as minimizing the amount of ground disturbance and seeding these areas would further decrease the chance of short-term direct and indirect sediment production. With the above-mentioned mitigation measures and design criteria, new temporary roads, landings, skid trails, yarding corridors, road maintenance, and road repair work are expected to have minimal effect on sedimentation.

As stated in the Soil Productivity section, prescribed fire (underburning) units have the potential to increase the on-site erosion risk, but are not expected to introduce additional sediment into surface water. A literature review by Beschta (1990) states, "Management practices that prevent the occurrence of hot slash burns and encourage rapid revegetation will help minimize potential increases in fire-related sedimentation from upslope sources." Relatively "cool" burns (such as the underburning units in this project) "should have little impact on erosion and sedimentation, regardless of general watershed slope."

Fuel treatment activities may increase surface erosion in the harvest units along temporary roads, landings, skid trails and yarding corridors. The amount of erosion is expected to be low and short lived due to mitigation measures and design criteria such as ground based logging restrictions on ground over 30 percent side-slope, ripping and water barring disturbed areas, and seeding disturbed areas. It is unlikely that any material would reach the aquatic system due to buffering by the Riparian Reserves, associated unmanaged zones within the Riparian Reserves, and the other required mitigation measures and design criteria such as ripping and water barring skid trails.

Sediment – Recreational Trails

As stated in the Soils Productivity section, some trail construction activities may increase the erosion risk on disturbed areas. According to the soils analysis, the highest chances of eroded material delivery to streams are stream crossings that have steep sideslopes adjacent to the crossing. The site with the highest potential is the West Fork Neal Creek crossing (T.1S.; R.10E.; Sec. 2) because it enters and exits the channel in very steep terrain. Even though this is the highest risk site, erosion modeling using the Disturbed Water Erosion Prediction Project (Disturbed WEPP) model indicates a 0 to 1% chance of this crossing delivering sediment to a stream the first year after construction. The highest potential for erosion and delivery are within the first year after construction and would diminish over time as disturbed material stabilizes and vegetation recovers. The total amount of eroded material is expected to be very minor to none due to implementation of project design criteria aimed at minimizing erosion.

Sediment – Road Decommissioning/Culvert Replacement
In general, culvert replacement would result in short-term direct and indirect input of sediment (immediately and up to 1 to 2 years after project completion) downstream from the project site. The highest potential for increased turbidity would be immediately after water is turned back into the completed project site. It is likely that this increase would be small and last for a short period of time (several hours) based on past monitoring of similar type projects. Downstream movement of sediment would be limited due to the small amount of material and the existence of velocity breaks due to flow obstructions (wood, boulders, pools etc.). Since these pipes are on fish-bearing streams, some sediment would be delivered to areas of existing resident fish habitat. The point of anadromy in West Fork Neal Creek is 3 miles below the furthest downstream culvert replacement; it is 2.8 miles below the furthest downstream culvert replacement in Neal Creek and 1.8 miles below the furthest downstream culvert replacement in North Fork Mill Creek. There is a low to moderate risk that some fine sediment may reach the upper point of anadromy in North Fork Mill Creek, but the amount would be very small and visually imperceptible due to the long distance between the work site and this point. The culvert replacement/removal sites on West Fork Neal Creek and Neal Creek are so far upstream from the points of anadromy that there would not be any short-term direct or indirect delivery of sediment to those sites. In addition, mitigation measures and design criteria that are focused on reducing sediment production including operating in the low-water season, isolating the work site from exposure to water, and revegetating disturbed areas after completion of work would minimize the amount of sediment entering surface water.

Culvert replacement would not only benefit fish movement, it would decrease aquatic habitat fragmentation. Larger culverts or bridges would allow wood, water and sediment to move more naturally through these crossing sites. Larger culverts or bridges would also reduce the risk of crossing erosion or failure due to the ability of the larger crossing opening to minimize channel constriction.

Culvert removal during road decommissioning would result in short-term input of sediment (immediately and up to 1 to 2 years after project completion) downstream from the project site. Expected effects would be similar to those described above for culvert replacements except the duration of turbidity increase may be longer. Mitigation measures and design criteria that are focused on reducing sediment production including operating in the low-water window, isolating the work site from exposure to water, and revegetating disturbed areas after completion of work would minimize the amount of sediment entering surface water.

Ripping of the road surface would help restore infiltration and resulting movement of water vertically through the soil profile. This in turn, should help restore flow quantity and timing and basin hydrology. Erosion and resulting sedimentation originating from these roads would also be reduced significantly due to revegetation and restoration of more natural water flow patterns.

Sediment – Road Closures

Road closures would reduce overall sediment input into area streams. Reid and Dunne (1984) found that a heavily used gravel road segment contributes 130 times as much sediment as an abandoned road. The largest reduction in sediment is expected in North Fork Mill Creek where a total of 9.2 miles of road is identified for some kind of closure with 1.8 miles of the closure occurring in Riparian Reserves.

Table 3-40 is a summary of proposed activities in the 7th field sub-watersheds and resulting qualitative changes in sediment input.

Table 3-40: Summary of Sediment Input for Alternative 1-Proposed Action

Sub-watershed	Trail Construction	Vegetation Treatments	Culvert Replacement/ Culvert Removal	Road Closure	Road Decommissioning
West Fork Neal Creek-24B	6 miles of new trail; 1 new stream crossing which would be a bridge. Low risk of very minor, short-term sediment input at West Fork Neal Creek stream crossing for 1-2 years.	1 acre aspen enhancement; 442 acres thinning; 0.4 miles new temporary road. Low risk of very minor, short-term sediment input related to aspen enhancement for 1-2 years.	7 culverts replaced, 1 culvert removed; Low-Moderate risk of minor, short-term sediment input at West Fork Neal Creek stream crossing for 1-2 years. Longer term reduction in sediment input due to larger crossing size that is less prone to erosion and failure.	1.6 miles total; 0.3 miles in Riparian Reserves. Small reduction of fine sediment input.	4.1 miles total; none of the decommissioning is in Riparian Reserves. Low risk of very minor, short-term sediment input at Mosier Creek stream crossing for 1-2 years. Small long-term reduction of sediment input.
Mosier Creek - 21K	2.6 miles of new trail; 1 new stream crossing. Low risk of very minor, short-term sediment input at Mosier Creek stream crossing for 1-2 years.	44.7 acres aspen enhancement; 927 acres thinning; 0.3 miles new temporary road. Low-Moderate risk of very minor, short-term sediment input related to aspen enhancement for 1-2 years.	1 culvert removed; Low-Moderate risk of very minor, short-term sediment input at West Fork Neal Creek stream crossing for 1-2 years. Longer term reduction in sediment input due to larger crossing size that is less prone to erosion and failure.	4.6 miles total; 0.4 miles in Riparian Reserves. Small reduction of fine sediment input.	2.8 miles total; 0.2 miles of decommissioning is in Riparian Reserves. Low risk of very minor, short-term sediment input at Mosier Creek stream crossing for 1-2 years. Small-Moderate long-term reduction of sediment input.
North Fork Mill Creek - 14A	5.3 miles of new trail; 1 new stream crossing. Low risk of very minor, short-term sediment input at a stream crossing on a tributary to North Fork Mill Creek for 1-2 years	2 acres aspen enhancement; 1344 acres thinning; 0.2 miles new temporary road. Low to Moderate risk of very minor, short-term sediment input related to aspen enhancement for 1-2 years.	1 culvert replaced, 1 culvert removed; Low to Moderate risk of very minor, short-term sediment input at West Fork Neal Creek stream crossing for 1-2 years. Longer term reduction in sediment input due to larger crossing size that is less prone to erosion and failure.	9.2 miles total; 1.8 miles in Riparian Reserves. Small to Moderate reduction of fine sediment input.	3.2 miles; 0.2 miles of decommissioning is in Riparian Reserves. Low risk of very minor, short-term sediment input at Mosier Creek stream crossing for 1-2 years. Small-Moderate long-term reduction of sediment input.

Sub-watershed	Trail Construction	Vegetation Treatments	Culvert Replacement/ Culvert Removal	Road Closure	Road Decommissioning
Neal Creek – 24A	None Planned	13.7 acres thinning; no increased risk of sediment introduction due to lack of nearby surface water.	1 culvert replaced; Low risk of very minor, short-term sediment input at Neal Creek stream crossing for 1-2 years. Longer term reduction in sediment input due to larger crossing size that is less prone to erosion and failure.	None Planned	None Planned
Alder Creek – 14D	None Planned	None Planned	1 culvert replaced; Low risk of very minor, short-term sediment input at Alder Creek stream crossing for 1-2 years. Longer term reduction in sediment input due to larger crossing size that is less prone to erosion and failure.	None Planned	None Planned

In summary, this proposal includes some activities that may cause some minor short-term direct and indirect increase in fine sediment. The largest risk is associated with culvert replacement and road decommissioning due to their location adjacent to or directly in stream channels. The majority of these projects are planned in the West Fork Neal Creek drainage. These same projects would reduce long-term sediment input after they have revegetated, which would benefit water quality.

Forest Plan Consistency

Key Watershed

The NWFP states, "The amount of existing system and non-system roads within Key Watersheds should be reduced through decommissioning of roads" (NWFP B-19). Within the Mill Creek Tier 1 Key Watershed, 25 miles of roads have been decommissioned to date since the inception of the Northwest Forest Plan. The reduction of road miles from 179 miles to 154 miles would result in an overall reduction of road related sediment through time in the Key Watershed. It is expected that approximately 0.2 miles of new temporary road would be constructed within the Key Watershed to facilitate access for this project. This would temporarily raise the miles of non-system road, but these roads would be decommissioned within 3 to 5 years of construction and total miles in this Key Watershed would return to 154. In addition, 3.3 miles of road are proposed for decommissioning in this Key Watershed so the final road mileage would be reduced to 151 miles after project implementation making this project consistent with the NWFP.

Road densities within 7th field sub-watersheds would change in the following way:

Table 3-41: Road Density by 7th Field Watersheds for Alternative 1

7th Field Sub-watershed	Existing Road Density (mi/mi^2)	Potential Road Density with Temporary Roads (mi/mi^2)	Final Road Density After Project Implementation (mi/mi^2)
North Fork Mill Creek*	3.2	3.3	2.7
Mosier Creek	3.2	3.3	2.0
West Fork Neal Creek	4.0	4.1	3.5

* 7th Field sub-watershed is within the Mill Creek Tier 1 Key Watershed.

Road densities increase slightly when temporary roads are included but total road density would be reduced below 3 mi/mi^2 in two of the three sub-watersheds after road decommissioning. As stated in the Existing Conditions section above, "Road densities within a sub-watershed that exceed 3.0 miles per square mile indicate areas that should be examined more closely for specific sediment related problems, although it is possible to have isolated areas of road instability even in areas of low road density. This value is based on professional judgment by local Forest Service hydrologists, fish biologists, and earth scientists".

Special Emphasis Watersheds and Peak Flow Analysis

There are no Special Emphasis Watersheds (Mt. Hood National Forest LRMP Standard FW-065, pg. Four-55) located within the project area.

Mt. Hood National Forest LRMP Standard FW-064 states that "Watershed impact areas at the sub-basin or area analysis level should not exceed 35 percent" (pg. Four-53) as part of a cumulative watershed effects analysis. This threshold is set to disperse activities in time and space to "minimize cumulative watershed effects" which in this case is primarily increased peak flow (Mt. Hood National Forest LRMP Standard FW-061, pg. Four-53). These increased peak flows can cause stream channel damage in the form of increased bank erosion, channel scour, channel widening, and sedimentation. An analysis of the watershed impact area for the three sub-basins that are part of the North Fork Mill Project is displayed in Table 3-42.

Table 3-42: Increased Peak Flow for Three Sub-basins (Alternative 1)

	Maximum Watershed Impact Area from LRMP	Pre-project Implementation Watershed Impact Area	Post-project Implementation Watershed Impact Area-
Mosier Creek	35%	5.3%	7.2%
North Fork Mill Creek	35%	3.3%	5.5%
West Fork Neal Creek	35%	15%	20.1%

All sub-basins are well below the maximum Watershed Impact Area percentage of 35% after implementation of the North Fork Mill project, so this project is consistent with this standard.

Proposed Action – Cumulative Effects

The table below (Table 3-43) provides a qualitative summary of potential cumulative watershed effects. It shows existing and potential projects, effects from those projects that may result in cumulative effects with the North Fork Mill Restoration Project, whether these projects overlap in time and space and an assessment if a measurable cumulative effect is expected. Findings of this summary are supported by the analysis above which utilizes pertinent research, mitigation measures and design criteria and applicable management standards and guidelines.

Table 3-43: Cumulative Effects Table for Water Quality

Project	Potential Effects	Overlap in Time	Overlap in Space	Measurable Cumulative Effect?	Extent, Detectable?
Existing Old Forest Service Timber Harvest Units	Suspended Sediment	No	Yes	No	Projects are completed. No remaining sediment, stream temperature and water quantity effects due to mitigation measures and design criteria implementation on the original projects and natural recovery.
	Stream Temperature	No	Yes	No	
	Water Quantity	Yes	Yes	No	
Forest Service Vegetation Treatment Activities Planned or Underway (South Fork Mill, Pre-commercial treatments)	Suspended Sediment	Yes	Yes	Not Measurable	There may be an overlap in timing of these projects with the North Fork Mill Restoration Project; any minor suspended sediment would not be measurable due to implementation of mitigation measures and design criteria, conformance with existing standards and guidelines on both the existing projects and North Fork Mill Restoration Project and the long distance between project areas. In the case of S. Fork Mill (The Dalles Watershed Fuelbreak) these two streams converge approximately 5 miles downstream of the North Fork Mill Restoration Project area.
	Stream Temperature	Yes	Yes	No	The North Fork Mill Restoration Project would maintain the primary shade zone in all of the projects except the trail crossings. As described in the effects section, the amount of shade providing vegetation removed is expected to be minimal, so no increase in stream temperature should result, so there should be no cumulative increase in stream temperature.
	Water Quantity	Yes	Yes	No	No cumulative water quantity effects due to mitigation measures and design criteria implementation, conformance with existing standards and guidelines and natural recovery on both the existing projects and . North Fork Mill Restoration Project.

		Overlap in			
Private Land Activities	Suspended Sediment	Yes	Yes	Yes	Some projects are completed so there are no remaining sediment effects due to natural recovery. Other ongoing projects on adjacent private land such as road maintenance and vegetation manipulation have a chance of some short-term introduction of fine sediment that may mix with minor fine sediment from the North Fork Mill Restoration Project. The highest risk of this would be in West Fork Neal Creek due to the culvert replacement projects, road reconstruction on the 1700 road, Long Prairie Grazing allotment, new proposed Off-highway vehicle (OHV) trails and timber harvest on private lands.
	Stream Temperature	Yes	Yes	No	Some projects are completed so there are no remaining stream temperature effects due to natural recovery. The North Fork Mill Restoration Project would maintain the primary shade zone in all of the projects except the trail crossings. As described in the effects section, the amount of shade providing vegetation removed is expected to be minimal, so no increase in stream temperature should result, and there should be no cumulative increase in stream temperature.
	Water Quantity	Yes	Yes	No	No cumulative water quantity effects due to mitigation measures and design criteria implementation, conformance with existing standards and guidelines on the North Fork Mill Restoration Project and natural recovery for some of the projects on private land.
Miscellaneous Tree Salvage (Hazard Trees)	Suspended Sediment	Yes	Yes	Not Measurable	There may be an overlap in timing of this project with the North Fork Mill Restoration Project; any minor suspended sediment would not be measurable due to implementation of mitigation measures and design criteria and conformance with existing standards and guidelines in both projects.
	Stream Temperature	Yes	Yes	No	The North Fork Mill Restoration Project would maintain the primary shade zone in all of the projects except the trail crossings. As described in the effects section, the amount of shade providing vegetation removed is expected to be minimal, so no increase in stream temperature should result, so there should be no cumulative increase in stream temperature.
	Water Quantity	Yes	Yes	No	No cumulative water quantity effects due to mitigation measures and design criteria implementation, conformance with existing standards and guidelines and natural recovery in both projects. .

		Overlap in			
Long Prairie Grazing Allotment	Suspended Sediment	Yes	Yes	Yes	Current unrecovered damage in riparian areas from grazing has a chance of some short-term introduction of fine sediment that may mix with minor fine sediment from the North Fork Mill Restoration Project. The highest risk of this would be in West Fork Neal Creek due to the culvert replacement projects, road reconstruction on the 1700 road, Long Prairie Grazing allotment, new proposed OHV trails and timber harvest on private lands. Long-term restoration of a more natural sediment regime is likely with recovery due to mitigation measures and design criteria in the Long Prairie Grazing Allotment project coupled with road decommissioning, culvert removal/ replacement and road closures associated with the North Fork Mill Restoration Project.
	Stream Temperature	Yes	Yes	No	The North Fork Mill Restoration Project would maintain the primary shade zone in all of the projects except the trail crossings. As described in the effects section, the amount of shade providing vegetation removed is expected to be minimal, so no increase in stream temperature should result, so there should be no cumulative increase in stream temperature.
Proposed OHV Project	Suspended Sediment	Yes	Yes	Yes	New OHV trails are proposed in the project area. There is a chance of some short-term introduction of fine sediment from OHV trail construction and use that may mix with minor fine sediment from the North Fork Mill Restoration Project. The highest risk of this would be in West Fork Neal Creek due to the culvert replacement projects, road reconstruction on the 1700 road, Long Prairie Grazing allotment, new proposed OHV trails and timber harvest on private lands.
	Stream Temperature	Yes	Yes	No	The North Fork Mill Restoration Project would maintain the primary shade zone in all of the projects except the trail crossings. As described in the effects section, the amount of shade providing vegetation removed is expected to be minimal, so no increase in stream temperature should result, so there should be no cumulative increase in stream temperature.
Invasive Plant Treatments	Suspended Sediment	Yes	Yes	Not Measurable	There may be an overlap in timing of this project with the North Fork Mill Restoration Project; any minor suspended sediment would not be measurable due to implementation of mitigation measures and design criteria and conformance with existing standards and guidelines in both projects. .

		Overlap in			
Invasive Plant Treatments continued . . .	Stream Temperature	Yes	Yes	No	The North Fork Mill Restoration Project would maintain the primary shade zone in all of the projects except the trail crossings. As described in the effects section, the amount of shade providing vegetation removed is expected to be minimal, so no increase in stream temperature should result, so there should be no cumulative increase in stream temperature.
Past Aquatic Restoration Projects	Suspended Sediment	No	Yes	Not Measurable	There may be an overlap in timing of these project effects with the North Fork Mill Restoration Project. Any minor suspended sediment may slightly slow the recovery resulting from restoration project implementation, but this would not be measurable due to implementation of mitigation measures and design criteria and conformance with existing standards and guidelines in both projects.
	Stream Temperature	Yes	Yes	No	The North Fork Mill Restoration Project would maintain the primary shade zone in all of the projects except the trail crossings. As described in the effects section, the amount of shade providing vegetation removed is expected to be minimal, so no increase in stream temperature should result, so there should be no cumulative increase in stream temperature.
	Water Quantity	Yes	Yes	No	No cumulative water quantity effects due to mitigation measures and design criteria implementation and conformance with existing standards and guidelines in both projects and natural recovery in the past restoration projects.
Future Aquatic Restoration Projects	Suspended Sediment	Yes	Yes	Not Measurable	There may be a spatial overlap of these project effects with the North Fork Mill Restoration Project. Any minor suspended sediment may slightly slow the recovery resulting from restoration project implementation but this would not be measurable due to implementation of mitigation measures and design criteria and conformance with existing standards and guidelines in all projects on National Forest.
	Stream Temperature	Yes	Yes	No	The North Fork Mill Restoration Project would maintain the primary shade zone in all of the projects except the trail crossings. As described in the effects section, the amount of shade providing vegetation removed is expected to be minimal, so no increase in stream temperature should result, so there should be no cumulative increase in stream temperature.
	Water Quantity	Yes	Yes	No	No cumulative water quantity effects due to mitigation measures and design criteria implementation and conformance with existing standards and guidelines in all projects on National Forest Land.

Proposed Action – Summary

Stream Temperature: No detrimental cumulative effects are expected as a result of increased water temperature due to mitigation measures and design criteria designed to maintain existing primary shade vegetation adjacent to streams in all projects except the new trail/stream crossings. As described in the direct and indirect effects section, this project would maintain existing water temperatures.

Sediment: Measurable cumulative effects are possible as a result of sediment introduction from this project. The risk depends on the timing of this project and other projects listed in the table above. If these projects are spaced closely together in time (within 3 years of each other), there is a higher chance that there would be a measurable cumulative effect than if they are implemented over a longer period of time. This is due to the dispersal of sediment throughout the stream system as time goes on. The highest risk of a cumulative sediment effect is in the West Fork Neal Creek due to the amount of activity confined in a fairly small area. The highest risk portions of this project are the culvert replacement and removals since they require work in the actual stream channel.

Water Quantity: A peak flow analysis was completed for this project and is displayed in the Special Emphasis Watershed section above. This project along with other projects on and off National Forest lands were included in the Watershed Impact Area calculation (LRMP Standard FW-067, pg. Four-55) and the sub-basins were found to be in compliance with LRMP Standard FW-064 so no cumulative effects are anticipated for water quantity.

Consistency with Direction (Northwest Forest Plan and Mt. Hood NF Management Plan)

As outlined in the effects section this project is consistent with applicable direction. Major highlights include:

- Not more than 15% of a treatment area would have detrimental soil damage
- The inclusion of mitigation measures and design criteria
- Establishment of Riparian Reserves and meeting standards within the Tier 1 Key Watershed
- Designing prescriptions within Riparian Reserves to contribute to attainment of Aquatic Conservation Strategy Objectives (see Aquatic Conservation Strategy for more details).

Alternative 2 – Direct and Indirect Effects

Stream Temperature

This alternative proposes to treat approximately 136 acres of vegetation within Riparian Reserves. Effects would be similar to those described for Alternative 1 due to implementation of mitigation measures and design criteria that minimize disturbance adjacent to perennial streams. In addition, the proposals for trail construction, reconstruction, road decommissioning/culvert replacement and road closures are the same as Alternative 1, so the direct and indirect effects are expected to be the same.

Sediment

Projects proposed in Alternative 2 are the same as Alterntiave 1 except there would be less temporary road construction and fewer acres of vegetation thinning. Table 3-44 is a summary of proposed activities in the 7th field sub-watersheds and resulting qualitative changes in sediment input for Alternative 2.

Table 3-44: Summary of Sediment Input for Alternative 2

Sub-watershed	Trail Construction	Vegetation Treatments	Culvert Replacement/ Culvert Removal	Road Closure	Road Decommissioning
West Fork Neal Creek-24B	6 miles of new trail; 1 new stream crossing which would be a bridge. Low risk of very minor, short-term sediment input at W. Fork Neal Creek stream crossing for 1-2 years.	1 acre aspen enhancement; 52 acres thinning; no miles new temporary road. Very low risk of very minor, short-term sediment input related to aspen enhancement for 1-2 years.	7 culverts replaced, 1 culvert removed; Low-Moderate risk of minor, short-term sediment input at W. Fork Neal Creek stream crossing for 1-2 years. Longer term reduction in sediment input due to larger crossing size that is less prone to erosion and failure.	1.6 miles total; 0.3 miles in Riparian Reserves. Small reduction of fine sediment input.	4.1 miles total; none of the decommissioning is in Riparian Reserves. Low risk of very minor, short-term sediment input at Mosier Creek stream crossing for 1-2 years. Small long-term reduction of sediment input.
Mosier Creek - 21K	2.6 miles of new trail; 1 new stream crossing. Low risk of very minor, short-term sediment input at Mosier Creek stream crossing for 1-2 years.	44.7 acres aspen enhancement; 472 acres thinning; 0.1 miles new temporary road. Low-Moderate risk of very minor, short-term sediment input related to aspen enhancement for 1-2 years.	1 culvert removed; Low-Moderate risk of very minor, short-term sediment input at W. Fork Neal Creek stream crossing for 1-2 years. Longer term reduction in sediment input due to larger crossing size that is less prone to erosion and failure.	4.6 miles total; 0.4 miles in Riparian Reserves. Small reduction of fine sediment input.	2.8 miles total; 0.2 miles of decommissioning is in Riparian Reserves. Low risk of very minor, short-term sediment input at Mosier Creek stream crossing for 1-2 years. Small-Moderate long-term reduction of sediment input.
North Fork Mill Creek - 14A	5.3 miles of new trail; 1 new stream crossing. Low risk of very minor, short-term sediment input at a stream crossing on a tributary to North Fork Mill Creek for 1-2 years.	2 acres aspen enhancement; 56 acres thinning; 0.2 miles new temporary road. Low risk of very minor, short-term sediment input related to aspen enhancement for 1-2 years	1 culvert replaced, 1 culvert removed; crossing for 1-2 years. Longer term reduction in sediment input due to larger crossing size that is less prone to erosion and failure. Low to Moderate risk of very minor, short-term sediment input at W. Fork Neal Creek stream	9.2 miles total; 1.8 miles in Riparian Reserves. Small to Moderate reduction of fine sediment input.	3.2 miles; 0.2 miles of decommissioning is in Riparian Reserves. Low risk of very minor, short-term sediment input at Mosier Creek stream crossing for 1-2 years. Small-Moderate long-term reduction of sediment input.

Sub-watershed	Trail Construction	Vegetation Treatments	Culvert Replacement/ Culvert Removal	Road Closure	Road Decommissioning
Neal Creek – 24A	None Planned	13.7 acres thinning; no increased risk of sediment introduction.	1 culvert replaced; Low risk of very minor, short-term sediment input at Neal Creek stream crossing for 1-2 years. Longer term reduction in sediment input due to larger crossing size that is less prone to erosion and failure.	None Planned	None Planned
Alder Creek – 14D	None Planned	None Planned	1 culvert replaced; Low risk of very minor, short-term sediment input at Alder Creek stream crossing for 1-2 years. Longer term reduction in sediment input due to larger crossing size that is less prone to erosion and failure.	None Planned	None Planned

In summary, sediment effects from this alternative are very similar to those described for Alternative 1. As is the case with Alternative 1, the largest risk is associated with culvert replacement and road decommissioning due to their location adjacent to or directly in stream channels. The majority of these projects are planned in the W. Fork Neal Creek drainage. These same projects would reduce long-term sediment input after they have revegetated, which would benefit water quality.

Forest Plan Consistency

Key Watershed

As is the case with Alternative 1, it is expected that approximately 0.2 miles of new temporary road would be constructed within the Mill Creek Key Watershed to facilitate access for this project. This would temporarily raise the miles of non-system road, but these roads would be decommissioned within 3 to 5 years of construction and total miles in this Key Watershed would return to 154. In addition, 3.3 miles of road are proposed for decommissioning in this Key Watershed so the final road mileage would be reduced to 151 miles after project implementation.

Road densities within 7th field watersheds would change as detailed in Table 3-45.

Table 3-45: Road Density by 7th Field Watersheds for Alternative 2

7th Field Sub-watershed	Existing Road Density (mi/mi^2)	Potential Road Density with Temporary Roads (mi/mi^2)	Final Road Density After Project Implementation (mi/mi^2)
North Fork Mill Creek*	3.2	3.3	2.7
Mosier Creek	3.2	3.3	2.0
West Fork Neal Creek	4.0	4.0	3.5

* 7th Field sub-watershed is within the Mill Creek Tier 1 Key Watershed.

These temporarily increased road densities are similar to Alternative 1 except no temporary road construction would occur in W. Fork Neal Creek. This alternative is consistent with the NWFP standards and guidelines for road construction in Key Watersheds.

Special Emphasis Watersheds and Peak Flow Analysis

As described in the Alternative 1 effects analysis, "Watershed impact areas at the sub-basin or area analysis level should not exceed 35 percent" (pg. Four-53) as part of a cumulative watershed effects analysis. The watershed impact area for the three sub-basins that are part of the North Fork Mill Project is displayed Table 3-46 below for Alternative 2.

Table 3-46: Increased Peak Flow for Three Sub-basins (Alternative 2)

	Maximum Watershed Impact Area from LRMP	Pre-project Implementation Watershed Impact Area	Post-project Implementation Watershed Impact Area-
Mosier Creek	35%	5.3%	5.8%
North Fork Mill Creek	35%	3.3%	3.4%
West Fork Neal Creek	35%	15%	15.2%

All sub-basins are well below the maximum Watershed Impact Area percentage of 35% after implementation of the North Fork Mill project, so this project is consistent with this standard. The post project values are quite a bit lower than Alternative 1 due to the reduction in the number of acres of thinning.

Alternative 2 – Cumulative Effects
Since proposed projects are very similar to those in Alternative 1, it is expected that cumulative effects would be similar to those described for that alternative. The following is a summary of those effects.

Stream Temperature: No detrimental cumulative effects are expected as a result of increased water temperature due to mitigation measures and design criteria designed to maintain existing primary shade vegetation adjacent to streams in all projects except the new trail/stream crossings. As described in the direct and indirect effects section, this project would maintain existing water temperatures.

Sediment: Measurable cumulative effects are possible as a result of sediment introduction from this project, but the effects would be less than Alternative 1 due to a reduced amount of ground disturbance associated with vegetation treatments. Due to the risk depends on the timing of this project and other projects listed in the table above. If these projects are spaced closely together in time (within 3 years of each other), there is a higher chance that there would be a measurable cumulative effect than if they are implemented over a longer period of time. This is due to the dispersal of sediment throughout the stream system as time goes on. The highest risk of a cumulative sediment effect is in the W. Fork Neal Creek due to the amount of activity confined in a fairly small area. The highest risk portions of this project are the culvert replacement and removals since they require work in the actual stream channel.

Water Quantity: A peak flow analysis was completed for this project and is displayed in the Special Emphasis Watershed section above. This project along with other projects on and off National Forest lands were included in the Watershed Impact Area calculation (LRMP Standard FW-067, pg. Four-55) and the sub-basins were found to be in compliance with LRMP Standard FW-064 so no cumulative effects are anticipated for water quantity.

Consistency with Direction (Northwest Forest Plan and Mt. Hood NF Management Plan)
As outlined in the effects section this project is consistent with applicable direction. Major highlights include:

- Not more than 15% of a treatment area would have detrimental soil damage
- The inclusion of mitigation measures
- Establishment of Riparian Reserves and meeting standards within the Tier 1 Key Watershed
- Designing prescriptions within Riparian Reserves to contribute to attainment of Aquatic Conservation Strategy Objectives (see Aquatic Conservation Strategy for more details).