Final

Supplement
to the
Basin Creek Hazardous Fuels Reduction Project FEIS

Soil Scientist Specialist Report
Basin Creek Hazardous Fuels Reduction Project – Soil Productivity
Best Management Practices Monitoring
Compliance with Regional Soil Quality Standards
Forest Plan Soil Monitoring Item 3

February 1, 2007

SUMMARY

On June 23, 2006, Judge Molloy issued an order stating: "The Basin Creek Hazardous Fuels Reduction Project is permanently enjoined and remanded to the Forest Service to conduct the required analysis of the Project's potential impact on soil productivity. The Forest Service may move to dissolve the injunction upon a showing that they have complied with environmental laws." This report responds to that remand.

This report shows monitoring conducted on the South Butte Salvage sale (and elsewhere on the Beaverhead-Deerlodge National Forest) demonstrates conservation practices and timber sale contract provisions are an effective means of achieving Regional Soil Quality Standards to maintain site productivity as required by the National Forest Management Act. The soil impacts and conclusions in the Basin Creek Hazardous Fuels Reduction FEIS are confirmed. The analysis presented in the Basin Creek Hazardous Fuels Reduction FEIS is valid and the determination in the FEIS that "By design under this proposal, detrimental soil disturbance in all units would be at or below 15 percent, which is the maximum level allowed by soil quality standards from all causes" is supported. The soil quality standards have been incorporated into the project contract and practices designed to achieve these standards have been implemented and monitored.

Further, the Forest Service has confirmed Forest Plan Monitoring Item 9-3 has been complied with as soil chemical and physical properties have not changed more than 20 percent due to project impacts. Ground cover is adequate to minimize erosion and provides adequate protection to maintain site productivity. In addition, at such time as operations can be resumed, soil mitigation measures will be completed and coarse woody debris requirements will be met in all units as specified in the Basin Creek Hazardous Fuels Reduction Project and the timber sale contract.

This report was made available for 45-day public review and comment on September 29, 2006 through a legal notice in the Montana Standard. Notice of the availability of the report was published in the Federal Register on October 3, 2006. (71 FR 58369). Notice of the availability of the report was also provided to approximately 158 parties who previously expressed interest in the Basin project; including all those who commented (23) on the DEIS.

The Beaverhead-Deerlodge National Forest received a total of 3 public comments on the report. Each public comment received a response. The Forest's responses and the public comments are available from the Forest. In response to the public's comments, additional material was added to the following sections of this report: Section III C. 3. South Butte Salvage Sale – BMP Effectiveness and Section IV. B. 1. Sensitive Soils. In addition, a new Appendix E was added detailing the physical soil properties or characteristics of the soils in the project area. Specifically, the Report now includes discussion and scientific support for the effectiveness of the mitigation measures of ripping, tilling and back-blading and discussion of the objective criteria used in determining sensitivity of soils. The public comments did not change the conclusions of the Report.

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Forest Plan Soil Monitoring Item 3
By

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I. Background: On June 23, 2006, Judge Molloy issued an order stating: "The Basin Creek Hazardous Fuels Reduction Project is permanently enjoined and remanded to the Forest Service to conduct the required analysis of the Project's potential impact on soil productivity. The Forest Service may move to dissolve the injunction upon a showing that they have complied with environmental laws." This report responds to that remand.

II. Basin Creek Hazardous Fuels Reduction Project – Alternative 3: The Basin Creek Hazardous Fuels Reduction project is located eight miles south of Butte, Montana. A Record of Decision (ROD) (corrected), authorizing treatments for the area (Alternative 3) was signed by Forest Supervisor, Thomas Reilly on June 7, 2004. The selected alternative (Alternative 3) proposed total treatment on 2,602 acres of the 14,320 acre project area. The ROD authorized a total of 2,268 acres of mechanical treatment and 334 acres of burning.

Subsequent to the ROD, field reconnaissance and layout of the project occurred prior to advertisement of the timber sale contract. (The South Butte Salvage timber sale was awarded on August 1, 2005 with some harvest conducted prior to court injunction. See Appendix A.). Based on field layout, the total acres treated in all treatment units is now 1,574 acres. Under the current operating plan filed by the purchaser, all acres will be tractor harvested with ground-based yarding systems to be used on 1,025 acres and helicopter yarding on 549 acres. (See AR Doc. N-9).

III. Soil Productivity

A. *Background:*

In his June 23, 2006 Order, Judge Molloy states the "Forest Service maintains that it will limit detrimental disturbance to 15 percent in order to meet the 'critical' Soil Quality Standards" (Order at 12), but holds that the EIS fails to explain how the Forest Service reached its conclusion.

The FEIS states "By design under this proposal, detrimental soil disturbance in all units would be at or below 15 percent, which is the maximum level allowed by soil quality standards from all causes. The soil quality standards would be incorporated into the project contract(s). The operations would be administered progressively through a 'performance-based end-results contract.'" (FEIS at 3.223).

However the court specifically stated:

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> But simply announcing a site-specific project will "by design" meet certain critical standards, without explaining and scientifically supporting the design's ability to meet those standards, is not enough. Every project must be designed to meet soil standards. NEPA requires that the Forest Service take a "hard Look" at how the project as designed will impact the environment and explain in the EIS how it conducted that "hard look."

Order at 11-12 (citations omitted). The court order further states:

> To support its conclusion the project will result in no more than 15 percent detrimental disturbance, the Forest Service relies in large part on its plan to implement Best Management Practices. Nevertheless, there is no analysis in the FEIS discussing how the Forest Service reached its conclusion that the use of Best Management Practices will keep disturbances within soil quality standards. The record contains reports indicating the implementation of Best Management Practices has protected soil productivity during timber harvest in other forests across the state, but the FEIS does not discuss the reports or attempt to tie their results to this Project.

Order at 12.

B. *NFMA and Regional Soil Quality Standards:*

The National Forest Management Act requires that Forest Service regulations implementing NFMA specify guidelines to insure that timber will be harvested from National Forest System lands only where "soil, slope, or other watershed conditions will not be irreversibly damaged." 16 USC 1604(g)(3)(E)(i). Region 1 Regional Soil Quality Standards identified as Forest Service Manual (FSM) R-1 Supplement 2500-99-01 (see AR Doc. H-72) were set forth to meet the direction of NFMA to manage Forest Service lands without permanent impairment of land productivity and to maintain or improve soil quality. The policy as stated in the FSM is to:

> Design new activities that do not create detrimental soil conditions on more than 15 percent of an activity area. In areas where less than 15 percent detrimental soil conditions exist from prior activities, the cumulative detrimental effect of the current activity following project implementation and restoration must not exceed 15 percent. In areas where more than 15 percent detrimental soil conditions exist from prior activities, the cumulative detrimental effects from project implementation and restoration should not exceed the conditions prior to the planned activity and should move toward a net improvement in soil quality.

(AR Doc. H-72 at 4). The Basin Creek FEIS describes these Region 1 Soil Quality Standards and their development. FEIS at 3.215 and 3.217. The regional soil quality standards further define detrimental soil disturbance as follows:

> Detrimental Soil Disturbance. These disturbances include the effect of compaction, displacement, rutting, severe burning, surface erosion, loss of surface organic matter, and soil mass movement. At least 85 percent of an activity area must have soil that is in satisfactory condition. Detrimental conditions include:

> Compaction: Detrimental compaction is defined as a 15 percent increase in natural bulk density. The cumulative effects of multiple site entries on compaction should also be considered since compacted soils often recover slowly.
>
> Rutting: Wheel ruts at least 2 inches deep in wet soils are detrimental.
>
> Displacement: Detrimental displacement is the removal of 1 or more inches (depth) of any surface soil horizon, usually the A horizon, from a continuous area greater than 100 square feet.
>
> Severely Burned Soils: Physical and biological changes to soil resulting from high intensity burns of long duration are detrimental. This standard is used when evaluating prescribed fire. Guidelines for assessing burn intensity are contained in the Burned-Area Emergency Rehabilitation Handbook (FSH 2509.13)
>
> Surface Erosion: Rills, gullies, pedestals, and soil deposition are all indicators of detrimental surface erosion. Minimum amounts of ground cover necessary to keep soil loss within tolerable limits (generally less than 1 to 2 tons per acre per year) should be established locally depending on site characteristics.
>
> Soil Mass Movement: Any soil mass movement caused by management activities is detrimental.

(AR Doc. H-72 at 5-6).

Another important component of soil productivity is the presence of organic matter and coarse woody material on site. Separate from detrimental soil disturbance, the Region 1 Standards also identify "organic matter guidelines." These guidelines provide "Objectives for fine organic matter layer thickness and distribution should be determined locally based on similar soils or ecological types. The benefits of coarse woody material to soils can vary widely, depending on ecological type. Research guidelines such as those contained in Graham et al. 1994, should be used if more specific local guidelines are not available." (AR Doc. H-72 at 6). Coarse woody material (woody material larger than three inches in diameter) is important for maintaining long-term soil productivity (Graham, 1994). Based on Graham, the Basin Creek FEIS specifies retaining 10 to 15 tons of coarse woody material per acre for treatment units farther than 200 feet from private property boundaries (ROD page 2, 23 and FEIS page 2.5).

Deerlodge Forest Plan soil standards require:

> Incorporate Best Management Practices (BMP's) into all land use and project plans. These BMP's will serve as the principal mechanism for controlling nonpoint pollution and meeting soil and water quality goals.
>
> Plan all management activities to sustain soil productivity. During project analysis, ground-disturbing activities will be reviewed and needed mitigation actions prescribed.

Forest Plan at II-27 (AR Doc. L-2).

C. *Best Management Practices Are Effective:*

Best management practices (BMPs) and site-specific mitigation measures were applied to the Basin Creek project as part of timber sale contract administration. Based on monitoring of other relevant sales and based on field monitoring of five harvested units within the Project area, BMPs are effective in limiting detrimental soil disturbances to maintain site productivity.

This section of this report: 1) describes the best management practices (BMPs) applied to the Basin Creek project, 2) documents that the BMPs and site-specific mitigation measures are being applied as part of timber sale contract administration for the South Butte Salvage Sale, 3) documents evidence showing the BMPs are effective in limiting detrimental soil disturbances to maintain site productivity based on monitoring and other studies and based on field monitoring of five harvested activity areas (harvest units) within the South Basin Salvage Sale itself.

1. BMPs and Design Criteria Applied:

In the Basin Creek project, soil and water resources are protected during land disturbing activities by use of site-specific Soil and Water Conservation Practices (see FEIS Appendix D), specific mitigation and monitoring adopted as part of the decision (see FEIS at 2.9-2.10) and other design features of the project.

Soil and Water Conservation Practices (identified in the FEIS Appendix D) are commonly known as Best Management Practices (BMPs) and were adopted from the Soil and Water Conservation Practices Handbook [FSH 2509.22, R1/R4 Amendment No.1, page 1]. The effectiveness of the soil and water conservation practices is discussed for each practice. (See FEIS Appendix D and AR Doc. H-70). The Soil and Water Conservation Practices Handbook together with the Forest Plan are used by the interdisciplinary team to develop site specific conservation practices as described in the Basin Creek FEIS. These practices are developed in an interdisciplinary process according to handbook direction (FSH 2509.12, 10.10; FSH 1909.15, 12.3) and are disclosed in the Mitigation and Monitoring section of the Basin Creek FEIS (at 2.6-2.11) and in Appendix D.

The mitigation and monitoring requirements (including BMPs) identified by the Interdisciplinary Team are displayed on pages 2.6 through 2.11 of the FEIS. They are adopted by the Record of Decision at page 23. They are implemented by incorporation in to the Timber Sale Contract and its provisions (AR Doc. N-3) and through a signed Letter of Agreement by the purchaser to comply with Regional Soil Quality Standards (AR Doc. N-3A). Appendix B to this report displays the relationship of the practices identified in the FEIS and SWCP Handbook to contract provisions agreed to by the purchaser to ensure Regional Soil Quality Standards are met. This provides the framework for limiting detrimental soil disturbances and maintaining site productivity as directed by the National Forest Management Act (NFMA) in the Basin Creek project area.

The specific monitoring and mitigation items relating to soils identified in the FEIS and adopted as part of the ROD are as follows:

1. Use of appropriate BMPs and applicable timber sale contract provisions during road maintenance, snow plowing and forest product yarding/piling will keep detrimental soil disturbance including erosion, compaction and displacement within soil quality standards. For

greater detail see the Soil and Water Conservation Best Management Practices (FSH 2509.22) listed in Appendix D.

2. When possible treat areas over snow or frozen ground to minimize ground disturbance my mechanized equipment.

3. Operate ground-based equipment when soils are dry. Where non-winter harvest operations are used, soil moisture will be assessed during harvest operations to determine periods when equipment operations should be halted. Assessments will be made following major precipitation events.

4. Designate main skid trails and recommend laying down treetops and limbs on these trails to protect the soil during skidding operations.

5. While logging is being conducted, break skid trails every 200 feet with slope breaks, waterbars or large woody debris to reduce buildup of overland flow in the skid trail.

6. Install water bars on designated skid trails at the completion of the project to minimize water erosion.

7. Place logs and debris on the skid trail surfaces following completion of the project to discourage off-road use.

8. Apply tilling or ripping on main skid trails in areas of detrimental soil compaction to maintain soil quality standards and fix existing problems.

9. Decommission temporary roads by tilling (subsoil) or re-contouring, seeding with native or desired species and spreading available slash over the road surface.

10. Retain a minimum of 10 tons per acre of large woody debris for organic matter recycling in units outside of the intermix community.

FEIS at 2.10.

In addition to these required mitigation and monitoring items, the design of the timber sale requires that all or portions of 23 units be helicopter yarded; which eliminates ground-based yarding equipment from the unit. Also, in terms of monitoring item #4 above (designate main skid trails), the South Butte contract explicitly requires such designation (contract provision C.4# ; AR N- 3 at 10) and the contract requires 100' spacing of the skid trails (contract provision C6.4#; AR N- 3 at 10). This provision of 100' spacing of skid trails would amount to a maximum of approximately 10% of an average 40 acre unit being disturbed by tractor skidding operations on the main skid trails (assuming a 10' wide skid trail). Further, not all of these acres would necessarily be detrimentally disturbed as BMP monitoring has shown that normal machinery operated on moist soils would increase soil bulk density after 15 passes considerably less than a 15% increase that would cause detrimental disturbance. The disturbance would be expected to be even less on frozen or dry soils. (See discussion below in the BMP Effectiveness sections of this report and the FY2004 Monitoring Report at 93.)

The Basin Creek FEIS did discuss that detrimental disturbance can be in the range of 30-60% -- but only without the application of BMPs and based on practices that are not part of the timber sale operation for Basin Creek proposal (ie. dozer piling of slash). FEIS at 3.225. Monitoring clearly shows,

where BMPs are applied, that BMPs are effective in minimizing detrimental soil disturbance. (See detailed discussion of monitoring below.) Specifically, forest monitoring shows that:

- Helicopter yarding - soil impacts are typically less than about 5%.
- Tractor yarding on dry soils – soil impacts are typically less than 10%.
- Tractor yarding on frozen soils – soil impacts are typically less than 5%.

For the South Butte Salvage Sale, the Timber Sale Inspection Reports document implementation of the design features, conservation and best management practices, and contract provisions binding the purchaser to comply with the Regional Soil Quality Standards as stated in the signed Letter of Agreement dated August 3, 2005 (AR N-3A).

Examination of all Timber Sale Inspection Reports (a total of 64 reports) prepared during the approximately 14- week period from September 3, 2005 to December 13, 2005, show references to the implementation of specific contract provisions and practices to minimize erosion and detrimental soil disturbances and compliance with Regional Soil Quality Standards. These reports document that administrative, preventive, and corrective practices were continuously implemented, monitored, and adjusted during sale administration. Specifically, they show, in addition to the implementation of other mitigation measures, the implementation of 100' skid trail spacing, the placing of slash, and operation on frozen ground to minimize soil compaction and detrimental disturbance. Appendix C to this report displays the practices and contract provisions for the seven units treated within the South Butte Salvage Sale and records the on-the-ground review of soil scientists during project operation and interaction of Forest Service timber sale administrators with the purchaser and equipment operators to assure that the design of the project and the BMPs are carried out to ensure that compliance with soil quality standards is achieved and site productivity is maintained.

2. BMP Effectiveness

The evidence, as discussed above, clearly shows that BMPs are being applied in accordance with the Basin Creek FEIS and ROD. However, the court in its Order of June 23, 2006 faulted the Forest Service for not discussing how it reached its conclusion that the use of Best Management Practices will keep disturbances within soil quality standards. The court stated: "the record contains reports indicating that the implementation of Best Management Practices has protected soil productivity during timber harvest in other forests across the state, but the FEIS does not discuss the reports or attempt to tie their results to this Project." Order at 12.

The record did contain monitoring reports from forested lands state-wide and from other forests as well as monitoring reports from the Beaverhead-Deerlodge National Forest that had been published at the time of the June 2004 Basin Creek ROD.

As an example, other than the Beaverhead-Deerlodge Monitoring reports, the record included AR Doc. H-79F the Montana Forestry Best Management Practices Monitoring and AR Doc. H-79G the Lolo BMP Effectiveness Monitoring Report. Both of these reports are applicable to the Basin Creek project as similar BMPs are being applied to the Basin Creek project.

AR Doc. H-79F is a 2002 study released by the Montana Department of Natural Resources evaluating the effectiveness of Forestry Best Management Practices state-wide on forested lands. (AR Doc. H-79F: Montana Forestry Best Management Practices Monitoring – 2002 BMP Audit Report). Forty-three (43) sites were evaluated for both the application of BMPs and their effectiveness in preventing soil erosion and non-point water pollution. Audit results showed that across all land ownerships, (including Forest System lands) BMPs were properly applied 96 percent of the time and were effective in protecting soil and water resources 97 percent of the time. AR Doc. H-79F at 8. On federal lands alone, BMPs were properly applied 89 percent of the time and were effective in protecting soil and water resources 89 percent of the time. AR Doc. H-79F at 9 and 93. Skid trail design and conducting skidding operations to minimize soil compaction and displacement are the primary BMPs applied to the South Butte Salvage Sale. These were evaluated during the state's 2000 audit and reported as Appendix I in the 2002 audit report. Skid trail design and skidding to minimize compacting soil were both rated "Adequate protection to soil and water resources." AR Doc. H-79F at 67. Skidding to minimize soil displacement was rated "Improved protection of soil and water resources over pre-project condition" as a result of the monitoring audit. AR Doc. H-79F at 67. The ratings are described at AR Doc. H-79G at 17.

Similarly, the BMP Effectiveness Monitoring for the Lolo National Forest (AR Doc. H-79G) also conducted in 2002, concluded that properly applied soil and water conservation practices are an effective means of protecting soil and water resources. The report is a comprehensive monitoring report of the effectiveness of soil and water conservation practices applied generally in the Region with monitoring conducted on the Lolo National Forest. The report documents monitoring of the site-specific application of 22 BMPs and their effectiveness. As stated in the report, soil productivity standards are maintained by applying best management practices. As an example, the report discusses the effectiveness of BMP 14.08 Tractor Skidding Design the objective of which is, in part, to maintain soil productivity and to minimize soil erosion, compaction and displacement. AR Doc. H-79G at 23. The monitoring found that the BMP was effective in meeting its objective, the BMP effectively protected the soil and with the use of the BMP there was no indication of compaction, erosion or displacement. Id. at 24.

In terms of monitoring from the Beaverhead-Deerlodge National Forest, the record contained the Deerlodge National Forest – Forest Plan Monitoring and Evaluation Report Fiscal Years 1988-1994 report (AR Doc. L-22) which reported on BMP effectiveness and soil monitoring conducted in accordance with the Deerlodge Forest Plan monitoring item. The report concluded that the soil impacts "were well within acceptable limits on the timber sales that were monitored." AR Doc. L-22 at 71. The court, however, found that the report "does not clearly support the Forest Service's claim that it has complied with the Forest Plan monitoring requirements." However, subsequent to this report for Fiscal Years 1988-1994, the latest monitoring report published by the Beaverhead-Deerlodge National Forest is the FY 2004 Forest Plan Monitoring and Evaluation Report. It was published in November 2005. It discusses monitoring results since the year 2000. It was not included in the Basin Creek project record because it was published after the June 2004 ROD but the monitoring report does include monitoring conducted both prior to and after the decision.

This FY 2004 Monitoring Report discloses monitoring showing the effectiveness of BMPs applied on the Beaverhead-Deerlodge National Forest and shows compliance with the Deerlodge Forest Plan monitoring requirement. (See discussion below in section IV. Forest Plan Monitoring 9-3 concerning compliance with the Deerlodge Forest Plan monitoring requirement.) Concerning, the effectiveness of

BMPs, the FY 2004 Monitoring Report documents monitoring of BMP effectiveness on the West Face Timber Sale (p. 30) and in the Joe/Fox sale area (p.93).

The West Face Timber Sale (Wisdom District, Beaverhead-Deerlodge NF), harvesting began in the winter of 2001. The project area is in the Pioneer Mountains and soils are generally derived from the Pioneer Batholith, which is broadly quartz-monzonite composition. While the Basin Project area is derived largely from the Boulder Batholith, soils from both areas are mineralogically, physically, and chemically similar. The common lay term for the soils in both West Face and Basin project areas are termed "granitics." The quantitative monitoring of the West Face sale showed that "detrimental disturbance was estimated at less than 10 percent overall." (FY 2004 Monitoring Report at. 30).

The FY 2004 Monitoring Report also reported on monitoring in the Joe/Fox sale. (FY 2004 Monitoring Report at 93). Soils in the Joe/Fox sale area are more susceptible to compaction than Basin Project area soils because they have volcanic ash mixed in the surface layer and generally have finer sand and more clay. Joe/Fox soils also had a soil water content of 18 to 20 percent on the date sampled, a moisture level which increases susceptibility to compaction. These soils were monitored under monitoring item 9-3 "Productivity Changes in Sensitive Soils." Monitoring results demonstrated that 15 passes of normal machinery on moist soil caused a 6.2 percent and 9.4 percent increase in surface and subsurface bulk density, respectively. These values are considerably lower than the 15 percent threshold for detrimental compaction. The percentage change is expected to be even less on frozen or dry soils. Id.

Other monitoring has also shown (as an example for the Frozen Face timber sale) that soil impacts on the Beaverhead-Deerlodge National Forest with helicopter yarding are minimal and are consistent with other studies that show typically less than about 5% disturbance for helicopter logging. AR Doc. 2233.

3. South Butte Salvage Sale – BMP Effectiveness

In addition, to the above described monitoring of other projects showing that BMPs are effective, monitoring was conducted on those units of the South Butte Salvage Sale for which harvest had been completed prior to injunction. Fuels reduction treatments began on the South Butte Salvage Sale shortly after the District Court denied a preliminary injunction on September 29, 2005. Harvest operations continued until November 22, 2005, when the District Court issued a stay of activities. Harvest activities have not resumed. Of the total sale acreage, approximately 158 acres have been treated to date. All treatments occurring so far have been ground based tractor operations. Five units have had harvest substantially completed with two more units where harvest is 75% completed. (See Appendix A – for a more detailed summary of the units that have been logged and the work still to be done on these units. Due to the injunction all activities have been halted in the units. Work needs to be completed in the units themselves to comply with contract requirements and to meet soil quality mitigation requirements. See discussion below.)

Trees were harvested and skidded to designated landings in November 2005 according to contract terms for the South Butte Salvage Sale. Initial erosion control measures including seeding, water-bar installation and slash placement were installed. However, when the injunction pending appeal was issued and fuels reduction operations were suspended, all mitigation work had not been completed. Impacts from temporary roads and main skid trails have not yet been mitigated as required by the FEIS (page 2.10) since project activities are enjoined. Among the specific mitigation measures not yet

conducted are item #8 “Apply tilling or ripping on main skid trails in areas of detrimental soil compaction to maintain soil quality standards and fix existing problems” and item #9 “Decommission temporary roads by tilling (subsoil) or re-contouring, seeding with native or desired species and spreading available slash over the road surface.” FEIS at 2.10. If the injunction is lifted, the Forest Service will be able to complete these mitigation measures to reduce soil impacts.

Numerous studies support that both tilling and ripping used to loosen detrimentally compacted soils and re-spreading or back-blading used to ameliorate displacement are effective.

Tilling and ripping are effective rehabilitation techniques used to loosen detrimentally compacted soils on skid trails and landings and will be applied on main skid trails in areas of detrimental soil compaction (FEIS pg. 2.10). Although detrimental compaction, is not extensive within activity areas sampled for the South Butte Salvage (Soils Specialist Report pages 11-12), this mitigation measure will be applied, further reducing the areal extent of detrimental disturbances. Several studies discuss the effectiveness of ripping, tilling or subsoiling as a restoration treatment. Studies cited by Froehlich and McNabb (1983) showed up to 39 percent improved seedling survival and growth after tilling compacted soil. Studies conducted in Canada showed rehabilitated landings treated with a subsoiler to loosen compaction improved tree regeneration even when displaced topsoil was not restored to compacted areas (Plotnikoff 1999).

Concerning soil displacement, the best way to establish productive nutrient cycles on rehabilitated sites is to conserve and respread the topsoil and the forest floor (Soil Rehabilitation Guidebook, Canadian Ministry of Forests and Range, 1997). Back-blading to redeposit displaced topsoil is expected to improve site productivity. Studies conducted in Canada suggest if topsoil had been retrieved during rehabilitation, higher C and N values would improve tree growth (Plotnikoff, et. al 1999). Soil texture and clay content of the soils in the Canadian study are similar to soils sampled in the South Butte (Basin Creek) project area. The dominant landtype of the five units sampled during the summer of 2006 on the South Butte project is 75GA3 (FEIS pg. 3.211, AR Doc. J-33 Landtype Map.) The primary soils in this area have sandy loam surface textures which are the same as the dominant soils observed in the Canadian study (Plotnikoff, pg 5). Additional Canadian research indicates that for landings constructed on coarse and medium textured soils, the evidence thus far indicates loosening the soil (using methods such as those described above) and loosening the soil in combination with topsoil recovery, respectively, appear to be sufficient to restore productivity (Sanborn, 1999).

However, in order to assess the effectiveness of BMPs on the units harvested the Forest Service undertook scientifically accepted soil quality monitoring (Howe 2002, [AR Doc: K-2262]) to evaluate Treatment Units 14, 24, 59, 65, and 70 during a two week period in late July 2006. The monitoring was conducted to determine levels of detrimental soil disturbance including detrimental soil compaction, rutting, displacement, and surface erosion. Percentage ground cover and tons of coarse woody debris per acre were also measured. In addition, soil chemical and physical analysis was conducted by an accredited soils testing laboratory to determine soil particle size distribution, organic matter content, cation exchange capacity, and pH. (This soil chemical and physical analysis is discussed below in section IV. Forest Plan Monitoring Item 9-3).

i. Detrimental Soil Disturbance on Harvested Activity Areas

Units 14, 24, 59, 65, 66, 68, and 70 of the South Butte Salvage Sale were logged or partially logged during September through November, 2005. These units were all tractor logged and include landings or portions of landings within the units. As stated previously, Unit 68 is one acre and was operationally included into Unit 66. Trees in Unit 66 have been felled but not skidded and logs and tops made it impractical to sample so it was omitted from monitoring. Soil monitoring will be done in Unit 66/68 when logging operations can be resumed.

The following methodology was used to monitor soil disturbance, ground cover and coarse woody debris in Units 14, 24, 59, 65, and 70 to determine if practices and provisions implemented during sale administration were effective in achieving Soil Quality Standards.

- Random GIS plot locations were generated by computer for each unit (activity area). Forty random plots were generated in each unit to get relatively evenly distributed plot locations. Each area of a unit was thus represented and each had an equivalent chance of being selected for sampling – including skid trails, landings and any temporary road that might have been located in the unit. Each random plot has an assigned unique number as well as a GIS location.
- Depending on unit size, at least two one-hundred foot transects were placed in each unit. Plot numbers were chosen randomly. The GIS plot location is the origin (start) of the transect. The direction of the transect line was determined by random numbers.
- Ground cover (litter, rock, lichen/moss/cryptogamic crust, vegetation, wood) was determined (point intercept method) at one-foot intervals along the transect (100 points per transect).
- The Howes Classification for new soil disturbance, classes 0-5 (Howes 2000), were also determined at five-foot intervals resulting in 20 points per transect.
- Soil penetrometer readings were also taken at five-foot intervals at the soil surface in Units 14 and 65, and also at 15cm depth in Units 24, 59, and 70 using a proving-ring penetrometer. Samples were taken at both near-surface and at approximately 12-15cm.
- Soil bulk density samples were taken in all units, usually two per transect at disturbed and undisturbed locations. Bulk density measurements were taken in part to confirm or calibrate visual indicators and observations of detrimental compaction made when using the Howes classification for assessing soil disturbance. A hammer core with three-inch diameter cores was used for sampling. Cores were sealed in plastic bags for transport to the lab.
- The other conditions that factor into detrimental soil disturbance - rutting, displacement, surface erosion and soil mass movement – were also analyzed and evaluated in determining the Howes Classification. (Severely burned soil is also a consideration, however, none of the units have been impacted by high intensity burns.)
- Field soil moisture was taken at each transect, usually at two locations.
- Observation of platy or massive structure was noted at each bulk density sampling location and at each 15cm-depth penetrometer reading.
- Large woody debris (equal or greater than three inches diameter) was recorded by size class utilizing the same transect location, but on a sixty-foot transect length, consistent with Browns (1974) method for determining woody debris.
- Photos were taken in each unit at most transects looking down the transect tape and overview shots were taken in each unit from several plot locations.

Additionally, soil samples were collected in representative disturbed and undisturbed locations in Units 14, 24, and 65 for laboratory chemical and physical analyses. These samples and the results of their analysis are discussed below in section IV. Forest Plan Monitoring Requirement 9-3.

Table 1 displays the percentage detrimental soil disturbance for the five activity areas monitored within the South Butte Salvage Sale. Field data collection sheets, bulk density measurements, and the calculations showing percentage detrimental soil disturbance by activity area are included in the background material supporting this analysis.

Table 1: Detrimental Soil Disturbance by Harvested Activity Area

Unit	Total Acres	Yarding Method	Number of Total Transect Points	Number of Transect Points Found to Have Detrimental Disturbance	Percent Detrimental Disturbance by Activity Area
14	47	Tractor	140	19	14
24	15	Tractor	60	6	10
59	21	Tractor	80	10	12
65	37	Tractor	140	25	18
70	3	Tractor	40	8	20

All of the units were tractor logged. Units 14, 24, and 59 comply with the Regional Soil Quality Standard to limit detrimental soil disturbance to no more than 15 percent of an activity area. Detrimental soil disturbance in Unit 65 exceeds the standard by three percent and detrimental soil disturbance in Unit 70 exceeds the standard by five percent. **These findings are prior to completion of all required mitigation measures.**

Of the detrimental soil impacts, detrimental soil displacement was the most common disturbance observed during field monitoring. It was found on 54 points of the 68 detrimental points (out of a total 460 points) in the five units. See Appendix D. Two of the points showing displacement also showed signs of minor erosion. Detrimental displacement is displacement that results in the loss of 1 or one more inches (depth) of any surface soil horizon, usually the A horizon, from a continuous area greater than 100 square feet. (AR Doc. H-72 – Soil Management Guidelines). Displaced soil can be back-bladed and smoothed with the harvesting equipment so the A horizon is restored to its original position. For the harvest units in the South Butte sale, this is easily accomplished as the displaced soil is within the skid trail corridor and has not been moved from its location adjacent to its original position. There was no surface erosion and no soil mass movement identified as detrimental. There was only one observation of rutting.

The following summarizes the monitoring results for each harvested unit.

<u>Unit 14:</u> The areal extent of detrimental soil disturbance from both compaction and displacement is 13.6 percent in Unit 14. The unit or activity area is 47 acres. 4.3 percent of the total disturbance is from detrimental soil compaction, 7.9 percent of the total disturbance is from detrimental soil displacement, and 1.4 percent is from a combination of both detrimental compaction and displacement. Operations during dry soil conditions and designation of main skid trails (Soil Mitigation Measures, FEIS pg. 2.9) were especially effective in limiting the amount of detrimental soil disturbances to comply with Regional Soil Quality Standards. Documentation of operations during dry soil conditions was noted for two timber sale inspections, each completed on November 5, 2005. Both Forest Soil Scientists were on the site

that day and agreed that soil moisture conditions were suitable for felling and skidding operations. One incidence of a deviation from approved skidding patterns (AR Doc. N-3, Conduct of Logging) was identified on November 2, 2005, however, the equipment operator was promptly notified that strict adherence to approved skidding patterns was required at all times as agreed to by the purchaser (AR Doc. N-3A). Placing slash on skid trails (FEIS page 2.9) is a very effective practice for preventing soil erosion and was also noted on the inspection reports. The average percentage effective ground cover for seven transects measured in this unit is 87percent. WEPP modeling to determine project specific requirements for effective ground cover predicts that 70 percent cover provides protective rainfall interception to prevent water erosion. Unit 14 complies with Regional Soil Quality Standards for limiting detrimental soil disturbance to less than 15 percent of the defined activity area.

Unit 24: The areal extent of detrimental soil disturbance within this unit is 10 percent. The unit is 15 acres. 8.3 percent of the total disturbance is from detrimental soil compaction and 1.7 percent is from a combination of detrimental soil compaction and displacement. Operations during dry soil conditions and designation of main skid trails (Soil Mitigation Measures, FEIS pg. 2.9) were especially effective in limiting the amount of detrimental soil disturbances to comply with Regional Soil Quality Standards. Documentation of operations during dry soil conditions was noted on November 3, 2005 during a routine timber sale inspection. Several notations by the Timber Sale Administrator (TSA) documented the success of approved skid trail spacing to limit the areal extent of detrimental disturbances. These were observations were made on November 15, 2005, November 17, 2005, and November 21, 2005. The TSA also noted one incidence of soil displacement on November 17, 2005; however, the displaced topsoil was back-bladed to correct the condition. The operator did a good job of correcting the condition which was noted on a subsequent inspection on December 12, 2005. Slash placement on skid trails as described above is an effective means of preventing erosion. The average percentage effective ground cover for three transects measured in this unit is 93 percent. This level of ground cover is more than adequate to protect the soil from water erosion. Unit 24 complies with Regional Soil Quality Standards for limiting detrimental soil disturbance to less than 15 percent of the defined activity area.

Unit 59: The areal extent of detrimental soil disturbance within this unit is 12 percent. The unit is 21 acres. 7.5 percent of the total disturbance is from detrimental soil displacement and 5.0 percent is from a combination of both detrimental compaction and displacement. This unit was combined operationally with Unit 24 so the weather conditions and operator expertise were the same for both units. Again, soil moisture conditions and skid trail spacing were effective practices used to limit the amount of detrimental disturbance and were noted on the timber sale inspection reports on November 15, 2005, November 17, 2005, and November 21, 2005. Slash placement was also used in this unit and the average percentage ground cover for five transects is 90 percent. Unit 59 complies with Regional Soil Quality Standards for limiting detrimental soil disturbance to less than 15 percent of the defined activity area.

Unit 65: The areal extent of detrimental soil disturbance from both compaction and displacement is 17.8 percent in Unit 65. The unit or activity area is 37 acres. 2.1 percent of the total disturbance is from detrimental soil compaction, 15 percent of the total disturbance is from detrimental soil displacement, and 0.7 percent is from a combination of both detrimental compaction and displacement. This unit was the first location harvested when operations began in October 2005. From the timber sale inspection reports it is apparent the operator was turning the skidder on the slope rather than backing down the same skidder path creating an unacceptable level of displacement at that location. Additional work,

specifically more back-blading to smooth out displaced soil will be necessary at such time work can be resumed. With the completion of the work, the unit will comply with the soil quality standards. The average percentage effective ground cover for seven transects measured in this unit is 83 percent. This level of ground cover is more than adequate to protect the soil from water erosion.

Unit 70: The areal extent of detrimental soil disturbance is 20 percent in Unit 70. No detrimental compaction was observed or measured in this unit, which is 3 acres. The small size of this unit is part of the reason for high percentage of displacement. One single skid trail occupies a greater percentage of the unit when compared to larger units increasing the percentage of disturbance. One notation (November 1, 2005) on the timber sale inspection report addresses the situation and states "some soil displacement remaining. Purchaser's representative says these areas will be smoothed when slash is placed on skid trails." This condition will be corrected at such time operations can be resumed. With the completion of the work, the unit will comply with the soil quality standards. Due to the small size of the unit, only a very small area would have to be corrected (approximately, 0.2-acre of back-blading and smoothing) to restore the unit to a condition that complies with the Regional Standard of <15% detrimental soil disturbance. However, mitigation will be applied to ameliorate all soil displacement. The average percentage effective ground cover for two transects measured in this unit is 90 percent. This level of ground cover is more than adequate to protect the soil from water erosion.

ii. Coarse Woody Debris and Ground Cover

As indicated in the FEIS, coarse woody debris (also referred to as large woody debris) is limited within the treatment units (FEIS at page 3.216, 3.229, and AR Doc. H-78 Soil Penetrometer and Coarse Woody Debris Data). This is validated by the recent soil monitoring which indicates that coarse woody debris averages from less than 1 ton to 3.9 tons per acre for the five units sampled. This range is adequate for areas within 200 feet of private property boundaries (FEIS 2.5) but does not comply with the 10-15 tons per acre required for the project. The South Butte Timber Sale contract specifies whole-tree yarding. Large limbs and cull wood that would comprise the coarse woody debris for distribution across the treatment units is piled at the landings since logging operations have been suspended. As such, presently none of the five units complies with the coarse woody debris requirement of retaining 10-15 tons of material greater than 3 inches left on-site to maintain soil productivity. At such time as operations can be resumed, coarse woody debris would be distributed across the units at 10-15 tons per acre and monitored for compliance with this requirement. Our on-the-ground review indicates that there is sufficient coarse woody debris to meet this ROD mitigation requirement. Meeting this requirement will be an important improvement for soils in the project area from the current existing condition.

The lack of coarse woody debris within the project area is the primary reason that soils within the Basin Creek Project area are termed "relatively poor" (FEIS 3.225). The FEIS states in the Effects Summary: "Soil organic carbon is one area of major concern covered by the SQS. FEIS at 3.229. The Basin Creek project will follow existing Forest Plan guidelines regarding large woody debris and Region 1 Soil Quality standards. The Forest Plan guidelines are in Appendix B of the Deerlodge Forest Plan under "Habitat Type Guidelines." These guidelines are generally in accordance with research regarding the amount of organic carbon that should occur on sites of various habitat types (Graham, et.al., 1994) and are consistent with the Region 1 Soil Quality standards.

The "Effects Summary" section of the FEIS at 3.229 also states: "The other parameters in the SQS that are of concern in this proposal are displacement, compaction, erosion, sedimentation, and burning. Currently, soils are not compacted over threshold limits compared to undisturbed, similar areas and sites generally do not approach threshold values (see proving-ring penetrometer data in the project file). While the existing condition is poorer than most similar sites (soil/landform/habitat type/community type combination) in respect to woody debris and litter layer, the surface soil is stable." (FEIS 3.229). This report shows that harvest has been conducted, utilzing BMPs, such that deterimental soil disturbance will be minimized and will be less than 15% and woody debris requirements will be met.

In addition to coarse woody debris monitoring, percentage ground cover within activity areas was also measured. Ground cover consists of vegetation, fine organic matter, coarse woody material and rock fragments larger than three-fourths inches in diameter in contact with the soil surface (AR Doc. H-72). Minimum amounts of properly distributed ground cover necessary to protect the soil from erosion are a function of soil properties, slope gradient and length, and precipitation and must be determined locally (AR Doc. H-72). In forest conditions, surface runoff and soil erosion are generally low because of the surface litter cover (Elliot, W., Page-Dumroese, D.; Robichaud, P.R. 1999.) The Water Erosion Prediction Project (WEPP) model is shown to be a useful tool in predicting the erosion impacts of different levels of vegetation removal at harvest, and different levels of compaction. Id. WEPP modeling was used to determine minimum amounts of ground cover necessary to protect soils from erosion within the South Butte Salvage Sale. Project specific parameters for soil texture, slope and preciptation were used as model inputs. The WEPP modeling shows that at 70% ground cover soil erosion is almost nil for the South Butte harvest units. All plot (transects) measured within the five harvested units of the South Butte Salvage Sale had over 70 percent protective ground cover in the form of litter, rock, lichen/moss/crytogamic crust, vegetation and wood. Average ground cover for the five units all exceeded 80 percent and ranged from 83 percent to 93 percent. The monitoring shows that ground cover is more than sufficient to provide protective cover from soil erosion to maintain soil productivity.

D. *Soil Impacts in Relation to Regional Soil Quality Standards*

The following table (Table 2) summarizes the existing detrimental soil conditions and the Basin Creek project's impact on soils by activity area (harvest unit), including those activity areas which are included in the South Butte Salvage Sale contract. There are a total of 30 activity areas or harvest units that will be completely or partially tractor yarded, all or portions of 23 units to be helicopter yarded, and 12 units to be treated with prescribed burning. Nineteen (19) post and pole units (not included in the South Butte Salvage) are proposed for ground based yarding using ATVs. In addition, one house-log unit (not included in the South Butte Salvage) is proposed for tractor yarding. For those activity areas or harvest units not included in the South Butte Salvage Sale, except for the one house log unit, the Forest Service intends to enter into separate small post and pole sales. ATVs are smaller than tractor yarding machinery and have less ground pressure with less compaction and less chance for displacement of soils. All prescribed burning prescriptions are written to eliminate the possibility of any severe intensity burns that could cause detrimental soil condition. Further, much of the burning is proposed in units dominated by sage and grass that lack heavy fuel conditions.

As discussed in the Court's Order of June 23, 2006, the FEIS disclosed the amount of existing detrimental soil disturbance in the project area and the methodology used to determine that amount.

Order at 9; FEIS at 3.215-16. Prior to harvest activities, the Forest Service conducted field testing using the Howes (2000) field protocol and sampled soils from approximately 62% of the project activity units. See FEIS 3.215 and Declaration of Dan Svoboda. Based on this field investigation, the Forest Service concluded that existing soil disturbance in the project area was "non-detectable to slight." FEIS at 3.225. Table 2 reflects this analysis of existing soil conditions.

In addition, Table 2 identifies the percentage of detrimental soil disturbance after project implementation. The levels of detrimental disturbance for the five activity areas monitored and disclosed in this report are highlighted and displayed by percentage of activity area. For the other units that have not been harvested the percentage of detrimental disturbance is identified as <15% for tractor units, <5% for helicopter units and <2% for prescribed burn units. However, we expect that that detrimental soil disturbance will be less than 15% for tractor units based on monitoring of the harvested tractor units. The BMPs adopted as part of the decision should minimize soil disturbance below 15% for all units based on the evidence discussed above.

All units have been field reviewed either through walk-through examination or intensive monitoring and transect locations and are documented in a GIS database and corresponding map in the project file.

Table 2: Summary of Activity Areas

Activity Area				Yarding Method or Rx Burning	% Detrimental Soil Disturbance before Treatment (AR Doc. H-64)		Total % Detrimental Soil Disturbance After Harvest	
Unit # Basin Cr. FEIS	Acres	Unit #So. Butte Salvage	Acres	Tractor/ Helicopter/ Burning	Acres	Percent of Activity Area	Areas Harvested	Areas to be Harvested
1	18	1	21	Tractor	0	0	N/A	<15
2	14	2 and 3	6	Tractor	0	0	N/A	<15
3	16	Included with 7b	2	Tractor	0	0	N/A	<15
4	8	Not in So. Butte Contract	8	Ground-Based*	0	0	N/A	<15
5	13	5a 5b	14 9	Tractor Helicopter	0	0	N/A	<15 <5
6	48	Not in So. Butte Contract	48	Ground-Based*	0	0	N/A	<15
7	129	7a 7b	95 51	Tractor Helicopter	0	0	N/A	<15 <5
8	40	8	22	Helicopter	0	0	N/A	<5

9	66	9a 9b	23 11	Tractor Helicopter	0	0	N/A	<15 <5
10	7	Not in So. Butte Contract	7	Ground-Based*	0	0	N/A	<15
11	28	11a and 11b	14	Helicopter	0	0	N/A	<5
12	23	12	19	Tractor	0	0	N/A	<15
13	62	13a 13b	37 9	Tractor Helicopter	0	0	N/A	<15 <5
14	40	14	47	Tractor	0	0	14	N/A
15	13	15	4	Tractor	0	0	N/A	<15
16	1	Not in So. Butte Contract	1	Ground-Based*	0	0	N/A	<15
17	88	17	15	Tractor	0	0	N/A	<15
18	64	18	35	Helicopter	0	0	N/A	<5
19	2	Not in So. Butte Contract	2	Ground-Based*	0.1	5	N/A	<15
20	15	20	12	Helicopter	0	0	N/A	<5
21	2	Not in So. Butte Contract	2	Ground-Based*	0	0	N/A	<15
22	74	22	56	Tractor	3.7	5	N/A	<15
23	38	23	23	Tractor	0	0	N/A	<15
24	6	24	15	Tractor	0	0	10	N/A
25	138	25a 25b	62 53	Tractor Helicopter	6.9	5	N/A	<15 <10
26	30	26a 26b	16 12	Tractor Helicopter	0	0	N/A	<15 <5
27	6	27	6	Tractor	0	0	N/A	<15
28	35	Not in So. Butte Contract	35	Rx Burn	0	0	N/A	<2

29	71	Not in So. Butte Contract	71	Rx Burn	0	0	N/A	<2
30	7	Not in So. Butte Contract	7	Rx Burn	0	0	N/A	<2
31	10	Not in So. Butte Contract	10	Rx Burn	0	0	N/A	<2
32	8	Included with 5a, 5b & 44	N/A	See 5a, 5b & 44	0	0	N/A	<2
33	2	Not in So. Butte Contract	2	Ground-Based*	0	0	N/A	<15
34	2	Not in So. Butte Contract	2	Ground-Based*	0	0	N/A	<15
35	48	Not in So. Butte Contract	48	Rx Burn	0	0	N/A	<2
36	47	Not in So. Butte Contract	47	Rx Burn	0	0	N/A	<2
37	37	Not in So. Butte Contract	37	Rx Burn	0	0	N/A	<2
38	9	Not in So. Butte Contract	9	Rx Burn	0	0	N/A	<2
39	18	Not in So. Butte Contract	18	Rx Burn	0	0	N/A	<2
40	4	Not in So. Butte Contract	4	Rx Burn	0	0	N/A	<2
41	6	Not in So. Butte Contract	6	Rx Burn	0	0	N/A	<2

42	9	Not in So. Butte Contract	9	Rx Burn	0	0	N/A	<2
43	33	Not in So. Butte Contract	House Log Sale	Tractor	0	0	N/A	<15
44	12	44	18	Helicopter	2.2	5	N/A	<10
45	10	Not in So. Butte Contract	10	Ground-Based*	0	0	N/A	<15
46	22	Not in So. Butte Contract	22	Ground-Based*	0	0	N/A	<15
47	6	Not in So. Butte Contract	6	Ground-Based*	0	0	N/A	<15
48	9	Not in So. Butte Contract	9	Ground-Based*	0	0	N/A	<15
49	3	Not in So. Butte Contract	3	Ground-Based*	0	0	N/A	<15
50	6	Not in So. Butte Contract	6	Ground-Based*	0	0	N/A	<15
51	3	Not in So. Butte Contract	3	Ground-Based*	0	0	N/A	<15
52	5	Not in So. Butte Contract	5	Ground-Based*	0	0	N/A	<15
53	6	Not in So. Butte Contract	6	Ground-Based*	0	0	N/A	<15

54	2	Not in So. Butte Contract	2	Ground-Based*	0	0	N/A	<15
55	22	Not in So. Butte Contract	22	Ground-Based*	0	0	N/A	<15
56	49	56	36	Helicopter	2.45	5	N/A	<10
57	38	57a 57b	24 4	Tractor Helicopter	0	0	N/A	<15 <5
58	112	58a 58b	66 10	Tractor Helicopter	0	0	N/A	<15 <5
59	36	59	21	Tractor	0	0	12	N/A
60	34	60	32	Helicopter	0	0	N/A	<5
61	7	61	5	Helicopter	0	0	N/A	<5
62	63	62	45	Tractor	0	0	N/A	<15
63	124	63a & b	116	Helicopter	0	0	N/A	<5
64	10	64	7	Helicopter	0.5	5	N/A	<10
65	37	65	37	Tractor	0	0	18	N/A
66	104	66	82	Tractor	0	0	N/A	<15
67	26	67	20	Helicopter	0	0	N/A	<5
68	1	68 Included with 66	1	Tractor	0	0	N/A	<15
69	94	69a 69b	57 13	Tractor Helicopter	0	0	N/A	<15 <5
70	3	70	3	Tractor	0	0	20	N/A
71	20	71	22	Tractor	0	0	N/A	<5
72	121	121	72a 72b	Tractor Helicopter	0	0	N/A	<15 <5
73	23	73	18	Tractor	0	0	N/A	<15
74	8	74	5	Helicopter	0	0	N/A	<5
75	173	75a 75b	14 14	Tractor Helicopter	8.65	5	N/A	<15 <10

* These harvest units are not included in the South Butte Salvage Sale. The units are small post and pole sales to be yarded by ATVs.

IV. Forest Plan Monitoring Item 9-3

A. *Background:*

The District Court, in its June 23, 2006 Order, also discussed compliance with the Deerlodge Forest Plan monitoring item 9-3. The court in referring to the FY 1994 Monitoring Report (identified in the record as AR Doc. L-22) concluded:

> The Forest Plan Monitoring and Evaluation Report does not clearly support the Forest Service's claim that it has complied with the Forest Plan monitoring requirements. On the contrary, it shows that the Forest Service has neither complied with the Forest Plan, nor satisfied NFMA's requirement that management decisions be evaluated based on "continuous monitoring and assessment in the field" so they will not permanently impair the productivity of the land. 16 U.S.C. 1604 (g)(3)(C).

Order at 14. The court in reaching this holding read the FY 1994 Monitoring Report to reveal that the Forest Service had monitored by personal observation rather than by sampling and lab analysis and that the methods used were more qualitative than quantitative. The court also stated that the FY 1994 report suggests that the Forest Plan should be amended to require new monitoring techniques. The court stated:

> The Forest Service does not address why it has not amended the Forest Plan in accordance with its own scientists' recommendations more than ten years ago. Instead it relies on its new soil impact threshold that demonstrates that is has given into the "temptation . . . to push but not exceed the threshold," without considering what is the desired soil condition on the Beaverhead-Deerlodge National Forest and working to achieve that condition, as its experts recommended.

Order at 14.

B. *Forest Plan Monitoring Item 9-3*

Deerlodge Forest Plan Monitoring Item 9-3 (Forest Plan at V-14) provides, in pertinent part, as follows:

Action, Effects or Resources to be Monitored	*Intent*	*Data Sources*	*Frequency*	*Report Time*	*Variability (+-) Which Would Initiate Action*
Productivity changes in sensitive soils	Insure that management practices do not adversely affect soil productivity	EAs and review of proposed activities. Field examinations and laboratory testing.	Annual	5 years	When changes of baseline levels of the soil's chemical and physical properties exceed 20% as determined by lab analysis.

See AR Doc. L-22 at V-14.

1. Sensitive Soils

The court stated in footnote 2:

> The Forest Service claims that soils in the Project area are not "sensitive" and that the Forest Plan monitoring requirement does not apply to this case. However, the Forest Plan does not define "sensitive soils," and the Forest Service produces no other evidence that soils in the Project areas should not be considered sensitive."

Order at 13, fn. 2.

Whether soils are sensitive can only be determined based on site-specific knowledge of the particular soil types located in the area. Based on our site-specific knowledge of the soils in the Basin Creek project area, it is our professional opinion as soil scientists that the soils in the Basin Creek area are not sensitive in the context of the planned activities.

Soil derived from relatively unweathered quartz-monzonite/granitic parent material is sometimes a concern with permanent road construction because concentrating runoff on these soils will erode them if an out-sloped grade is not maintained. The potential concern for soil sensitivity in Basin would be from erosion because of the granitic soil parent materials. The existing condition assessment showed no erosion. The physical soil properties or characteristics that effect soil behavior and are important in determining the "sensitivity" of a specific soil to certain uses and management actions considered in a general sense for this project are: soil particle size, moist bulk density, organic matter, and erosion factors. An explanation of each of these physical soil properties or characteristics is provided along with specific information about the Windyridge, Como, Caseypeak, and Hiore soils series comprising Map Unit 75GA3 within the project area in Appendix E. In addition, average ground cover within the five units monitored ranged from 83 to 93 percent. This level exceeds the 70% ground cover which the WEPP model showed would result in almost no chance of soil erosion. (See discussion below.) Further, the post-harvest monitoring shows extremely limited erosion with minimal erosion noted in two points out of several hundred measured. The WEPP model predicts erosion/sediment chance of 3% over 30 years of precipitation events with 70% soil cover. Given these facts, the soil conditions in the Basin Project are not sensitive.

The Basin Project FEIS (existing condition, soils, page 3.219) describes the results for WEPP soil erosion and sediment model runs on existing condition and for the wild fire scenario. The WEPP model was again applied to the conditions encountered during our recent post-harvest monitoring. We found during monitoring that, even in those units that did not meet the soil quality standards based on displacement and compaction, soil cover was high averaging about 89% for of the units monitored (range of 73 -100%). The WEPP model runs were made calibrated to both 50 and 70 percent ground cover following timber harvest, typical slope lengths and angles were applied, the most common 'Unified' soil classification was used, and the model was run for 30 years of average climate based on the model's 'Rock:Clime climate generator. On these soils, with 50% cover, the model predicts a very slight probability of soil erosion with about 10% probability of sediment delivery if erosion occurs during the first year based on 30 years of climate. At 70% ground cover, the model predicts that the chance of soil erosion is almost nil, and a 3% probability that there could be sediment during the first year

following disturbance based on 30 years of climate. However, as discussed above, the average ground cover of the harvested units in the South Basin Sale is 89% - greater than the 50% or 70% model runs. The lack of susceptibility of the soils to erosion is supported by on-the-ground review. In fact, we are now approaching 1 year following disturbance and the identification of erosion during soil monitoring was noted just twice in short sections of road; in one instance on a permanent road and in one instance on a temporary road. Further, there was no sediment as the runoff does not go to a channel but to lower, flat slopes.

Based on the professional judgment of the project soil scientist, soils within the Basin Creek project area are not considered "sensitive" in the context of the planned activities and the Forest Plan FEIS.

2. Revision of Forest Plan Monitoring Requirements

As discussed by the court in its Order of June 23, 2006, the FY 1994 Monitoring Report did include a discussion, at the time the report was written, of reasons that the Deerlodge Forest Plan soil monitoring item 9-3 should be revised. These reasons focused on providing more specifics about the kind of monitoring, monitoring intensity, monitoring techniques and a need to focus on defining desired condition and achieving those conditions. However, subsequent to this FY 1994 Report, important new efforts related to soil productivity and monitoring techniques were undertaken by the Forest and incorporated into its implementation of the existing Forest Plan monitoring requirement – without the need to amend the monitoring item itself.

First, the Forest undertook a comprehensive soil inventory. The inventory provides the data to better understand site-specific soil/vegetative conditions and potential. This, in turn, enables projects designed to achieve desired conditions that protect and enhance soil productivity rather than just remaining below a threshold. Second, in 1989 the Region adopted new guidance in the form of the Region 1 Soil Quality Standards. These standards, updated in 1994 and again in 1999, provided a monitoring methodology to predict soil impacts and identified types of monitoring and intensity. The Beaverhead-Deerlodge National Forest has been following the guidance of the Region 1 Soil Quality Standards in how it implements its soil monitoring. Third, the Beaverhead-Deerlodge implemented new quantitative monitoring techniques that are used in both monitoring under the Region 1 Soil Quality Standards and Forest Plan Monitoring Item 9-3.

The FY 2004 Monitoring Report discussed below shows how the Beaverhead-Deerlodge has responded to the recommendations in the FY 1994 Report under the current monitoring requirement. The FY 2004 Report shows the use of new monitoring techniques to predict soil impacts before they occur with a focus on minimizing soil impacts rather than just staying below the threshold.

Based on these changes, the Beaverhead-Deerlodge National Forest determined to proceed under the existing monitoring item until Forest Plan revision. The proposed revised Beaverhead-Deerlodge Forest Plan (AR Doc. L-37), which was released for public comment in June 2005, provides for the protection of soil resources through site-specific prescriptions developed from soil inventory data, application of the Regional Soil Quality Standards, Best Management Practices, project design and analysis, riparian area standards, and appropriate mitigation measures. (AR Doc. L-37 at 28).

3. FY 2004 Forest Plan Monitoring and Evaluation Report

The FY 2004 Forest Plan Monitoring and Evaluation Report is the latest monitoring report published by the Beaverhead-Deerlodge National Forest. It was published in November 2005. It discusses monitoring results since the year 2000. It was not included in the Basin Creek project record filed with the court because it was published after the June 2004 ROD but the monitoring report does include monitoring conducted both prior to and after the decision.

This monitoring report shows that, in fact, soil monitoring techniques have changed since the FY 1994 report with quantitative analysis included in the report, harvest techniques changing and a clear focus on minimizing impacts to soils and not simply meeting thresholds. The report shows that for both the Beaverhead and the Deerlodge Forests design criteria and BMPs are achieving their purpose of not just meeting the threshold but keeping soil impacts at a minimum. The monitoring report states:

> More recent timber harvest treatments show penetration resistance values within the same range as the old areas but over less area. Dozer site preparation has been shown to be unnecessary and the practice has been generally been abandoned. In the last 10 years or so, operating windows have generally excluded the spring season and have narrowed to the driest times of the summer and to winter logging over snow. In addition soil quality standards have been implemented at the activity level since 2001 which has placed more emphasis on reducing ground disturbance. On the West Face timber sale units monitored in September 2004, detrimental disturbance was estimated at 10% percent overall. An exception was noted on a unit where excessive disturbance occurred near a landing and a road. Soil resistance values on disturbed plots ranged from 96 to >254 psi or .6 to >1.75 MPa (natural to moderate impacts).
>
> . . .
>
> Forest Plan standards require that Best Management Practices for soils (FSH 2509.22) be refined and adopted during the environmental analysis process and incorporated into project design and implementation and activities be designed to sustain site productivity. Monitoring of West Face Timber Sale showed standards were being met and implementation was being modified to sustain site productivity.
>
> In 2004, we participated in a Regional soil quality and function monitoring effort aimed at protecting soil productivity. The program is in its early stages. Based on the projects that have been assessed since 2001, it appears that the trend in detrimental disturbance is likely downward (less disturbance) since the introduction of greater management concern for soil productivity, biodiversity, and function.

FY 2004 Monitoring Report at 30.

> Slash piling – Normally machinery is not operated on soils unless the soil is frozen or is drier than 12 percent water content. The increase in soil bulk density after 15 passes was 6.2% for the surface 3 inches and 9.4% for the 9-12 inch layer well within the 20% change in the Forest Plan Standard and the 15% limit in the Region 1 Soil Quality Standards. The 6.2% increase

> was calculated by using the lowest bulk density value for no passes and the highest value after 15 passes in order to evaluate the worst case.
>
> The penetrometer readings and bulk densities both show increases with more passes of the machinery and both indicate that the increases should have little effect on long term productivity because of compaction. The pattern also indicates that 15 passes of the excavator has slightly exceeded the threshold, 1 MPa, where more passes would begin to produce undesirable effects on productivity. The soils sampled were wetter than normally accepted for machinery operation. Drier soils would likely increase the number of passes needed to cause undesirable effects on productivity.
>
> Evaluation: Changes in the physical properties of soils were tested using a penetrometer and bulk density analysis. Tests of slash piling operations with multiple machine passes result in compaction levels well within the 20% change in the Forest Plan standard and the 15% limit in the Region 1 Soil Quality Standards. . . We will continue evaluating the relationship between bulk density and penetrometer measurements as part of the Regional program for monitoring soil quality and function which began this year, 2004.

FY 2004 Monitoring Report at 93.

C. *South Butte Salvage Sale – Compliance with Forest Plan Monitoring Item 9-3.*

As discussed above, field examinations were conducted to show that the project is consistent with Forest Plan monitoring item 9-3, even though site-specific knowledge demonstrates that the soils in the Basin Creek area are not sensitive in the context of the planned activities and the Forest Plan.

Further, three soil samples were taken – one from unit 14 and two from unit 65 for laboratory chemical analysis to address soil monitoring requirement 9-3 in the Deerlodge Forest Plan. These samples were compared to the physical and chemical properties of reference soils. Although soils within the analysis area were not identified as "sensitive soils," laboratory analysis was conducted to confirm this hypothesis. Samples were chosen to represent the variability observed during the existing condition surveys and during the post-logging monitoring of five activity area units. This includes the range of soil texture, color, and organic matter content.

The soil from Unit 65, Transect 3, Plot 25, is identified as sample B06071133001. A review of the laboratory results indicates this sample correlates with a sample from the Deerlodge soil inventory identified as 092V91W005, map unit 207a, Galena Gulch, a loamy skeletal, mixed, Lamellic Eutrocryept. This sample would be a minor component of soil map unit 207a (Ruppert, pers. com.). Examination of the laboratory data indicates that the two are reasonably similar in terms of particle size class and other physical characteristics. The sample from the project area however has high soil organic matter content. The reference soil and the collected sample are relatively similar and there is not a 20% difference in properties that would cause a detrimental decline in soil productivity.

A second sample from Unit 65, Transect 4, Plot 22, identified as sample B06071133004, is more typical since it is dominant in several units mapped within the Basin Creek project area. A soil previously sampled and used for the Deerlodge soil survey, 070601R3, a loamy-skeletal, mixed Typic

Cryochrept is used as a reference for comparison. A review of the laboratory data indicates that both these soils are typical physically and chemically and both would be expected to have similar productivity.

The last soil sampled from Unit 14, B06071133005, is similar to the above soil B06071133004, physically and chemically. Therefore the same previously sampled soil 070601R3, can be used for comparison. Again, a review of the laboratory results indicates that both of these soils are physically and chemically similar in both the surface and subsurface and would be expected to have similar productivity.

All three of the samples were taken where there had been harvest activities. However, two of the Basin soils sampled had no apparent disturbance; a litter layer was present and there were no signs of surface erosion. The other B0607113005 was recently disturbed at the surface (litter displacement) by a mechanical feller/buncher or skidder in Unit 14. A direct comparison of the disturbed soil and its close match, B060711300, from Unit 65 indicates that the two are not more than 20% different relative to cation exchange capacity, based mostly on inherent variability, and appear otherwise similar physically and chemically.

The laboratory analysis shows that there is not more than 20 percent change in soil chemical and physical properties between reference samples and samples collected from project area, nor between undisturbed soil within an activity area and soil that has been impacted by management activity. Soil chemical and physical analysis was conducted by an accredited soils testing laboratory to determine soil particle size distribution, organic matter content, cation exchange capacity, and pH. This confirms the line of reasoning established by the project soil scientist that monitoring item 9-3 did not apply to soils in the project area. Project area soils were not considered sensitive and there was not a change in soil chemical and physical properties of more than 20 percent.

V. Conclusion:

Monitoring conducted on the South Butte Salvage sale demonstrates that conservation practices and timber sale contract provisions are an effective means of achieving Regional Soil Quality Standards to maintain site productivity as required by the National Forest Management Act. The soil impacts and conclusions in the Basin Creek FEIS are confirmed.

This project proposal is an attempt to achieve desired conditions that protect soil productivity in the long-term. The proposed project is to remove large volumes of fuel that could burn with an intensity that will threaten long-term soil productivity and hydrologic stability in the project area. Fire scenarios discussed in the FEIS show detrimental soil quality impacts expected to occur in areas of severe burning with effects predicted from erosion and the fire models that are expected to be long- term. FEIS at 3.222.

The Forest Service's analysis of the impacts of the project on soil productivity within the five harvest units of the South Butte sale shows that the analysis presented in the Basin Creek Hazardous Fuels Reduction Project is valid and the determination that "By design under this proposal, detrimental soil disturbance in all units would be at or below 15 percent, which is the maximum level allowed by soil quality standards from all causes" is supported. The soil quality standards have been incorporated into the project contract and practices designed to achieve these standards have been implemented and monitored.

Further, the Forest Service has confirmed that soil chemical and physical properties have not changed more than 20 percent due to project impacts. Ground cover is adequate to minimize erosion and provide adequate protection to maintain site productivity. In addition, at such time as operations can be resumed, soil mitigation measures will be completed and coarse woody debris requirements will be met in all units as specified in Basin Creek Hazardous Fuels Reduction Project.

Appendix A: Status of Harvested South Butte Salvage Timber Sale Units

#14: The unit has been cut and timber removed from sale area. Large woody debris needs to be distributed throughout unit to comply with the 10-15 tons per acre requirement. Landing slash needs to be piled. Pre-existing access road within unit would have berms removed and drivable dips installed.

#24 and #59: These units lay side-by-side on the ground and were logged together utilizing the same landings. Except for the very north end of both units, these units have been cut and the timber skidded to landings and decked. Some logs have been removed from the sale area. Large woody debris needs to be distributed throughout unit to comply with the 10-15 ton per acre requirement. Landing slash needs to be piled. A constructed skid trail would need to be recontoured. Erosion control work was completed in the fall of 2005 for spring run-off; however final erosion control work is not complete.

#65: This unit has been cut and timber removed. Large woody debris needs to be distributed throughout unit to comply with the 10-15 tons per acre requirement. Landing slash needs to be piled. All erosion control work was completed in the fall of 2005 for spring run-off; however final erosion control work is not complete.

#66 and #68: These units lay side-by-side on the ground and were logged together utilizing the same landings. Unit 68 is one acre and was operationally included with unit 66. About 75 percent of the unit has been cut and approximately 2/3 of the wood has been skidded. Slash has been distributed on completed skid trails to mitigate soil erosion. Temporary roads need to be recontoured and large woody debris distributed throughout unit to comply with the 10-15 tons per acre requirement. Landing slash needs to be piled.

Unit #70: This unit has been cut and timber removed. Large woody debris needs to be distributed throughout unit to comply with the 10-15 tons per acre requirement. Erosion control work was completed in the fall of 2005 for spring run-off; however final erosion control work is not complete.

Appendix B: Best Management/Soil Conservation Practices and Relationship to Timber Sale Planning and Compliance with Regional Soil Quality Standards

Practice FEIS Appendix D (FSH 2509.22)	Timber Sale Planning and Resulting Contract Provisions (AR Doc. N-3)	Relationship to Region 1 Soil Quality Standards (FSH 2509.18-2003-1)
TIMBER SALE PLANNNING (Practice 14.01) TIMBER HARVEST UNIT DESIGN (Practice 14.02)	Mitigation measures and practices identified during the NEPA process that determine which contract provisions are necessary to implement project. Design considerations of slope, access, harvest prescription, and sensitive areas are incorporated into unit layout and ultimately in determining contract provisions necessary to comply with the governing environmental document.	Minimizes potential soil disturbances during and following the sale layout and subsequent logging operations; mitigates soil disturbances for treated areas where impacts are unavoidable; identifies environmentally sensitive areas where impacts from proposed treatments cannot be mitigated to conform to standards and would not be included in unit design.
DETERMINING TRACTOR LOGGING GROUND (Practice 14.07)	The above design considerations will dictate which harvest method should be used and will Conditions on the ground determine which logging system should be used and trigger specific contract provisions. Provisions used in the South Butte Timber Sale are: B6.4 – Conduct of Logging B6.42 – Skidding and yarding B6.422– Landings and skid trails C6.4# - Conduct of Logging B6.6 – Erosion Control Measures C6.6# - Erosion Control Measures C6.601 – Erosion Control Seeding	Insures that timber harvest unit design will maintain soil productivity and minimize soil erosion and sedimentation. Sets conduct for skidding, yarding and landings as these are primary concerns regarding soil disturbance. Establishes erosion control measures, and identifies skid road and landing locations to limit areal extent of soil disturbances. Sets parameters for suitable conditions when logging operations will cause the least amount of soil disturbance.
USE OF SALE AREA MAPS FOR DESIGNATING SOIL AND WATER PROTECTION NEEDS (Practice 14.03)	B6.5 – Stream Course Protection B6.6 – Erosion Control + Protection C6.4 – Conduct of Logging	Identifies harvest method and specific protection areas such as Stream Side Management Zones.
LIMITING THE OPERATING PERIOD OF TIMBER SALE ACTIVITIES (Practice 14.04)	B6.311 – Plan of Operations B6.6 – Erosion Control + Protection C6.316 – Limited Operating Period	Controls the timing of activities to reduce the potential for detrimental soil compaction and detrimental soil rutting.
TRACTOR SKIDDING DESIGN (Practice 14.08)	C6.4# -Conduct of logging B6.42 – Skidding and Yarding B6.422 – Landings and Skid Trails	Establishes main skid trail spacing to be at least 85 to 100 feet apart to limit areal extent to 10 to 15 percent of activity area.
EROSION PREVENTION AND CONTROL MEASURES DURING TIMBER SALE OPERATIONS (Practice 14.12)	B6.6 Erosion Prevention and Control B6.63 – Temporary Roads B6.631- Temporary Roads to Remain Open B6.64 – Landings B6.65 – Skid Trails and Fire Lines B6.66 – Current Operating Areas B6.67 – Slash Disposal	Minimizes surface erosion (Rills, gullies, pedestals) and soil displacement by limiting the areal extent of soil disturbances. Addresses conditions that might contribute to increased soil compaction during periods of increased precipitation or soil moisture.

EROSION CONTROL ON SKID TRAILS (Practice 14.15)	C6.65# - Skid Trails and Fire Lines	Minimizes soil surface erosion (Rills, gullies, pedestals) on skid trails
	Beaverhead-Deerlodge N.F. Letter of Agreement with Purchaser (AR: Doc. N3-A)	FS agrees to purchaser's designation of skid trails in tractor cutting units providing the purchaser creates no more than 15 percent detrimental soil disturbance. FS approves purchasers skid trail layout. Skid trail layout must comply with other contract provisions and best management practices.

Appendix C: Timber Sale Inspection Reports to Comply with Regional Soil Quality Standards

Unit	Practice and/or Provision	Date	Discussion
Sale Area	B6.6, B6.65	10/11/05	Both Forest Soil Scientists visited the sale. There is a concern with amount of soil disturbance from the feller-buncher when the equipment makes a turn. These areas will be back-bladed to fix the problem.
65, 14	B6.6, B6.65	10/12/05	Soil disturbance (displacement) mentioned in previous day's inspection report has been corrected.
65	B6.422, B2.32, B6.42, B6.65, B6.6	10/13/05	Ensure equipment stays on the main skid trail on return trips to pick another bundle of logs. Erosion control work will be needed on the main skid trail. The main spur road will be ripped (to relieve compaction) and recontoured when it is no longer need. Forest Service will determine erosion control needed.
65	C6.7, B6.41, B6.6	10/17/05	Some small trees being pushed over instead of being cut. This has increased soil disturbance. Where possible all trees should be cut from the stump and not pushed over.
66	C6.4, C6.632	10/24/05	Approved temporary road to access a portion of the unit, which will alleviate the need for another landing in a sage/grass opening. Temporary road will be recontoured and seeded after use.
65	C6.4, C6.632. B6.6	10/24/05	Temporary road will be recontoured and seeded when operations in this area are completed. TSA noted several areas where soil displacement had not been smoothed. Operator was instructed to smooth the majority of displacement so topsoil is available to root systems.
65	B6.6	10/24/05	Skidders are bringing back slash to spread on main skid trails instead of waterbars. Completed skid trail looks good and should effectively control erosion.
68	B6.6	10/25/05	Operator is doing a nice job of minimizing turns and reducing the amount of soil displacement in this unit. Displacement not smoothed during skidding will need to be smoothed especially when there is a continuous track extending some distance.
65	B6.6, C6.4	10/25/05	TSA conducted a walk-through examination with the Zone Contracting Officer to discuss soil disturbance, particularly displacement, erosion control, and slashing skid trails. ZCO agrees that this unit has an unacceptable amount of displacement that they should be smoothed. This was discussed with the operator and documented in a separate report.
65	B6.6	10/25/05	Soil Scientist walked through parts of Units 14, 65, and 68. SS is also concerned with amount of displacement in Unit 65. Discussed placing slash on skid trails for erosion control would be better in most cases than waterbars and liked what had been completed so far. Percent of ground in skid trails is generally within standards but activity of main skid trails seems excessive in Unit 65. SS will have a better idea after transects are run in completed units.
65	B6.6	10/26/05	Operators are doing a nice job of spreading slash on trails. Work completed so far is acceptable on trails; trails will be seeded when equipment is finished in area. Soil displacement is being smoothed along with skid trail erosion control work.
Sale Area	B6.6	10/31/05	Checked soils on site; apparently rain and snow have not fallen on area as soils are as dry as last week.
70	B2.2	11/1/05	Some soil displacement remaining. Purchaser's Rep says these will be smoothed when skid roads have slash scattered on them.
14	C6.4	11/2/05	TSA noted some places where logs were skidded straight to the landing rather than to main skid trails and then to landing. Purchaser's Rep was told that this is not acceptable. Meeting Forest soil disturbance criteria requires strict adherence to approved skidding patterns at all times.
Sale Area	B6.6	11/3/05	TSA advised purchaser rep. to "squeeze some dirt". If soil "balls up" clipping and skidding operations should not start up. This is a field

			method for determining if soil moisture is too wet for operations.
14, 24, 66	B6.6	11/3/05	TSA walked skid trails and areas where buncher was working. Soil was quite dry under the snow.
14, 66	B6.6	11/5/05	Forest Soil Scientists were on site monitoring soil conditions. Both commented that soil moisture was drier than expected; both felt that soil conditions were suitable for felling/skidding.
24, 59	C6.4, B6.6, B6.422	11/15/05	TSA measured distances between skid trails. Trails in south part of units are well within spacing requirements for skidding patterns. On west side of 24, a loop configuration of main skid trail was noted, which at the widest part was considered < 100' spacing requirement. Spoke with operator and purchaser about maintaining distance between skid trails as agreed to in Letter of Agreement (Doc AR: N-3A)
66	C6.4, B6.422, B6.63, C6.632	11/16/05	TSA spoke at length with operator and purchaser about maintaining 100' skid trail spacing. Soils in the area are soft and displacement is a problem even when operators take precautions turning and on side-hills. Mostly, these areas are holding up well and freezing conditions are helping.
Sale Area	C6.4	11/16/05	Measurements taken to date between skid trails are ranging from 75-150' with most skid trails ranging from 90-100'.
66	A2, B2.2 B6.6	11/17/05	Reworking missed areas for pulp wood would not cause an unreasonable amount of soil displacement. Operator was instructed not to "churn" soil.
24, 59	C6.4, B6.6	11/17/05	Skid trail spacing looked good; some displacement needs to be smoothed when slash is spread on skid trails.
59	B6.6	11/17/05	Soil at one area was very soft and significant displacement was created. Operator left area but damage was done. This area will need attention.
24, 59	C6.4, B6.422	11/21/05	Skid trails are spaced well above 100' requirement in most places but are narrowing around landing to less than 100'. Should average out.
24, 59	B6.6	11/21/05	Skid trails are holding up. Road is sloppy on top but not rutting badly. Operator smoothed out displacement in Unit 59 (reported 11/17).
24, 59	C6.42, B6.6	11/22/05	Frozen ground is holding up thru afternoon in shaded areas. Skid trails with direct sun in the afternoon are not being used.
	Operations Suspended	11/22/05	TSA received notice that temporary restraining order was in effect and operations would have to be suspended.
14, 24, 59, 65, 66	B6.6, C6.6	11/28/05	Regardless of future options all erosion control work will be completed for skid trails, temporary roads and landings. Skid trails will be slashed or water barred, temporary roads will be winterized with cross drains and berm openings, landings will have slash piled and cross drains if needed.
Sale Area	B6.6, C6.6	11/28/05	Erosion control work will be completed and accepted prior to equipment needed for the work is removed from the sale.
Sale Area	C6.601	11/28/05	All temp roads constructed to date will require recontouring and seeding when conditions are suitable next year.
14, 24, 59, 66	B6.6, C6.6, C6.7	12/5/05	Slash is being piled on skid trails and landings to prevent erosion over winter because operations are suspended.
66	C6.4, B6.6, C6.6, B6.36	12/07/05	TSA walked skid trails and noted a few trails that did not have adequate slash to provide soil protection. The skidder went back and applied additional slash after which all skid trails in unit 66 are current with operations and accepted where completed.
Sale Area	B6.6, C6.6	12/12/05	TSA inspected skid trails that had been slashed, noted 2 trails that need erosion control that were missed. Notified Purchaser.
24, 59	B6.6, C6.6	12/12/05	Skid trails in north end of units need erosion control work. Displacement identified in report dated 1/17/05 was back-bladed and smoothed to prevent erosion. Operator did a good job.
Sale Area	C6.632	12/13/05	Temporary roads and constructed skid trails will need to be recontoured next summer when conditions are suitable. If authorization is not granted (from the Court) to skid remaining logs prior to spring breakup, temporary roads will need berms removed and cross-drains installed.

Appendix D: Soil Disturbance by Transect Point by Unit

Butte South Salvage Timber Sale
Soil Monitoring Transect Data Summary

Table 1. Soil Condition Classification Summary by Unit by Number of Transect Points

Unit	All	Satisfactory	Unsatisfactory	Unsatisfactory Components		
	Total	Total	Total	Compaction	Displacement	Displacement & Compaction
	Number of Points			Number of Points		
14	140	121	19	6	11	2
24	60	54	6	5	0	1
59	80	70	10	0	6	4
65	140	115	25	3	21	1
70	40	32	8	0	8	0
Total	460	392	68	14	46	8

Table 2. Soil Condition Classification Summary by Unit as a Percentage of the Unit

Unit	Total	Satisfactory	Unsatisfactory	Unsatisfactory Components		
	Percent			% Compaction	% Displacement	% Displacement & Compaction
14	100	86.4	13.6	4.3	7.9	1.4
24	100	90.0	10.0	8.3	0.0	1.7
59	100	87.5	12.5	0.0	7.5	5.0
65	100	82.1	17.9	2.1	15.0	0.7
70	100	80.0	20.0	0.0	20.0	0.0

Appendix E: Physical soil properties or characteristics about the Windyridge, Como, Caseypeak, and Hiore soils series comprising Map Unit 75GA3 and Explanation.

Table 1. Physical Soil Properties – Deerlodge National Forest Area, Montana

Map Symbol and Soil Name	Depth	Sand	Silt	Clay	Moist Bulk Density	Organic Matter	Erosion Factors	
75GA3							Kw	Kf
	Inch	*Pct*	*Pct*	*Pct*	*g/cc*	*Pct*		
Windyridge	0-5	-	-	5-15	1.20-1.40	2.0-4.0	.17	.17
	5-12	-	-	5-10	1.20-1.40	1.0-2.0	.15	.17
	12-60	-	-	-	-			
Como	0-1	-	-	0	0	28-70	-	-
	1-8	-	-	10-18	1.35-1.55	1.0-3.0	.10	.20
	8-15	-	-	10-18	1.40-1.60	0.5-1.0	.05	.17
	15-60	-	-	2-8	1.55-1.75	0.0-0.5	.02	.10
Caseypeak	0-1	-	-	0	--	28-70	-	-
	1-6	-	-	5-15	1.40-1.60	0.5-2.0	.05	.20
	6-17	-	-	5-27	1.50-1.70	0.05-1.0	.10	.28
	17-20	-	-	-	-	-	-	-
	20-60	-	-	-	-	-	-	-
Hiore	0-2	-	-	8-20	1.20-1.40	2.0-4.0	.10	.20
	2-7	-	-	8-18	1.40-1.60	1.0-2.0	.17	.17
	7-35	-	-	8-18	1.50-1.70	0.5-1.0	.05	.20
	35-60	-	-	2-12	1.50-1.70	0.0-0.5	.02	.20

"Particle size" is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller. For example, the Como series has a sandy loam surface and sand or loamy sand subsoil. Sand is the dominant particle size and the percent clay is low, ranging from 2 to 18 percent throughout the soil.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification. The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Due to the sandy surface texture of Como soils, water infiltrates the soil surface rapidly. These soils are excessively drained and have low water capacity. These soils have a moderate potential for erosion (see description of K factor below) and are not easily compacted because of coarse surface texture and low clay content. Based on these characteristics Como soils (as well as Windyridge, Casepeak and Hiore soils which have similar characteristics)

would not be considered “sensitive” in that they are not particularly prone to erosion or compaction.

"Moist bulk density" is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3- or 1/10-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. The estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 g/cc can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure. Moist bulk densities for Como, Caseypeak, and Hiore soils can exceed 1.4 g/cc (Table 1) in some soil horizons. However, since the texture of these soils is sandy loam or coarser, water storage and root penetration would not be restricted, especially when considered with the low levels of organic matter.

"Organic matter" is the plant and animal residue in the soil at various stages of decomposition. In Table 1, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained by returning crop residue, slash or fine woody debris to the soil. Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms. Organic matter content of the mineral horizons for the Windyridge, Como, Caseypeak, and Hiore soils ranges from 0.05 to 4 percent. This amount of organic matter is typical for cold, dry soils formed under coniferous vegetation.

"Erosion factors" are shown as the K factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and Ksat. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments. The erodibility of the whole soil for the Windyridge, Como, Caseypeak, and Hiore soils ranges from .02 to .17. The Hiore soil is more erodible than the Como soil, although neither is approaching the value of .69 which would be considered highly erodible by wind or water.

"Erosion factor Kf" indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size. The erodibility of the fine-earth fraction of the Windyridge, Como, Caseypeak, and Hiore soil series ranges from .10 to .28 The fine-earth fraction is slightly more erodible than the whole soil for these soils, however neither is approaching the value of .69 which would be considered highly erodible by wind or water.

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