COVER INFORMATION

Reply To: 2550 Soil Management
2520 Watershed Protection and Management

Subject: SOIL AND GEOLOGY REPORT
Bridge Environmental Assessment

To: District Ranger, McKenzie River Ranger District

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Date: November 3, 2007

I. INTRODUCTION

A. PURPOSE AND NEED FOR PROJECT

The District Ranger of the McKenzie River Ranger District of the Willamette National Forest has determined that a need exists to commercially thin about 2800 acres of managed and fire regenerated stands in the McKenzie River / Quartz Creek Watershed. The purpose of the project is to:

1) Improve the growth of various plantation timber stands and promote forest health by reducing current stocking levels to enhance growth and vigor of the remaining trees and to reduce future losses from fire, insects, disease, and from snow breakage; 2) Restore structural diversity in stem exclusion stands to enhance wildlife habitat; 3) Maintain or reduce the existing road system as much as is practical; and 4) Provide a sustainable supply of commercial wood products.

In summary, the purpose of this project is to improve timber stand health and vigor, enhance tree growth, maintain roads, and provide wood products from previously managed stands. An additional aim of the project is to enhance conditions in riparian areas to meet Aquatic Conservation Strategy Objectives. By enhancing tree growth, larger trees will better provide more shade for streams, moderate microclimate, improve overall structural diversity, and contribute future sources of coarse woody debris for streams.

B. PROPOSED ACTION AND CONNECTED ACTIONS

The District Ranger for the McKenzie River Ranger District of the Willamette National Forest proposes to implement the following actions during the next five years within previously managed or naturally fire regenerated stands in various management allocations in the lower McKenzie watershed. The Bridge project includes the following proposed actions:

1. Commercially thin or selective cut harvest in approximately 2800 acres of 30 to 120 year old stands with ground based, sky line, or helicopter yarding systems, as appropriate.

2. Construction of temporary roads or reconstruction and maintenance of older system roads to provide access for various management activities.

3. Reduce management created fuels or natural fuel accumulations through various methods such as hand and machine piling and pile burning or broadcast under-burning to lessen the fire hazard.

4. Precommercial thin about several hundred acres of adjacent managed plantations, and fertilize these stands if funds are available.

5. Manage or expand development in the Blue River, Mill Creek, and Mill Creek Overlook Rock Quarries to provide a variety of rock products for various management activities.

II. SUMMARY

A. RESOURCES CONSIDERED

This report documents the existing conditions and potential impacts to the soil and geology resource. The major short-term impacts to soil productivity from harvest activity, as discussed in the Willamette National Forest Final Environmental Impact Statement (FEIS 1990), include displacement, compaction, nutrient loss, and instability. In most situations, preventing soil impacts is the most effective and feasible way of ensuring long-term soil productivity.

B. METHODS

The information for this report was obtained by intensive field reconnaissance of proposed units as well as the terrain surrounding the units. In almost all units, where ground based harvest methods were proposed, transects were walked and information taken to determine the numerical extent of existing compaction, as a percentage of the transect distance.

C. RESULTS

Anticipated direct effects to the soils resource will be within Willamette National Forest Standards and Guidelines. Recommended suspension requirements will control the potential for unacceptable displacement. Skyline yarding with one end suspension will be recommended for units or portions of units with side slopes greater that 30% to avoid excessive disturbance from heavy equipment. In one specific case, Unit 21 is located on very flat terrain, but has numerous wet soil areas. Full suspension is recommended on this unit to avoid excessive disturbance from equipment or cable yarding corridors. Potential nutrient loss will be controlled by duff retention standards. Slope instability is not considered a concern for any unit in this project area. Compaction will be controlled by designated skid or forwarder roads, the use of existing roads as much as possible, and subsoiling.

The field investigation indicated that none of the units as a whole exceeded the Willamette National Forest FW-081 Standard of 20% of an activity area impacted by compaction. Some units, like Unit 5 had relatively high levels, and some units like Units 9, 10 and 24 had high individual transect values that approach the standard. Usually, these were transects that crossed old landing sites. However, these two units as well as the others are, on average sufficiently below the threshold not to be considered a concern. One of the goals with entry into all these units is to provide the opportunity to subsoil the existing skid roads as much as is practical in order to reduce compaction to lower levels. With entry into any ground-based unit, evident skid or haul roads will be utilized before any new skid road is approved. It is possible with this proposed action that cumulative compaction in some portions of some units may exceed the threshold at the completion of harvest activities. Consequently, subsoiling is recommended enhancement to insure that cumulative levels remain below the 20% standard. In total all these units together would generate around 50 acres of enhancement subsoiling at an approximately cost of around $18,000. If some of these units are not included for harvest or if sufficient

enhancement funds are not present for all units, then the dollars that are available will be distributed on a priority basis to the units with the greatest level of initial compaction, receiving the most attention.

D. CONCLUSIONS

The soils mitigation measures are designed to maintain long term soil productivity and provide a level of erosion control that is consistent with the standards and guidelines of the Willamette National Forest's Land and Resource Management Plan (1990) and Oregon State Department of Environmental Quality guidelines. All prescriptions or mitigation measures discussed in this report are designed to meet or exceed the requirements outlined in the General Water Quality Best Management Practices Handbook (Pacific Northwest Region, November 1988). Prescriptions for soil protection and watershed considerations take into account past and predicted future land management activities. Standard contract language should provide sufficient erosion control measures during timber sale operations (BMP T-13). Revegetation of areas disturbed by harvest activities (such as landings, temporary roads, and equipment storage areas) is required with an appropriate seed mix (BMP T-14, T-15, and T-16).

III. REGULATORY FRAMEWORK

A. LAWS AND REGULATIONS -- 36 C.F.R. 219.14(a) directs the Forest Service to classify lands under their jurisdiction as not suited for timber production if they fall into any of four categories:

a. Non-forest;
b. Irreversible soil or watershed damage (from NFMA 6(g)(3)(E)(i));
c. No assurance of reforestation within five years;
d. Legislatively or administratively withdrawn.

This report considers the first three categories of land. On the Willamette National Forest these areas are defined by landtype, which will be explained in much greater detail in the Procedures and Methodology Section.

B. REGIONAL GUIDELINES -- Forest Service Manual R-6 Supplement No. 2500.98-1 (Title 2520 Watershed Protection and Management) clarifies direction for planning and implementing activities in areas where soil quality standards are exceeded from prior activities; redefines soil displacement; provides guidance for managing soil organic matter and moisture regimes. In addition, the USDA FS Pacific Northwest Region handbook on General Water Quality Best Management Practices (November, 1988) provides a guide on practices which are applicable in conducting land management activities to achieve water quality standards to ensure compliance with the Clean Water Act, as amended, and Oregon Administrative Rules.

C. FOREST PLAN -- Chapter IV of the Willamette Forest Plan states the Forest-wide Standards and Guidelines for a variety of resources and activities. Soil and Water Quality protection are addressed in the section from FW-079 to FW-114. Based on direction in the Forest Wide Standards and Guides, FW-079 and FW-080 and BMP T-1, T-2 and T-3, the following activities were performed as part of the planning process: verifying the present SRI land type boundaries; determining the location of unsuited and unmanageable landtypes; prescribing slash treatment and suspension objectives for the possible units; and evaluating potential watershed impacts from management.

IV. DESIRED FUTURE CONDITION

The major short-term impacts to soil productivity from harvest activity, as discussed in the Willamette National Forest Final Environmental Impact Statement (FEIS 1990), include displacement, compaction, nutrient loss, and instability. In most situations, preventing soil impacts is the most effective and feasible way of ensuring long-term soil productivity. The total area of cumulative detrimental soil conditions should not exceed 20% of the total acreage within the activity area, including roads and landings.

A. DISPLACEMENT --Displacement is defined as the removal of more than 50% of the topsoil or humus enriched soil horizons from an area of 100 square feet which is at least 5 feet in width. Displacement can occur with timber management during road or landing construction, yarding, or the mechanical treatment of slash, such as machine piling. Contract requirements which reduce or eliminate displacement are the primary way to minimize this concern.

B. COMPACTION -- Compaction is defined as an increase in soil bulk density of 15% or more and/or by a reduction of macropore space of 50% over the undisturbed soil. Excessive soil compaction from heavy, mechanized equipment used during logging can decrease soil productivity by restricting root growth, reducing rainfall infiltration rates, and increasing over land flow and run off. Prior management on some units, conducted before any requirements were established, created compaction conditions which may now approach or exceed the currently accepted standards and guidelines. Activities which minimize further compaction such as skyline logging, utilize existing compacted areas as much as possible, or reduce existing compaction through mechanical means (subsoiling) are recommended.

C. NUTRIENT LOSS --The primary mechanism for excessive nutrient loss is uncontrolled wild fire at high fuel loadings, low fuel moistures, and adverse weather conditions. Fire recurrence intervals of 100 to 200 years are apparent in the natural system, with shorter intervals in some critical high lightning areas or with suspected aboriginal burning. The actual thinning or harvest of these units is not as much concern for long term soil productivity as the concomitant slash accumulation and the potential for wild fire. On the other hand, NO ACTION IS NOT considered beneficial for long-term soil productivity either. Overstocked stands will rapidly see density increase, growth slow, and mortality rise. Fuel accumulations from blow down, snow down, and bug kill provide an ever increasing amount of fuel loading. Activities, which reduce stocking levels, improve stand vigor, and eliminate excessive fuel loading are favored.

D. INSTABILITY -- Slope instability is also a natural ecological component of the Cascade Range ecosystem. Debris chute failure recurrence is generally associated with more episodic large fire and / or flood events. Slump / earth flow instability is more steady state and may extend for centuries. Slope failures of either type carry large wood and rock to stream systems. This material is needed to both create suitable structure for sediment storage and provide the gravels required for fish and other aquatic habitat. On the other hand, numerous failures, without the associated boulder or log structure, can overload a system with sediment and destroy functioning habitat. Activities which do not exacerbate existing unstable areas or promote long-term stability are favored.

V. ANALYSIS METHODS

Field work was conducted intermittently through the fall of 2006 and the winter, spring, summer and fall of 2007. During that period, I conducted a field reconnaissance of potential harvest units

and surrounding areas for a planned timber sale in order to help implement Willamette National Forest program direction. Specific field days included April 28, May 30, July 19, 21, and 24, August 18, September 27, October 14 and 30, and November 7, 14, and 28, 2006, and February 1, 15, and 21, March 8, 13, and 15, April 4 and 5, and June 7, 2007.

A. FIELD INVESTIGATION STANDARDS

A major portion of the field investigation was directed at distinguishing the various identifiable landtype components within the study area and mapping them on the photo overlays. Much of the landtype analysis referenced in this report was originally conducted for previous timber sale planning activities. In general, the field investigation confirmed some of the original 1973 SRI designations and the previously mapped work. The major portion of the field work involved site specific evaluation of existing conditions within each of the units. My field investigation of landtypes and the determination of the impacts from prior management activities formed the basis for the site-specific recommendations and mitigations that follow in this report.

B. LANDTYPES -- Description and discussion

1. Unsuited and unmanageable landtypes have been delineated within the project area as part of the landtype mapping process (FW-180). Unsuited and unmanageable landtypes occur in two basic categories - those acres that are un-regenerable and those where harvest will cause irreversible impacts. Those landtypes that are considered to have regeneration difficulties (BMP T-20) could include 1, 2, 3, 4, 5, 6, 7, 62, 210, 310, 610, and 710 or combinations of these landtypes. Almost all have numerous rock outcrops and cliffs, shallow gravelly soils with rock fragment content generally greater than 70%, and talus. Landtypes 6 and 7 are wet and dry meadows, respectively, and most areas of Landtype 6 are considered "wetlands" (BMP T-17 and W-3). All are currently considered noncommercial forestland or non-reforestable in the five-year time frame. Officially, 210, 310, and 610 are defined as marginally reforestable at least to extensive levels on easterly and northerly aspects, and non-reforestable in the five-year time frame on southerly and westerly aspects. However, almost no successful timber management has ever occurred on any aspect related to these specific landtypes on the McKenzie River Ranger District. Consequently, the north and east aspects of 210, 310, and 610 are considered unmanageable (no sufficient assurance of regeneration within the five year time frame) land in this report.

2. Landtypes considered unsuited because harvest will result in irreversible resource damage are primarily those that are actively unstable or potentially highly unstable (FW-105, BMP T-6). They could include the primary Landtypes 25 and 35, and the complexes of 255 (25 plus 35), 256, and 356. Landtypes 256 and 356 have actively unstable areas very closely associated and generally in direct contact with stream riparian areas or stream courses. These areas all commonly display slump type topography and include such features as tension cracks, bare soil scarps, leaning and fallen trees, sags and depressions, seeps, and disrupted drainages. Failure depths are such that root strength probably has little effect. However, the instability problem can be aggravated by timber harvest, as removing the trees tends to raise ground water levels due to the loss of evapotranspiration. This in turn reduces the soil strength and can cause increased or renewed instability. On the other hand, thinning these areas can create thriftier stands that have greater root strength and increased evaporation over time. Other landtype complexes that contain elements of 25 or 35, such as 225, 235, 251, 252, 253, 254 and 353 need to be evaluated on a case-by-case basis as management activities are proposed.

3. Landtype complexes, such as 15-16, 201-301 or 236-553-554 have elements of both or all landtypes that were either not differentiable at the photo scale, or sufficient field time was not available to distinguish the various components.

4. The remaining landtypes are adequately discussed in the Willamette National Forest Soils Resource Inventory. This document, first developed in 1973 and updated in 1990, was made to provide some basic soil, bedrock and landform information for management interpretations in order to assist forestland managers in applying multiple use principles. The 1973 text and descriptions are used here. A copy is on file with the Natural resources Staff group at the McKenzie River Ranger District.

C. BASIS FOR EVALUATING EFFECTS

For the soil resource the scale of analysis for both direct / indirect effects and cumulative effects is almost always the "unit", i.e. the stand polygon proposed for silvicultural treatment. The unit of measure for evaluating those effects is generally considered the percent of the "unit" affected. The summing of acres for various units, such as the total acres of skyline logging in a given alternative, is not an evaluation criterion for soils impacts. Impacts are evaluated on a unit-by-unit basis, and are generally the same in any given unit for all action alternatives, unless otherwise noted.

VI. EXISTING CONDTION AND ENVIRONMENTAL CONSEQUENCES

A. INTRODUCTION

This project area is located within the Lower McKenzie drainage area and lies completely within the Western Cascades physiographic region. More specifically, these deposits are basaltic lava flows, flow breccias and pyroclastic deposits representing both early and later events of the Western Cascade volcanic sequence. In the western portion of the project area, these volcanic units are mapped by Walker and Duncan (1989) as "Tu", tuffaceous sedimentary rocks, basalt flows , and tuffs of Miocene and Oligocene age, approximately 32 to 17 million years old. In the eastern portion of this project area, these volcanic rocks are mapped by Walker and Duncan as "Tfc", basalt flows and clastic rocks from about 17 million to 10 million years old (19189). Also, Walker and Duncan (1989) map several large areas of "Qls" or landslide debris of Holocene or Pleistocene age in the Mill Creek area. This field reconnaissance determined that evidence for those landslide deposits is scant or not present, and they are likely moraine remnants. Interestingly, Legard and Meyer (1973) did not map any landslide deposits in this area either (Landtype 13). Nor did they map any glacial deposits (Landtypes 44 or 55) as they considered this entire basin primarily in-place, weathered volcanic soils. Suffice it to say that after much field reconnaissance, some small areas of landslide debris are present as are areas of weathered in-place volcanic rocks, but the large majority of this drainage is comprised of glacial deposits, such as outwash, ground, end or lateral moraine remnants.

In the last several million years, these rock formations have been extensively modified by stream erosion and mountain glaciation, especially with Pleistocene to Holocene glacial activity. Glacially derived soils are common in many units within this project. Ice cap glaciers probably covered the High Cascade platform many times during the Pleistocene, sometimes with sheets of ice hundreds of feet thick. During the early and most extensive glacial periods, valley glaciers surged away from

the large ice mounds along the Cascade crest and traveled south and west down the McKenzie River drainage or north and northwest out the South Fork drainage, as they acted as outlets for excess ice accumulation for the large ice platforms along the Cascade crest. Whether these two extensive valley glaciers ever coalesced is difficult to determine without considerably more extensive field work. Late Pleistocene glaciations were likely much smaller and localized valley glaciers did not extend this far west along the primary river valleys. Little or no evidence can be found that the rugged peaks of Castle Rock, Deathball Rock or Thors Hammer contained small localized cirques, common to similar peaks, much farther to the east.

The rocks and glacial deposits of these younger Tertiary volcanic strata and Pleistocene drift, moraine, and fluvioglacial material are generally quite stable in this project area. Because of extensive glacial scour, most volcanic rocks are usually not well weathered at this point. Residual soils are often relatively coarse grained, occasionally rocky, and usually contain few clays. Soils developed from glacial deposits, even on the steeper side slopes are usually quite stable. Consequently, because of the gentle side slope slopes in the valley bottoms, the lack of very fine soil particles in most areas, especially the glacial and outwash soils, and the fact that glacial scour removed deeper pockets of fine-grained soils on much of the steep terrain, most soils are quite stable. These various volcanic land types are generally well drained where permeability is rapid in the surface soil and moderately rapid in the subsoil. On the other hand, the glacial and alluvial soils in the valley bottoms are very well drained, and permeability is rapid to very rapid in both the surface soil and subsurface soil layers. Because of high infiltration rates in the broad valley bottoms, overland flow is generally uncommon. In the proposed units, side slopes range from near zero to about 30% on the gentler slopes to 40 to 80% on the steeper terrain. Offsite erosion is generally not a concern because of the vegetative ground cover, the high infiltration rates, and the gentle to moderate side slopes for many units.

Most of this project area was burnt by either natural or aboriginal fires that were likely prevalent and carried through much of the project area in the last several hundred years. Many areas may have been under burnt instead of stand replacement. Consequently, natural accumulations of down woody debris may not have been prevalent in many parts of this project area. These conditions would vary across the landscape, depending on aspect, elevation, and slope position.

B. ALTERNATIVES

All action alternatives and the no-action alternative will be evaluated for impacts to the soil resource. In this analysis, all the action alternatives have the same basic effects and the same soil protection measures, as described on a unit-by-unit basis, and will be considered similarily. Evaluating impacts and their potential significance between or among alternatives requires discussing the duration and intensity of those impacts. Often various words are utilized to describe those conditions. The following definitions apply to impacts described in this report.

1. Duration

- Short-term: The effects last for a few weeks to one or two years;
- Intermediate: The effects last from one or two years to about a decade:
- Long-term: The effects last from about 10 years to several score years or longer.

2. Intensity

- Low, negligible, little or no, minimal, minor: The impacts are essentially zero, at the lowest levels of detection, or very slight but still noticeable.

- Moderate, reasonable: The impacts are readily apparent, but meet standards and guides.
- Excessive, substantive, major, critical: The impact is moderately severe and likely approaches the upper limits of standards and guides.
- Significant, unacceptable: The impacts are severe, and likely exceed standards and guides or do not meet Best Management Practices.

3. Basis for Evaluation.

For the soils resource the scale of analysis for both direct / indirect effects and cumulative effects is almost always the "unit", i.e. the stand polygon proposed for silvicultural treatment. The unit of measure for evaluating those effects is generally considered the percent of the "unit" affected. The summing of acres for various units, such as the total acres of skyline logging in a given alternative, is not an evaluation criterion for soils impacts. Impacts are evaluated on a unit-by-unit basis, and are generally the same in any given unit for all action alternatives.

C. DIRECT AND INDIRECT EFFECTS

The major short-term, intermediate, or long-term impacts to soil productivity from harvest activity, as discussed in the Willamette National Forest Final Environmental Impact Statement (FEIS 1990), include displacement, compaction, nutrient loss, and instability. In most situations, preventing soil impacts is the most effective and feasible way of ensuring long-term soil productivity. The following sections discuss in more detail (1) how the proposed action may affect the soil resource or (2) mitigations that can be utilized to avoid potentially undesirable effects.

1. No Action Alternative

Stands will continue to develop. Many of the stands proposed for thinning currently have little understory vegetation because of the lack of sunlight to the forest floor. Intermediate and suppressed trees would slowly be removed from the stand through mortality and decay. In areas of heavy stocking, stands would stagnate. Blow down and snow down would continue to add fuel to the forest floor. In general, plant diversity would diminish as well as soil biota because of the lack of sunlight. Evidence of compaction from previous entries is still present in most ground-based units. In areas already compacted or disturbed by the initial entries, the soil building process will continue to return the soil to near preharvest conditions in the longer term. Short-term to intermediate term impacts from harvest, such as soil disturbance, dust (or mud), slash accumulation and disposal, and longer term impacts such as compaction and nutrient loss would not occur. Slope instability is not a geologic process that is active in this project area. Consequently, no effects to slope instability are anticipated whether the units are managed or not.

2. All Action Alternatives

All action alternatives have the same basic effects and the same soil protection measures, as described on a unit-by-unit basis. Some units may be evaluated that do not end up being considered in any action alternative.

A. Displacement

a) Existing Condition

Displacement occurs with three separate timber harvest activities: yarding, slash treatment, and road building and maintenance. Yarding activities on the existing plantations have for the most part occurred with the appropriate suspension requirements. Slash treatments usually maintained

some amount of duff, though the current duff retention standards may not have been achieved. Some of the oldest managed stands may have been tractor piled. Tractor piling can result in both excessive disturbance and excessive compaction. Whether these two activities resulted in moderate to major detrimental impacts to productivity in some units is difficult to determine. Tractor piling has NOT been considered acceptable as a management tool for over 20 years on the Willamette National Forest. Stand, shrub and brush growth, as well as duff accumulation over the decades has provided an effective ground cover. At the point in time, little physical evidence can be found in any unit to indicate whether these two timber management activities resulted in significant, long-term detrimental soil displacement, off-site soil movement, or substantive loss of productivity.

Road development in this project area is extensive, and most large blocks of forest have been accessed. Most major road systems were constructed in the 1960s and 1970s with older road construction standards, though most all roads are located on stable benches, flats or ridges. The amount of new road construction slowed considerably in the late 1980s, and with subsequent entries reconstruction began to dominant. Newer roads, when required, were constructed to different and better standards. Road grades were steepened and pitched to better fit roads to the terrain. Cuts and fills were minimized, and drainage controls were added to promote long term slope stability. Most road cuts and fills have naturally vegetated over the years. Because the side slopes are relatively gentle and overland flow is limited throughout this project, erosion from roads is not generally considered a concern, except in a few localized areas.

NOTE: Some specific roading options will be discussed in a separate section that follows the Slope Stability review at this end of this long part of the document.

b) Environmental consequences

The logging suspension requirement for a proposed unit is mandated in the Land and Resource Management Plan to protect the soil from excessive disturbance or displacement (FW-107 and BMP T-12). The area near tail trees and landings is generally excluded from this suspension constraint. Unless otherwise stated or mitigated, all designated streams require full suspension or yarding away from the stream course during the yarding process (MA-15-27). To adequately protect the soil resource, the primary yarding objective for all units will be either ground based systems with predesignated skid roads and directional falling as appropriate, or skyline yarding with one end suspension, except at tail trees and landings. The primary factor differentiating these two yarding systems will be side slope.

Ground-based yarding systems may be employed on those acres in each unit where slopes are gentle enough (generally 30% or less) for ground-based systems. Ground based yarding systems, such as processor / forwarder, conventional line pulling or shovel, could be utilized in many units. All areas where ground based yarding might occur, are well away from active drainages, or skid roads will cross ephemeral swales only during dry periods and at right angles. All ground based yarding will require the B6.422 contract clause be strictly adhered to, and/or line pulling and directional falling will be implemented, as appropriate. In all cases, existing skid or haul roads will be utilized before any additional new skid or forwarder roads are developed.

Skyline yarding with one end suspension will be recommended for units or portions of units with side slopes greater that 30% to avoid excessive disturbance from heavy equipment. In one specific case, Unit 21 is located on very flat terrain, but has numerous wet soil areas. Full suspension is recommended on this unit to avoid excessive disturbance from equipment or cable yarding corridors.

In conclusion, disturbance from yarding will be well within the Regional and Forest standard and significant adverse impacts are not anticipated. With appropriate suspension during logging, soil disturbance is minimal and off site erosion is essentially non-existent. During harvest, the retention of stream adjacent trees and the requirement of full suspension yarding over or away from stream courses will minimize or eliminate off-site erosion.

NOTE: A more complete discussion of yarding suspension requirements and effects follows in the compaction section and can also be found in the unit summary tables.

B. Compaction

a) Existing Condition

The major source of compaction (and also much disturbance) is ground based skidding equipment. Unrestricted tractor yarding and tractor piling are not considered an option on those landtypes where sideslopes are gentle enough (generally less that 30%) to support tractor usage (BMP T-9 and VM-1, and FW-107). The silty nature of the fine-grained soils, and evidence that significant soil moisture is available most of the year indicate that any type of unrestricted tractor yarding and piling (even low ground pressure) would lead to excessive soil compaction and/or disturbance. Restricted tractor yarding from predesignated skid roads (B6.422 contract clause) is considered an option if the adversely affected area remains less than 20% of the activity area (BMP T-11). With tractor yarding, skid roads are predesignated, approved in advance of use by the Timber Sale Officer and generally 150 to 200 feet apart. With a processor/forwarder system the skid roads are usually only about 50 to 60 feet apart, but the number of trips for each individual road are substantially less than with skidding.

Extensive monitoring over many years has also shown that when designated skid roads are properly utilized in conjunction with line pulling and directional falling, compaction from ground-based tractor operations generally remains at about 9 to 13%. Residual compaction from the original harvest of these plantations needs to be considered.

Reducing the effective weight of the tractors and reducing the number of trips over a piece of ground are other means to reduce the risk of soil compaction and displacement. Yarding over frozen ground or over a deep, solid snow pack (24 inches of dense snow **or equivalent**) also substantively reduces soil disturbance and compaction (BMP VM-4). Over-the-snow yarding is encouraged for any of these units, as long as other resource objectives can be achieved, and sufficient snow accumulation is available. Monitoring of previous over-the-snow operations on various Districts has shown that essentially no displacement or compaction occurs, when it is properly implemented.

b) Environmental consequences

Evidence of compaction from previous entries is still present. Field reconnaissance through almost all the proposed units show some level of existing compaction. Oriented transects were walked through all the larger portions of possible tractor units. Transects were usually about 500 to 1000 feet in length, though both shorter and longer transects were walked. The results of the field investigation follow this paragraph. In no case was compaction measured directly. Heavily disturbed skid roads, landings or other areas where equipment tracks were evident are considered adversely compacted. Transects measure the amount of compacted ground along a line within a proposed unit. They were generally oriented to obtain information on management activities. They are not random, nor statistically representative of a particular unit. However, they do provide a strong indication of the degree of concern for the unit under investigation. In

some cases multiple transects were walked in some units in different directions in order to provide more information, or to monitor and evaluate the initial results for accuracy. Ranges indicate some degree of uncertainty in the presence of compacted skid roads because of brush or other factors.

Unit No. Percent compacted along an individual transect.

2	13 to15
3	12, 15, and 12 to13
5	15 to17
6	14 to 15
8	12 to 13, and 10
9	18 to 20, 10 to 12, and 12
10	16 to 18, 13 to 14, and 6 to 8
18	north portion - 8
19	8
20	14 to 16 and 11 to 13
21	10 to 15, wet, difficult to evaluate
22	no information
23	14 to 16
24	18, and 10 to 12
30	8 to 10, estimate from reconnaissance
43	6 to 10
44	8 and 8
45	10
46	12 to 14
50	no information
61	10
62	10
67	10
95	8 and 10
96	8 to 10
97	15+
98	15+
99	12
103	no information.

The field investigation indicated that none of the units as a whole exceeded the Willamette National Forest FW-081 Standard of 20% of an activity area impacted by compaction. Some units, like Unit 5 had relatively high levels, and some units like Units 9, 10 and 24 had high individual transect values that approach the standard. Usually, these were transects that crossed old landing sites. However, these two units as well as the others are, on average sufficiently below the threshold not to be considered a concern. One of the goals with entry into all these units is to provide the opportunity to subsoil the existing skid roads as much as is practical in order to reduce compaction to lower levels. With entry into any ground-based unit, evident skid or haul roads will be utilized before any new skid road is approved. It is possible with this proposed action that cumulative compaction in some portions of some units may exceed the threshold at the completion of harvest activities. Consequently, subsoiling is recommended enhancement to insure that cumulative levels remain below the 20% standard. Based on previous experience, this effort should be successful. For example in previous activities with other units with past subsoiling, the overall compaction was reduced by about 5 to10% from initial levels.

Consequently, at the completion of harvest activities, some subsoiling is recommended for most ground based units in order to reduce compaction levels and improve overall productivity. Units 3, 8, 9, 10 19, 20, 22, 23, 24, 30, 40, 50, 61, 62, 67, 95, 96, 97, 98, 99 and 103 are primarily ground based and contain a total of over 600 acres. Assuming approximately 5% reduction in compaction, the equivalent of 30 acres could be subsoiled. At about $350 per subsoiled acre, this totals to over $10,000 of recommended enhancement. In addition, Units 2, 4, 5, 6, 15, 18, 26, 35, 36, 42, 43, 44, 45, 46, 47, 48, 49, 51, 54, 64, 66, 69, 72, 100, and 102 have portions of the unit which could be ground based while other parts are recommended for skyline, because of side slope constraints. These units total over 1000 acres. Assuming about one half the area is suitable for ground based harvest, approximately 500 additional acres might be available for ground based harvest. Again, assuming about a 5% reduction with subsoiling, this would generate about 25 acres of additional enhancement subsoiling at an approximately cost of just over $8000. In total, if all these units were considered in an action alternative, then about $18,000 is recommended for collection for enhancement subsoiling. If some of these units are not included for harvest or if sufficient enhancement funds are not present for all units, then the dollars that are available will be distributed on a priority basis to the units with the greatest level of initial compaction, receiving the most attention. In summary, with the use of designated skid roads, the reuse of the existing skid road system, and the subsoiling of primary landings and skid roads, compaction is not anticipated to exceed the 20% value in any unit and should be below the 15% level (or lower) in most units. Therefore it is not cumulatively significant. Subsoiling may be curtailed in some areas in order to reduce the amount of root pruning of leave trees and to avoid excessive amounts of exposed soil.

Skyline operations in thinning units with small wood and intermediate supports usually impacts less than 1% of the unit area. Skyline yarding with one end suspension is proposed for most or all of Units 1, 11, 12, 13, 14, 16, 17, 27, 28, 29, 31, 32, 34, 37, 38, 39, 52, 53, 55, 56, 57, 58, 59, 60, 63, 65, 74, 80, 81, 82, 83, 84, 88, 89, 91, 101, and 105. Most of these units had low existing compaction levels at generally less than 5% for these units. In addition, Units 2, 4, 5, 6, 15, 18, 26, 35, 36, 42, 43, 44, 45, 46, 47, 48, 49, 51, 54, 64, 66, 69, 72, 100, and 102 have moderate to larger portions of the unit which are proposed for skyline yarding with one end suspension because of side slope constraints. The more gently sloping areas could be ground based. Skyline landings are primarily planned at old existing landings, road turnouts, and road junctions. Little new spur road will be required. Consequently, cumulative effects from existing compaction and skyline yarding are not anticipated.

C. Nutrient Loss

a) Existing Condition

Many of the stands in this project area may have had an active fire history in the last 100 to 500 years or so, primarily with natural or aboriginal under burning. As a result, large expanses never had much down woody debris, or all of the accumulating down woody debris was removed by the fires. Many of the managed stands also had the initial harvests when PUM standards were in effect. This required that larger waste material (usually 8 inches wide and 10 feet long or greater) be removed from the units to reduce fire intensity. On the other hand, some of the oldest stands were harvested when utilization standards were low or absent, and this resulted in concentrations of large woody debris in some locations. In addition, most managed stands were broadcast burned which removed additional amounts of above ground organic matter. Consequently across numerous older managed stands, management generated, down woody debris or slash is at low levels, likely replicating the natural condition in many areas. Conversely, some localized areas have substantive accumulations. Younger plantations retained much more slash and large woody debris as was the current Forest plan direction. As a result, a wide range in the above ground tonnage of decomposing organic matter exists with amounts generally varying management history and fire intensity. The variety exists both between and within units.

b) Environmental consequences

Duff Retention objectives were specifically developed many years ago by the Willamette National Forest to apply to clear cut harvest prescriptions with broadcast burns on various landtypes with differing surface soil erosion potentials. Duff retention is the amount of duff thickness remaining after management activities are completed. For example, if average premanagement duff thickness was one inch, and approximately one half inch remained after broad cast burning, then duff retention would be 50%. When these standards were developed, duff retention on partial cut harvest prescriptions was not a significant issue, and none were formulated. Monitoring and field reconnaissance in recent years has shown that the duff retention percentages for under burns in partial cuts, thinnings, or fuels reduction within unmanaged stands, which maintain an intact live root mat and live canopy cover over most of the unit, could be less (to much less) and still achieve adequate soil protection. Having said that, actual duff retention measurements on under burns (both natural and management directed) on various Districts in the last few years indicate that the "broadcast burn" standards for duff retention are generally achieved, even if they are not specifically required. Consequently, they serve as a good goal and are recommended as a desired objective for the units in this report.

In the unit summary section, objectives for duff retention will be specified for each unit. For all action alternatives, within the managed plantations, slash will either be scattered in the units, piled and burned, or perhaps broadcast or under burned. Piling may occur by hand or with a grapple machine. Grapple piling occurs with a grapple not with a dozer brush rake. Grapple piling requires only one pass of the machine across the landscape, and the machine works while sitting on slash. Extensive monitoring of grapple machine piling operations indicates that little or no additional compaction or displacement occurs. On typical thinning, hand piles number about 40 per acre and occupy about 20 square feet per pile for a total of about 800 square feet per acre or about 1.8% per acre. Machine piles are substantively less in number, but correspondingly larger in size so that the 1.8 to 2% figure is maintained. In many cases only a few acres of any particular unit are hand piled or machine piled. Burning the piled slash may develop sufficient heat to affect the underlying soil. However, pile burning is usually done in the fall or winter months when duff and soil moistures are higher, and this helps reduce the downward heat effects to the soil. Consequently, pile burning is considered a minor effect and not cumulative because of the limited overall acreage involved.

Another aspect of long term nutrient availability and ectomycorrhizal formation is the amount of larger woody material retained on site. Management activities will be planned to maintain enough large woody debris (dead and down) to provide for a healthy forest ecosystem and ensure adequate nutrient cycling (FW-085). At this time, site specific needs will be considered commensurate with wildlife objectives as outlined in FW-212a and FW-213a (as amended).

In summary, duff retention objectives will be provided on a unit-by-unit basis in the unit summary table. Concentrations of larger down logs that were produced naturally with the initial harvest should be left undisturbed as much as possible. Consequently, with the retention of adequate duff and woody debris, potential adverse impacts to long-term soil productivity are not anticipated.

D. Instability

a) Existing Condition

As was stated previously, this portion of the lower McKenzie drainage on the McKenzie River Ranger District is considered quite stable. Active slope instability from either debris chutes or

slump / earth flow complexes does not usually occur. The recent intense rainstorms from 1996 to 2000 generated no in-unit instability within this project area, and only a few road failures were noted. These were primarily where culverts were overwhelmed or blocked with debris, and not because of soil or slope failure.

b) Environmental Consequences

Potential slope instability with proposed management is not considered a concern. No specific mitigation is proposed for these units, as none is needed.

E. Transportation Development

Some units may require temporary roads to access suitable landing sites for either ground based or skyline yarding systems. In all cases, these temporary roads are located on gentle stable side slopes in common material. Little or no full bench construction is required, and if needed, end haul of excess excavation will be required to a suitable waste area. For the most part, no active drainages are crossed. Some units are accessed by opening old logging roads constructed many decades ago. In most cases, use of these old roads will allow for drainage structure improvements and fill stabilization. Some units are accessed by using newer Forest Service roads that now require some additional work to maintain adequate road drainage and surface integrity. In summary, development of the transportation system for this sale will maintain slope stability, will produce little or no off site erosion, and will provide opportunity to rehabilitate old road courses.

Site specific discussions for access to various units follows:

1) Unit 39: The proposed spur climbs quickly from FS Rd. 1501 and is about 800 feet long. Most of the route, about 600 feet, is located on an existing old skid road on 10 to 30% side slopes, running along the contour at a primary slope break. The first 200 feet requires a steep favorable pitch with full bench construction on 40 to 70% side slopes in common material. The soils here are stable, and the recommended cut slope is 1:1. The excavated material, approximately 200 cubic yards, needs to be moved ahead to be used as a fill to construct the first landing. I am recommending that the first section be sensitive construct in order to control the location, the amount of excavated material, and its fill placement at the landing. This spur would likely be native surface with a standard operating season, and closed after logging activities are completed. The entire route is located within the proposed cutting unit, and no streams, floodplains or wet lands are involved.

2) Unit 43: Several options are available. The initial thought was to access a possible skyline landing on a side ridge near the west boundary by coming in from the north. This route is located on gentle side slopes between 0 and 10%. However, this access involves several wet soil areas and possible wetlands. Though feasible, it did not look desirable. Instead we located a route that comes in from the west. This route is also on gentle side slopes in common material on dry ground. It crosses a small stream / wet soil area for about 50 feet. This site would need a temporary culvert. This spur would be native surface with a standard operating season, and closed after logging activities are completed. The entire length of the spur is within the proposed cutting unit. Another option would be to avoid this area entirely. By using intermediate supports and adjusting the proposed unit boundary, it may also be possible to harvest all the skyline portion of this unit from a landing at the junction of FS Rd. 1501000 and Rd. 1501202. Since this is a rocked landing on an existing, well rocked road, a considerably extended operating season would be available.

3) Unit 51: Two options are available to harvest this unit. a) With the construction of an approximately 1000 feet of spur on gentle side slopes in common material, almost all this unit can be harvested by

ground based systems. All this route is within the proposed cutting unit, and most of this spur is located on an existing old skid road. This proposal would require a native surface road and dry season operation, usually considered July through September. The steeper ground along FS Rd. 1501700 would need to be directionally felled to the existing road or to gentler ground.

b) With this option, almost the entire unit would be sky line logged with partial suspension. A landing would need to be constructed on Rd. 700 at the northeast corner of the unit. Approximately 100 cubic yards of common material would be excavated from the cut bank and used to construct a 10 to 12 foot wide fill along the road for about 40 feet of distance. The fill slope is located on an approximately 30% to 35% side slope. Approximately, 10 to 20 cubic yards of pit run would be required to rock the constructed fill. Since this would be a rocked landing immediately adjacent to a well-rocked road, the operating season in this option could be a considerably extended season for this low elevation unit. This landing would serve as a turnout for the road at the completion of harvest activities.

4) Unit 55: This skyline unit has an excellent landing site on a broad stable bench at the top of the unit. Accessing this landing requires about 500 feet of spur road, most of which is not located within the cutting unit. The last 300 feet is on a broad, stable ridge with gentle side slopes in common material. The first 200 feet is somewhat more complicated. In order to leave the existing spur road (FS Rd. 1501702), grades in excess of 15% adverse are required to avoid undercutting the existing road, as side slopes here at about 45 to 70%. This will require truck assist for the haul. However, in order to avoid a switchback in large old growth timber on the bench, we steepened the grade to 22 to 26% adverse. This was done in order to avoid cutting numerous, large, old growth Douglas fir. Such grades are considered at the upper limit of truck assist, but are still feasible for this short distance with relatively straight alignment. This first portion of the route will be a full bench cut in common material on stable side slopes. The cut slope would be 1:1. It appears to avoid impacting any old growth timber. The excavated soil can be pushed ahead to be used as fill for the short section of road on the bench. Again, sensitive construct is recommended, primarily to control the location of this route, the amount of cut, and the placement of excavated material. This route would generally be considered a native surface road and standard operating season. At this point, the only other feasible option to harvest this unit, if the truck assist route is not utilized, is helicopter.

5) Langasher Road: The Langasher Road is the primary access road along the south side of the McKenzie River that runs east from near Finn Rock to Road 19, a distance of nearly seven miles. It accesses many of the units in this sale, and much of it is currently in poor condition. Considerable portions of this route are located on essentially flat sideslopes, and the road surface has chuck holes, swales and depressions in many areas. Several ephemeral and intermittent streams cross the road way at fords. Cross drains and stream culverts are few. During wet weather periods, ponded areas along the road way are common. It is proposed that the road way be raised about 12 to 24 inches along much of its length to provide a better road bed and improve road drainage.

The proposed road fill project can be divided into five segments.

Segment 1: Extends from Rd. 19 to Point A. No distance was measured. This segment is well rocked and was reconstructed with a previous timber sale. It would require some limited culvert work and spot rocking in a few critical areas. .

Segment 2: Extends for Point A to Point B. It is 1.2 miles long. Point B is located at a major spur road junction that access several units. Most of this section has large pot holes or water running across the road. It would require rocking or through fills to raise grade and improve drainage.

Segment 3: Extends from Point B to Point C. It is 0.9 mile long. Most of this section has large pot holes

or water running across the road.

Segment 4: Extends from Point C to Point D. It is 0.7 mile long. The section from C to D includes a large number of units. Point D is located at a major spur road junction that access several more units. Most of this section has large pot holes or water running across the road. It would require rocking or through fills to raise grade in order to improve drainage.

Segment 5: Extends from Point D to FS Rd. 2618 at Quartz Creek. No distance was measured. Most of this section is located on private land and is well rocked. It would require some limited culvert work and spot rocking.

This segmentation assumes the following: All the units on the west side of the project area would haul from Point C to the west. All the units on the east side of the project would haul form Point B to the east. No haul would occur in the space between Point B and Point C. There are no proposed units located there The borrow site for the east side work is located about 0.1 mile south of Point B, in a large patch of scotch broom. The borrow site for the west side work is located somewhere between D and C in the unit (or units) that are located along both sides of the road in this section.

D. CUMULATIVE EFFECTS ASSESSMENT

For the soils resource the scale of analysis for both direct / indirect effects and cumulative effects is almost always the "unit", i.e. the stand polygon proposed for silvicultural treatment. The unit of measure for evaluating those effects is generally considered the percent of the "unit" affected. The major short-term impacts to soil productivity from harvest activity include displacement, compaction, nutrient loss, and instability. Forest-wide Standards and Guidelines FW – 081, Detrimental Soil Conditions, state that the total area of cumulative detrimental soil conditions should not exceed 20% of the total acreage within the activity area, including roads and landings. In most situations, preventing soil impacts is the most effective and feasible way of reducing cumulative effects and ensuring long-term soil productivity.

The primary previous impact to the soil resource from management is compaction, the effects of which can remain apparent for decades. Potential cumulative effects from displacement, nutrient loss, and instability with previous management were not observed in the field reconnaissance. Existing compaction levels have been documented and discussed for the various units. The impacts are evaluated on a unit-by-unit basis, and are generally the same in any given unit for all action alternatives, unless otherwise noted. The soils mitigation measures are designed to limit the amount of additional compaction, and the subsoiling is intended to reduce compaction where levels would exceed standards and guides. It is possible that some ground based units may approach the 20% standard at the completion of yarding, grapple piling, and pile burning. No unit is anticipated to exceed the 20% standard in total, and units will be prioritized so that limited enhancement dollars will be expended on those units with the greatest anticipated cumulative effects from management. The objective is to remain below the 20% cumulative level, maintain long term soil productivity, and provide a level of erosion control that is consistent with State guidelines.

All prescriptions or mitigation measures discussed in this report are designed to meet or exceed the requirements outlined in the General Water Quality Best Management Practices Handbook (Pacific Northwest Region, November 1988). Prescriptions for soil protection and watershed considerations take into account past and predicted future land management activities.

At this time, no single unit measure of long-term soil productivity is widely used. Information on the survival and growth of planted seedlings may indicate short-term changes in site productivity. However, the relationship of short-term changes to long-term productivity is not fully understood at present. Experience indicates that the potential impacts on soils are best evaluated on a site specific, project-by-project basis. The major soils concerns - compaction, nutrient loss, displacement and instability - are most effectively reviewed, for both short and long-term effects, at the project level. With proper project implementation, as specified by my recommendations that immediately follow in the next section on mitigation measures and design standards, unacceptable cumulative effects on the soils resource are not anticipated from any of the action alternatives (BMP W-5). Consequently, the utilization of soil protection measures and best management practices as defined in this report will generally preclude the need for additional cumulative effects analysis. Deviations from the standards and guidelines would be the primary trigger for a cumulative effects review, and no deviations are planned.

E. MITIGATION MEASURES, by unit and common to all action alternatives

The various proposed units are located on productive soils as localized unsuited areas of rocks and cliffs or potentially unstable areas were generally avoided, unless otherwise listed. Recent thinning on similar landtypes on this and other Ranger Districts has shown that 1) By avoiding sensitive landtypes, slope stability has been maintained after harvest; 2) With appropriate suspension during logging, soil disturbance was minimal and off-site erosion was essentially non existent; and 3) With appropriate contract language and enforcement, excessive compaction which results from unrestricted tractor yarding did not occur.

1. Soil Protection Measures

The following table discusses mitigations that would be necessary on a unit-by-unit basis. The information and recommendations were developed based on A) direction in the Forest Wide Standards and Guides (primarily FW-079, FW-090 and FW-179) to maintain or enhance soil productivity and stability, B) the field reconnaissance, and C) experience gained from extensive monitoring of similar projects. This data table addresses both suspension requirements and duff retention objectives, as well as pertinent specific comments for particular units (where necessary). The second list, that follows this table, has implementation mitigation measures that would also be applied to all units in any action alternative.

Unit	**SRI**	**Suspension**	**Duff Retention %**	**Comments**
1	201	Partial	60-80	Rocks along NW boundary
2	214, 44, 236	Partial, Ground	30-50	Wetland along north boundary. Yarding method depends on side slope. Implement B6.442 on ground based portions.
3	15-16	Ground	20-40	Implement B6.422. Wetland along west boundary.
4	201, 236	Partial, Ground	40-60	Yarding method depends on side slope. Implement B6.442 on ground based portions.

5	201, 236	Partial, ground	40-60	Yarding method depends on side slope. Implement B6.442 on ground based portions.
6	231-233, 212, 236, 44, 201	Partial, Ground	40-60	Yarding method depends on side slope. Implement B6.442 on ground based portions.
7	6			Wetland and hardwoods. Unsuited
8	15-16	Ground	20-40	Wetland along south boundary. Implement B6.422
9	15-16	Ground		Implement B6.422
10	15-16	Ground	20-40	Implement B6.422
11	201-301, 212	Partial	60-80	
12	201-301	Partial	60-80	
13	201	Partial	60-80	Rocks (unsuited land) in unit along NW and NE boundaries.
14	201, 201-301	Partial	60-80	Rocks at NW and E boundary
15	201-301, 15-16	Partial, Ground	50-70	Rocks along SW boundary. Yarding method depends on side slope. Implement B6.442 on ground based portions.
16	201	Partial	60-80	Rocks along SW boundary.
17	201	Partial	60-80	Rocks (unsuited) in unit at SW boundary.
18	201, 15-16	Partial, Ground	50-70	Yarding method depends on side slope. Implement B6.442 on ground based portions.
19	15-16	Ground	20-40	Implement B6.422
20	15-16	Ground	20-40	Implement B6.422
21	15-16	Full	50-70	Wet soil area, full suspension required to avoid excessive disturbance.
22	15-16	Ground	20-40	Implement B6.422
23	15-16	Ground	20-40	Implement B6.422
24	15-16	Ground	20-40	Implement B6.422
25	212, 201-301	Partial	60-80	
26	16-162, 201-214	Partial, Ground	50-70	Yarding method depends on side slope. Implement B6.422 on ground based areas.
27	201	Partial	60-80	
28	212	Partial	50-70	
29	201-214	Partial	60-80	Rocks at east boundary.
30	16-55	Ground	20-40	Implement B6.422
31	201-214	Partial	60-80	Rocks at north tip.
32	201-214, 443-447-553	Partial	30-50	
33	3-610, 644			Unsuited rock outcrops
34	214, 443	Partial	50-70	
35	16-55, 214	Partial, Ground	50-70	Yarding method depends on side slope. Implement B6.422 on ground based areas. Rocks at NE boundary.
36	55-234, 203-214,	Partial, Ground	50-70	Yarding method depends on side slope. Implement B6.422 on ground based areas.

				Rocks at SW boundary.
37	203-214	Partial	60-80	
38	44	Partial	40-60	
39	44, 214	Partial	50-70	
40	16-55	Ground	20-40	Implement B6.422
41	3-610			Rock Source – Mill Creek Rock Pit
42	214, 44, 55	Partial, Ground	40-60	Yarding method depends on side slope. Implement B6.422 on ground based areas.
43	201-214, 236-553-554	Partial, Ground	40-60	Yarding method depends on side slope. Implement B6.422 on ground based areas.
44	16-55, 44	Partial, Ground	40-60	Yarding method depends on side slope. Implement B6.422 on ground based areas.
45	236-553-554, 44, 55	Partial, Ground	40-60	Yarding method depends on side slope. Implement B6.422 on ground based areas.
46	236-553-554,	Partial, Ground	40-60	Yarding method depends on side slope. Implement B6.422 on ground based areas.
47	212, 236-553-554	Partial, Ground	40-60	Yarding method depends on side slope. Implement B6.422 on ground based areas.
48	201, 236-553-554	Partial, Ground	40-60	Yarding method depends on side slope. Implement B6.422 on ground based areas.
49	16, 605	Partial, Ground	50-70	Yarding method depends on side slope. Implement B6.422 on ground based areas.
50	16	Ground	20-40	Implement B6.422
51	16, 441	Partial, Ground	40-60	Yarding method depends on side slope. Implement B6.422 on ground based areas.
52	44	Partial	40-60	
53	44	Partial	40-60	
54	443-553-554	Partial, Ground	40-60	Yarding method depends on side slope. Implement B6.422 on ground based areas.
55	214, 443-553-554	Partial	40-60	
56	201-214, 204	Partial	60-80	Some rocky soil areas.
57	201, 204	Partial	60-80	Some rocky soil areas.
58	443, 55-234	Partial	40-60	
59	55-234, 443	Partial	40-60	
60	443, 212	Partial	50-70	
61	55	Ground	20-40	Implement B6.422
62	55	Ground	20-40	Implement B6.422
63	201	Partial	60-80	
64	55-233, 201, 214	Partial, Ground	50-70	Yarding method depends on side slope. Implement B6.422 on ground based areas.
65	201, 214	Partial	60-80	
66	214, 236-553-554	Partial, Ground	40-60	Yarding method depends on side slope. Implement B6.422 on ground based areas.
67	55	Ground	20-40	Implement B6.422
68				
69	55-234, 55, 443	Partial, Ground	30-50	Yarding method depends on side slope. Implement B6.422 on ground based areas.
70				
71	15-16			Borrow site for fill material

72	164, 214, 443-553-554	Partial, Ground	40-60	Yarding method depends on side slope. Implement B6.422 on ground based areas.
73				
74	44	Partial	40-60	
75				
76				
77				
78				
79				
80	201	Partial	60-80	
81	201	Partial	60-80	
82	212, 236	Partial	50-70	
83	201	Partial	60-80	Rocks at SW boundary.
84	201, 201-214, 214	Partial	60-80	Unit surrounds rocky meadows.
85	3-210			Rocky, open meadows.
86	3-210			Dry meadows with rocks
87	3-210			Rocky unsuited areas
88	201	Partial	60-80	Rocks in unit and at NE boundary.
89	201	Partial	60-80	Rocks at SE boundary.
90				
91	44	Partial	40-60	
92				
93				
94				
95	15-16	Ground	20-40	Implement B6.422
96	15-16	Ground	20-40	Implement B6.422
97	15-16	Ground	20-40	Implement B6.422
98	15-16	Ground	20-40	Implement B6.422
99	15-16	Ground	20-40	Implement B6.422
100	13-16	Partial, Ground	20-40	Yarding method depends on side slope. Implement B6.422 on ground based areas.
101	13-16	Partial	30-50	
102	13-16, 15-16	Partial, Ground	30-50	Yarding method depends on side slope. Implement B6.422 on ground based areas.
103	15-16	Ground	20-40	Implement B6.422
104	3-610			Mill Creek Overlook Rock Source
105	201	Partial	60-80	

NOTES:

A) **Some units (or portions there of) that were reviewed in the field reconnaissance and discussed in this report and the unit summary section may not be included in any action alternative, or have been combined with other units. They are included to document the work that was accomplished.**

B) Partial means skyline logging with one end suspension and full suspension over draws and drainage courses. The area at tail trees and landings is excluded. Ground means a ground based system such as tractor, shovel or processor / forwarder.
C) These Duff Retention objectives were specifically developed to apply to clear cut harvest prescriptions on these particular landtypes. The percentages for partial cuts, thinnings, or underburns of unmanaged stands, which maintain an intact live root mat and canopy cover over most of the unit, could be less (to much less) and still achieve adequate soil protection. Duff retention monitoring in the last few years on underburns on various Districts indicates that these levels of duff retention are generally achieved, even if they are not specifically required.

D) Several units are planned for harvest with helicopter yarding. This is done to reduce the development of a transportation system that would be needed for conventional logging and is not required for adequate soil protection.

2. Site Specific Mitigation Measures -- common to all action alternatives

a) Ground-based equipment should generally operate in the dry season, usually considered from May through October, unless otherwise restricted by other resource concerns or waived by Forest Service personnel.

b) Where operable, harvested trees should be topped and limbed in the units in order to provide small limbs and needles for nutrient recycling. This objective has to be tempered with the need to reduce fuel loading to control potential wild fires, and to meet site specific standards for slash loadings.

c) Horses and ground -based equipment are usually limited to side slopes less than 30%, unless otherwise directed by Forest Service personnel, in order to reduce soil disturbance.

d) Ground-based skidding equipment shall stay on designated skid trails. Ground-based skid trails will be predesignated and preapproved before use (B6.422). Existing skid roads should always be used before new skid road locations are approved. They should not usually exceed 15 feet in width, and the objective is to maintain a 10 to 12 foot width throughout the length. Where practical the skidder, cat, shovel or forwarder should travel on slash. Traveling on slash has been shown to reduce off site soil erosion or lessen soil compaction. Skid roads will generally be 100 to 200 feet apart with conventional line pulling operations, and 40 to 60 feet apart with processor / forwarder operations.

e) Partial or one end suspension is required on skyline units, except at tail trees and landings. Given the gentle to moderate slope of the terrain, small sections of ground lead may occur in some areas, and this is acceptable.

f) The reopening of temporary, unclassified roads should usually occur in the dry season, generally considered May through October to avoid surface erosion from exposed soil (unless directed otherwise by Forest Service personnel). Open roads should be storm proofed if they have to set through extended periods of wet weather.

g) Where practical, at the completion of harvest activities, limbs and woody debris should be placed on areas of exposed soil to reduce the potential for off site soil erosion.

h) Unclassified or temporary roads used outside the standard operating season, should generally be rocked, snow covered, or frozen to reduce the potential for erosion, unless other mitigating or extenuating circumstances are present.

i) Cable corridors spacing should be set to both minimize damage to standing timber, as well as the under lying vegetation and soil.

j) Trees, not designated for harvest in riparian buffers that need to be cut to facilitate harvest operations, should be dropped into the stream if possible to aid in woody debris recruitment.

k) Avoid disturbance to the existing large down woody debris concentrations created by the initial entry as much as practical.

l) At the completion of harvest activities, spur roads, tractor skid roads or forwarder roads should be water barred and scarified, as is necessary. Where possible, skid roads and landings should be subsoiled in order to reduce compaction and return the site to near original productivity. Subsoiling needs to be considered in light of the potential for root pruning, damage to existing regeneration, and the increased amount of soil disturbance.

F. MONITORING REQUIREMENTS

As the proposed project is carried out, it will be monitored to evaluate implementation efficiency, prescription adequacy, and to update sale area rehabilitation needs or protection. Primary implementation monitoring will be conducted at the contract administration phase of the project by the Timber Sale Officer. The logger will be required to maintain adequate suspension during the harvest process, to remain on designated skid roads and landings with equipment, and to limit the number and extent of skid road utilized. In addition, a host of other contract requirements dealing with such items as erosion control, hazardous material use, fire restrictions, etc. will be enforced. Duff retention will be monitored as part of any post sale activity that may affect the soil resource, such as spot or pile burning, grapple piling, or broadcast burning.

VII. CONSISTENCY WITH DIRECTION AND REGULATIONS

A. STANDARDS AND GUIDELINES

Prescriptions for soil protection, watershed considerations and riparian needs of the sub-basin take into account past and predicted future land management activities. The soils mitigation measures are designed to provide a level of protection and erosion control that is consistent with the standards and guidelines of the Willamette National Forest's Land and Resource Management Plan (1990). On site sedimentation is anticipated to be within National Forest and Oregon State Guidelines. All prescriptions or mitigation measures discussed in this report are designed to meet or exceed the requirements outlined in the General Water Quality Best Management Practices Handbook (Pacific Northwest Region, November 1988). Standard contract language should provide for sufficient erosion control measures during timber sale operations (BMP T-13). Revegetation of areas disturbed by harvest activities (such as landings, temporary roads, and equipment storage areas) is required with an appropriate seed mix (BMP T-14, T-15, and T-16).

Other applicable Standards and Guides and/or Best Management Practices may exist which were not directly referenced in this document. Their exclusion does not indicate that they were overlooked or are inapplicable. As project development proceeds, appropriate constraints or mitigations may be added or changed in order to better meet the intent of adequate resource protection or enhancement as directed in the 1990 Willamette National Forest Land and Resource Management Plan and Final Environmental Impact Statement.

B. IDENTIFICATION OF IRREVERSIBLE OR IRRETRIEVABLEE RESOURCES

No irreversible and /or irretrievable use of the soils or geology resource is anticipated, beyond that which has been previously identified in the Willamette National Forest Land and Resource Management Plan, as amended. Road or landing aggregate, either crushed or pit run, that might be required for this sale could come from various rock sources. Development could occur within the Blue River, Mill Creek, and Mill Creek Overlook Rock Quarries to provide various rock products for road maintenance and road reconstruction associated with the harvest and haul needs. Minor clearing, generally of less than one acre for any individual pit could be associated with the development of any of these rock sources. Clearing could include managed stand trees in plantations or brush, or adjacent snags and danger trees.

C. CONSULTATION WITH OTHERS - Logging systems work was done on several units in conjunction with Dan Fleming, Logging Systems Specialist on the McKenzie River Ranger District. Some unit development, especially in the west part of the project area and north of Hwy. 126, was conducted and evaluated in the field with Shane Kamrath, Wildlife Biologist, and Mei Lin Lantz, AFMO and Fuels Specialist. The Langasher Road reconstruction proposal was developed with considerable input from Dave Kretzing, District Hydrologist.

VIII. REFERENCES CITED

Legard, Harold A. and Meyer, LeRoy C., 1973: Willamette National Forest Soil Resource Inventory, Pacific Northwest Region, 167 p.

Walker, George W. and Duncan, Robert A., 1989, Geologic Map of the Salem 1 (degree) by 2 (degree) Quadrangle, Western Oregon: Miscellaneous Investigations Series, U. S. Geological Survey, 1989G.

Respectfully submitted,

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