Soils Report
Sugarberry Project

Feather River Ranger District
Plumas National Forest

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1. Introduction

The purpose of the Sugarberry Project is to implement the Herger-Feinstein Quincy Library Group Forest Recovery Act, which is generally intended to promote the ecological health of lands and economic health and stability of communities in the northern Sierra Nevada. Proposed projects include 2,100 acres of a defensible fuel profile zone (DFPZ), 1040 acres of group selection treatments, 155 acres of individual tree selection (ITS) treatments, transportation system improvements (road reconstruction, closure, and decommissioning), aspen regeneration, 100 acres of black oak stand enhancement, streambank restoration, stream crossing improvements, and meadow restoration. For more information refer to the Sugarberry “Proposed Action” on file in the project record.

The purpose of the Sugarberry “Soils Report” is to analyze the direct, indirect, and cumulative effects of the Sugarberry Project to long term soil productivity, hydrologic function,

and buffering capacity. The land management activities proposed under this project have the potential to affect the soil resource in a beneficial, indifferent, or adverse manner. Soil productivity is the inherent capacity of a soil to support growth of plants, plant communities, and soil biota (USDA Forest Service 1995).The land management activities proposed under this project have the potential to benefit or adversely effect long term soil productivity. Soil productivity is determined by measuring soil cover, soil porosity, and organic matter (see Section 4 “Indicators and Measurements”). Soil hydrologic function is the capacity of a soil to intake, retain, and transmit water. Soil buffering capacity is the inherent capacity of soil to absorb, filter, or degrade added chemicals, heavy metals, or organic materials. Below is a summary of expected cumulative effects for each alternative. For more detailed information on direct, indirect, and cumulative effects refer to Section 7 “Environmental Effects”.

1.1 Summary of Cumulative Effects Alternative A – No action Alternative

- In all proposed treatment units effective soil cover exceeds Forest Plan standards and guides (See Section 6.2.1 “Existing Condition – Measure 1: Soil Cover”). Under Alterative A, soil cover would not be removed and would continue to accumulate at its current rate. However, a reduction of fuel loading would not occur. It has been detriment that fuel loading conditions are high within the Sugarberry Project and there is a need to create a DFPZ. If a high intensity fire were to ignite in the untreated DFPZ, then it could result in significant reduction in soil cover that would likely exceed changes expected under the action alternatives.
- Past land management activities have caused detrimental soil compaction, which has resulted in a decrease in soil porosity (see Section 6.2.2 “Existing Condition – Measure 2: Soil Porosity”). Under Alternative A, no new detrimental compaction would occur to further effect soil productivity and soil hydrologic function.
- Under the existing condition fine organic matter and large woody material meets or exceeds the Region 5 Soil Management Handbook recommended thresholds in the majority of the proposed treatment units surveyed (see Section 6.2.3 “Existing Condition – Measure 3 Organic Matter”). Under Alternative A fine organic matter would not be removed and continue to accumulate at its current rate. Existing large woody material would remain, and continue to accumulate if

there are trees with the stand at least 12 inches dbh. In most plantations there are no trees of sufficient size available to create large woody material. Continued management of timber stands as part of the Sugarberry Project would accelerate the diameter and height growth of residual trees, provide periodic inputs of woody debris from thinning operations, and provide for future opportunities for recruitment of snags and down woody material. It has been detriment that fuel loading conditions are high within the Sugarberry Project and there is a need to create a DFPZ. Increased organic matter, especially fine organic matter, would contribute to increased ground and surface fuel loads, which may lead to increased fire severity and intensity during a fire event. Fires instantaneously combust organic matter and causes the rapid acceleration of decomposition rates and nutrient cycling processes that are essential for plant growth and soil organisms. The effects of fire have short-term and long-term adverse effects (Neary et al. 2005). If a high intensity fire were to ignite in the untreated DFPZ, then it could result in significant reduction in organic matter that would likely exceed changes expected under the action alternatives.

- Treatments used to regenerate fire-resilient species using an uneven-aged management strategy would not occur under alternative A. Therefore, the accelerated development of soil cover, fine organic matter, and large woody material in proposed treatment units would not occur in deficient areas, such as plantations.
- Implementation of transportation system improvements, aspen regeneration, black oak stand enhancement, and watershed restoration would not occur under alternative A. These would represent lost opportunities to benefit the soil resource long term.

1.2 Summary of Cumulative Effects Alternative B – Proposed Action

- Short term reductions in soil cover are expected within proposed thinning, ITS, group selection, and prescribed burning treatment units. Reductions in soil cover would reduce the high fuel loading conditions and fire risk. Effective soil cover in all proposed treatment units is expected to meet or exceed Forest Plan standards and guides. Based on the cumulative effects analysis, proposed group selection treatment unit 908 has a high risk for reduction of effective soil cover

below Forest Plan standards and guides. Mitigations would be used to ensure Forest Plan standards and guides are met. These mitigation measures would include seeding and mulching bare soil caused by disturbances during treatment operations.

- Within the Sugarberry soil analysis area legacy detrimental compaction was observed in the majority of the proposed treatment units surveyed. It is expected than proposed thinning, group selection, and ITS treatments with ground-based mechanical equipment use would cumulatively increase the level of detrimental compaction. Skyline and helicopter operations due not effect soil porosity. Most of the analysis area contains soils classified as loam or sandy loam, with some occurrence of clay loams. The current LTSP study suggests that soil compaction does not affect soil productivity, except with poorly drained or perennially wet soils (unusual occurrence for general forest soils). Regardless, project design mitigations have been included to decrease the level of detrimental soil compaction that would occur as a result of proposed treatments (see Section 6.2.1.2). To reduce the risk of detrimental compaction effecting long term soil productivity, a Limited Operation Period (LOP) would be applied to the entire Sugarberry Project. The LOP would only allow ground-based harvest equipment to operate only when soils are considered dry. Soil is defined as “dry” when the upper 8 inches is not sufficiently moist to allow a soil sample to be squeezed and hold its shape, or crumbles when the hand is tapped. Dryness would be determined by the sale administrator upon the recommendation of a soil scientist. In addition to the LOP, subsoiling would occur on all landings used, 200 feet of the main skid trail approach to the landing, and temporary roads. Subsoiling on skid trails would not exceed a 25 percent slope, to prevent unacceptable risks of soil erosion and to tree health. Ground-based mechanical equipment operations within proposed mastication treatment units are not expected to increase detrimental soil compaction. Proposed mastication treatments are also included in the LOP and equipment specifications would be included in the service contract.
- •The cumulative quantity of fine organic matter was estimated using the analysis for soil cover. Soil cover is expected to meet Forest Plan standards and guides in all proposed treatment areas. Effects of the removal of soil organic matter are expected to be short-term and have no effects to long term soil productivity.

- There are proposed treatments units under the existing condition that are below the Region 5 Soil Management Handbook recommended threshold for large woody material (see Section 6.2.3 “Existing Condition – Measure 3: Soil Organic Matter”). A reduction of large woody material is expected in treatments units with a follow up prescribed burning. The Region 5 guidelines allow for the adjustment of this threshold when fuel management treatments are needed. It has been determined that the Sugarberry Project is needed for fuel management. Recent research demonstrates that organic carbon and nitrogen concentrations are much higher in decaying wood material than mineral soil and concludes that large woody material is not considered important for nutrient storage or cycling with respect to soils (personal communication with Robert Powers). However large woody material plays a large role for wildlife habitat, and retention of large down logs would be mitigated for wildlife Forest Plan standards and guides (refer to Sugarberry “Wildlife Biological Evaluation/Biological Assessment” for more information).
- There are no anticipated cumulative effects to soil hydrologic function as a result of the incorporated mitigation measures used to prevent increased detrimental soil compaction.
- It is not expected that soil buffering capacity within the Sugarberry Project area would be changed by proposed management activities. No materials would be added to the soil that would alter reaction classes, buffering or exchange capacity.
- The goal of road decommissioning, as described in the proposed action, is to restore the designated land base to natural conditions. This would uncompact the roadbed and restore soil porosity and hydrologic function, which would allow natural revegetation to occur and increase soil cover and organic matter. Through time these changes would reduce surface erosion and greatly benefit long term soil productivity.
- Black oak and aspen enhancements would remove competing vegetation to allow for the recruitment of black oak or aspen, and reduce the high fuel loading conditions. Treatments are hand thinning or helicopter removal, which do not cause decreases in soil cover, or soil organic matter, or soil porosity. These treatments would not adversely affect the soil resource.

1.3 Summary of Cumulative Effects Alternative C

Effects of proposed treatments under Alterative C are expected to be the same or similar to Alternative B. There is a reduction in proposed thinning, group selection, and ITS treatments under Alternative C. Cumulative effects from these treatments are expected to be less than the cumulative effects under Alternative B. All mitigation measures under Alternative B apply to Alternative C.

1.4 Summary of Cumulative Effects Alternative G

Direct, indirect, and cumulative effects of soil productivity under Alternative G are expected to be the same or similar compared to Alternative C (see Section 7.2.1). Under alternative G there are additional roads proposed for decommissioning. The goal of road decommissioning, as described in the proposed action, is to restore the designated land base to natural conditions and allow natural revegetation and restore soil productivity.

2. Regulatory Framework

2.1 National Forest Management Act

The National Forest Management Act (NFMA) of 1976 mandates that land management plans be prepared for each National Forest (See Plumas National Forest Land Resource Management Plan below), and that guidelines be specified that will:

“Insure research on and (based on continuous monitoring and assessment in the field) evaluation of the effects of each management system to the end that it will not produce substantial and permanent impairment of the productivity of the land.” and

“Insure that timber will be harvested from National Forest System lands only where - "(i) soil, slope, or other watershed conditions will not be irreversibly damaged.”

2.2 Sierra Nevada Forest Plan Amendment Final Supplemental Environmental Impact Statement and Record of Decision

Table 2 of the 2004 Record of Decision on the Sierra Nevada Forest Plan Amendment Final Supplemental Environmental Impact Statement describes applicable standards and guidelines of the HFQLG Pilot Project area for the life of the Pilot Project (USDA Forest Service 2004). The standard and guide states “Determine retention levels of down woody material on an individual basis. Within Westside vegetation types, generally retain an average over the treatment unit of 10-15 tons of large down wood per acre… Consider the effects of follow-up prescribed fire in achieving desired retention levels of down wood.”

2.3 Plumas National Forest Land and Resource Management Plan

The 1988 Plumas Nation Forest Land and Resource Management Plan (commonly referred to as the "Forest Plan") specifies standards and guidelines for the maintenance and improvement of soil resources on page 4-44 (USDA 1988). These standards and guidelines are:

1. Prevent significant or permanent impairment of soil productivity.
    A. During project activities, minimize excessive loss of organic matter and limit soil disturbance according to the Erosion Hazard Rating (EHR) as follows:
        a) EHR 4-8: Conduct normal activities
        b) EHR 9-10: Minimize or modify use of soil-disturbing activities
        c) EHR 11-13: Severely limit soil-disturbing activities
    B. Determine adequate ground cover for disturbed sites outside of streamside management zones during project planning on a case-by-case basis, based on specialist evaluation, using the following as a guide:
        a) Low EHR (4-5): 40% minimum effective ground cover
        b) Moderate EHR (6-8): 50% minimum effective ground cover
        c) High EHR (9-10): 60% minimum effective ground cover
        d) Very high EHR (11-13): 70% minimum effective ground cover
    C. To avoid land base productivity loss due to soil compaction, dedicate no more than 15% of timber stands to landings and permanent skid trails. Measurement will be along the travel way and shall not include width of cut and fill slopes.
    D. Develop specific soil evaluation and mitigation measures for each project site as needed.
    E. Incorporate measures for protection of long-term soil productivity in controlled burn prescriptions through an interdisciplinary process. Specify objectives for organic material retention for maintenance of ground cover.
2. Eliminate excessive soil loss
    A. Develop and apply erosion control plans to road construction and other site disturbance projects. Develop specific mitigation measures for each project site as needed.
    B. Document observations of slope failures, significant erosion of and from road surfaces, erosion of mine spoils, and any other sources of sediment

that are affecting water quality or channel stability. Use for future erosion control planning.

3. Management Direction

3.1 National Soil Management Handbook FSH 2509.18-91-1 (USDA Forest Service 1991)

The Soil Management Handbook (USDA Forest Service 1991) is a national soils handbook which defines soil productivity and components of soil productivity, establishes guidance for measuring soil productivity, and establishes thresholds to assist in forest planning. The handbook contains the following definitions:

1. Significant changes in productivity of the land are indicated in soil properties that are expected to result in a reduced productive capacity over the planning horizon. Based on available research and current technology, a guideline of 15 percent reduction in inherent soil productivity potential will be used as a basis for setting threshold values for measurable or observable properties or conditions. The threshold values, along with the areal extent limits, will serve as an early warning signal of reduced productive capacity. A more stringent basis than 15 percent can be used where appropriate and documented. The allowable areal extent of significantly changed soil is to be established as part of soil quality standards.
2. Soil compaction is a physical change in soil properties that results in a decrease in porosity and an increase in soil bulk density and soil strength.
3. Soil compaction is more than a 15% increase in bulk density, or a 10% reduction in total porosity.
4. Soil displacement is the movement of the forest floor (litter, duff, and humas layers) and surface soil from one place to another by mechanical forces such as a blade used in piling or windrowing. Mixing of surface soil layers by disking, chopping, or bedding operation, are not considered displacement.
5. Surface erosion is the detachment and transport of individual soil particles by wind, water, or gravity.
6. Detrimental soil disturbance is the condition where established threshold values of soil properties are exceeded and result in significant changes.

The following are the Soil Management Handbook recommendations for the establishment of soil quality standards to use during forest planning:

1. Base threshold values on soil properties and soil conditions that are observable or measurable and that correspond to significant change. When setting threshold values for soil properties or conditions, use the estimated 15 percent reduction in soil productivity as a guideline for determining when the change becomes detrimental or significant.
2. When changes in soil properties reflect an estimated 15 percent or more reduction in productive capacity, a warning is indicated to adjust practices to prevent significant impairment. The 15 percent guideline is to be used as a judgment.
3. Use compaction, displacement, erosion, puddling, protective plant cover, and burning as applicable to categorize soil disturbances.

3.2 Region 5 Soil Management Handbook FSH 2509.18-95-1 (USDA Forest Service 1995):

The Forest Service Region 5 (R5) Soil Management Handbook establishes regional soil quality analysis guidelines and provides threshold values that indicate when changes in soil properties and soil conditions would likely result in a significant change or impairment of the soil productivity potential, hydrologic function, or buffering capacity of the soil. When these threshold values are exceeded the result is considered detrimental soil disturbance. The handbook states that the extent of detrimental soil disturbance that affects soil productivity, shall not be of a size or pattern that would result in a significant change in production potential for the activity area. The R5 soil quality analysis guidelines apply only to those areas dedicated to growing vegetation. They are not applied to other dedicated uses, such as system roads and developed campgrounds.

The following list includes soil properties, conditions, and associated threshold values to avoid detrimental soil disturbance and to evaluate management effects on soil productivity, soil hydrologic function, and soil buffering capacity:

1. Soil porosity should be at least 90 percent of total porosity found under natural conditions. A ten percent reduction in total soil porosity corresponds to a threshold for soil bulk density that indicates detrimental soil compaction.
2. Organic matter is maintained in amounts sufficient to prevent significant short or long-term nutrient cycle deficits, and to avoid detrimental physical and biological soil conditions. Prescribe surface organic matter in amounts that would not elevate wildfire risk or severity to the point that desired organic matter for nutrient cycling cannot be achieved or maintained because of increased wildfire

risk potential. If there is no viable alternative for providing surface organic matter without elevating wildfire risk, prescribe an amount that does not significantly increase wildfire risk and monitor soil nutrient status. Apply mitigation measures if decreased nutrient supply has the potential to affect ecosystem health, diversity or productivity. The prescribed amount shall not reduce the amount needed for soil cover to prevent accelerated erosion. Use the kinds and amounts of organic matter identified below.

A. Soil organic matter in the upper 12 inches of soil is at least 85 percent of the total soil organic matter found under natural conditions for the same or similar soils. Soil organic matter is used as an indicator of soil displacement effects on nutrient and soil moisture supply.

B. Surface organic matter is present in the following forms and amounts:

   a) Fine organic matter occurs over at least 50 percent of the area. Fine organic matter includes plant litter, duff, and woody material less than 3 inches in diameter. The dry weight of fine organic matter without woody material is about 0.2 to 3 tons per acre. Determine minimum organic layer thickness and distribution locally and base it on amounts sufficient to persist through winter season storms and summer season oxidation. Use the presence of living vegetation that could contribute significant annual litter fall to compensate for conditions when immediate post-disturbance fine organic matter coverage is too thin or less than 50 percent. The preference is for fine organic matter to be undisturbed, but if disturbed, the quantity and quality should avoid detrimental short and long-term nutrient cycle deficits.

   b) Large woody material is at least 5 well distributed logs per acre representing the range of decomposition classes defined in Exhibit 02 of the Soil Management Handbook. To alleviate the risk of adverse fire effects, dry weight should be less than about 3 tons per acre. Desired logs are at least 20 inches in diameter and 10 feet long. Protect logs in decomposition classes 3 through 5 from mechanical disturbance. Do not count logs less than 12 inches in diameter or stumps as large woody material. The amount of large woody material that is recommended should consider the potential for the ecological

type in the project area to generate large woody material and also the fuel management objectives for the area.

c) Fine organic matter and large woody material together should amount to less than about 6 tons per acre dry weight to alleviate the risk of potential detrimental wildfire effects. Other surface organic matter (3 inches to 20 inches in diameter), or amounts of fine organic matter and large woody material in excess of amounts described in detail above need not be retained. Large woody material and fine organic matter amounts (except when needed for essential erosion control) may be reduced to meet fuel management objectives in strategic fuel treatment areas, on fuel breaks, and in other critical areas. Evaluate or monitor soil nutrient status in fuel treatment areas and other areas that lack sufficient large woody material and fine organic matter.

d) Soil Moisture Regime is unchanged where productivity or potential natural plant community is dependent upon specific soil drainage classes.

3. Soil Hydrologic Function - Avoid accelerated surface runoff, infiltration and permeability reduction of ratings to 6 or 8 as defined in the R5 Erosion Hazard Rating system.
4. Soil Buffering Capacity - Materials added to the soil must not alter soil reaction class, buffering or exchange capacities, or microorganism populations to the degree that significantly affects soil productivity, bioremediation potential, soil hydrologic function, or the health of humans or animals.

Region 5 also recommends standard operating procedures (B and C clauses) to mitigate for detrimental soil disturbance. Detailed descriptions of all recommended B and C clauses that would be used during the implementation of the Sugarberry Project are included in Appendix A of this report.

4. Management Indicators and Measurements

The soil effects analysis is based on the soil quality analysis guidelines as described in the R5 Soils Management Handbook (see Section 3.2, “Management Direction”). Indicators analyzed include soil productivity, soil hydrologic function, and soil buffering capacity.

4.1 Indicator 1: Soil Productivity

Soil Productivity is the inherent capacity of a soil to support growth of plants, plant communities, and soil biota (USDA Forest Service 1995). Important measures of soil productivity include: soil cover, soil porosity, and organic matter.

4.1.1 Measure 1: Effective Soil Cover

Effective soil cover consists of low-growing vegetation (grasses, forbs and prostrate shrubs), plant and tree litter (fine organic matter), surface rock fragments, and may also include applied mulches (straw or chips) (USDA Forest Service 1995). Vegetative cover serves several purposes in the mitigation of accelerated soil erosion by dissipating the energy of falling raindrops through interception (CSSC 1989). Without vegetative cover, an intense storm can generate large quantities of sediment from hillslopes (Cawley 1990). The litter layer absorbs water, increases storage capacity, and slows the velocity of overland flow. At higher velocities of overland flow, falling rain causes rain splash which detaches and mobilizes soil particles and overland flow occurs as sheet-wash. Effective soil cover was measured in field surveys, and the Erosion Hazard Rating (EHR) system was used to quantify the kind, amount, and allowable disturbance of soil cover necessary to prevent detrimental accelerated soil erosion as defined by the Forest Plan (see the “Analysis Methods” Section).

4.1.2 Measure 2: Soil Porosity

Soil porosity is the volume of pores in a soil that can be occupied by air, gas, or water and varies depending on the size and distribution of the particles and their arrangement with respect to each other. A ten percent reduction in total soil porosity corresponds to a threshold for soil bulk density that indicates detrimental soil compaction (USDA Forest Service 1995). Detrimental soil compaction was determined in field surveys at a depth of 4 to 8 inches (see the “Analysis Methods” Section). The use of heavy forestry equipment and frequent stand entries increases bulk density and decreases the porosity of soils, which increases the potential for detrimental compaction (Powers 1999). The degree and extent of susceptibility to compaction is primarily influenced by soil texture, soil moisture, depth of surface organic matter, ground pressure weight of the equipment, and whether the load is applied in a static or dynamic fashion. The potential or possible effects of compaction on tree growth are well documented (Poff 1996). Effects of soil compaction can cause increased soil strength, slowed plant growth, impeded root development, poor water infiltration, restricted percolation, increased overland flow during high precipitation events, and cause plant nutrients to be relatively immobile.

4.1.3 Measure 3: Soil Organic Matter

Soil organic matter consists of living biomass (plant roots, microorganisms, invertebrates, and vertebrate fauna) and dead biomass (dead bark, large woody debris, litter, duff, and humus materials). Soil organic matter is the primary source of plant-available nitrogen, phosphorous, and sulfur, provides habitat for the diverse soil biota that carry out energy transformation and nutrient cycles, contributes to soil structure and porosity of soils, protects soils from erosion, and enhances infiltration and hydrologic function (Neary et. al. 2005). The R5 Soil Management Handbook provides recommend measures and thresholds for maintaining organic matter in the amounts sufficient to prevent significant short or long-term nutrient cycle deficits and to avoid detrimental physical and biological soil conditions (see Section 3.2, "Management Direction"). Measures include fine organic matter and large woody material. Fine organic material includes plant litter, duff, and woody material less than 3 inches in diameter. Large woody material consists of down logs that are least 20 inches in diameter and 10 feet long. Fine organic matter and large woody material was collected during the Sugarberry Forest Inventory and Analysis (FIA) and soil field surveys.

4.2 Indicator 2: Soil Hydrologic Function

Soil hydrologic function is the inherent capacity of a soil to intake, retain, and transmit water and is influenced by infiltration and permeability (USDA Forest Service 1995). Infiltration is the rate of water movement into the soil and is determined by soil texture and soil porosity (USDA Forest Service 1990). Permeability is the rate at which water percolates or moves down through the soil and is primarily based on soil porosity (USDA Forest Service 1990). The Plumas National Forest Soil Resource Inventory (USDA Forest Service 1988) included an estimation of infiltration and permeability for each soil map unit. Infiltration rates are grouped according to the intake of water when soils are thoroughly wet and receive precipitation from long duration storms and are described as high (low runoff potential), moderate, slow, and very slow (high runoff potential). Permeability is measured as the number of inches per hour that water moves downward through saturated soil and is described as: very slow, slow, moderately slow, moderate, moderately rapid, rapid, and very rapid. The Erosion Hazard Rating (EHR) system was used to estimate soil hydrologic function.

4.3 Indicator 3: Soil Buffering Capacity

Soil buffering capacity is the inherent capacity of soil to absorb, filter, or degrade added chemicals, heavy metals, or organic materials (USDA Forest Service 1995).

5. Analysis Methods

5.1 Geographic Scope of the Soil Effects Analysis

The scope of the analysis for direct, indirect, and cumulative effects for all proposed activities is limited to the proposed treatment units. Changes to soil productivity do not occur outside of the proposed treatment units. Refer to the "Sugarberry Project Map" on file in the project record for proposed treatment unit locations.

5.2 Time Frame of the Soil Effects Analysis

The current soil conditions observed reflect the cumulative effects of past activities, regardless of when they took place, so there is no definite time frame or limit for the analysis. For example, if multiple activities have occurred in a given treatment unit over the past 50 years, it is not necessarily possible to separate the effects of older treatments from more recent ones. As a result, it is not practical to set a time constraint on those effects. The future timeframe for the soils analysis must extend until the resource has recovered from the impact of the proposed activities. The persistence of soil effects into the future can vary widely. For example, soil cover may recover within one to two years following a treatment. Soil compaction, however, may last for decades.

5.3 Field Data Collection

A representative sample of proposed treatment units were surveyed in fall 2005 and summer of 2006. The sampling strategy took into account the level and similarity of known past management activities, soil map unit occurrence and soil type, slope configuration, and the level of soil disturbance expected from the proposed management activity. Non-surveyed proposed treatment units are expected to have similar existing conditions and project effects as surveyed proposed treatment units (Table 5, "Existing Condition" Section). There are a few non-surveyed proposed treatment units where existing condition is less known, because a comparison cannot be made to surveyed proposed treatment units as a result of different known past management activities or soil types (see section 5.3.2 and 5.3.3 below). The following criteria were utilized to stratify and prioritize units for field survey and to correlate which non-surveyed treatment units have existing conditions similar to surveyed units.

5.3.1 Level of Ground Disturbance Created by the Sugarberry Project

Surveys were conducted on high priority proposed treatment units. High priority proposed treatment units included thinning, group selection, and ITS treatments areas with ground-based mechanical equipment operations. These types of treatments have the potential to

adversely affect long term soil productivity. For group selection treatment areas, the silvicultralist determined the maximum area available for group selection treatments. Within this larger area multiple 1-2 acres plots could be treated for group selections. The maximum area available for group selection was analyzed for the maximum area that could potentially have disturbance to soil indicators, meaning expected effects assume a maximum area disturbed. The treatment units proposed for skyline or helicopter (including group selection treatments and aspen restoration) were not surveyed. Skyline and helicopter were selected for this method of treatment due to the steep slopes. Skyline and helicopter treatments do not employ mechanical ground-based equipment; because of this, soil cover would not be removed, and there would not be additional detrimental soil compaction. Therefore, they were not included in the calculations for the cumulative effects analysis.

Hand cut and pile burn and underburning was a selected treatment method in area of steep slopes, treatment units that are mostly composed of Riparian Habitat Conservation Areas (RHCAs are stream buffers used to protect streams during land management activities), and areas of black oak restoration. Typically these areas do not have known past management activities in the last twenty-five years and there is thick duff and litter layer (soil cover) and high fuel loading conditions. Under the existing condition proposed underburning treatments exceed the Forest Plan standards and guides for effective soil cover (see the “Existing Condition” Section). Observations of past projects (BMP monitoring of the Brush Creek DFPZ) that used prescribed burning on areas with similar fuel types and fuel loading conditions have not resulted in a loss of soil cover below Forest Plan standards and guidelines. This was due to an existing condition having a thick duff and litter layer that does not burn all the way to the topsoil and needle cast following the burn. Due to the similar fuel types and fuel loading conditions between the Brush Creek and Sugarberry projects it is expected that the post-project conditions in Sugarberry Project would exceed “Forest Plan” standards and guides for soil cover. Therefore, they were not included in the calculations for the cumulative effects analysis, but discussion of possible cumulative effects to soil productivity is included in this report (see Section 7 “Environmental Effects”).

Areas of road reconstruction or new road construction were not analyzed for effects to soil indicators. Forest Service system roads are designated by the Forest Plan as areas unsuitable for timber growth and are not include as part of a timber stand. Proposed road decommissioning and restoration activities were considered a long-term improvement to soil productivity and are discussed in this report (see Section 7 “Environmental Effects”).

5.3.2 Known Past Land Management Activities

Surveys were conducted in proposed treatment units with known and unknown past land management activities (Table5). An emphasis was placed on proposed treatment areas with known past land management activities that had the potential to cause detrimental soil compaction or soil erosion and displacement (areas with the use of ground based mechanical equipment). Known past land management activity information was based on information gathered for the hydrology cumulative off-site watershed effects assessment (for more information see the "Sugarberry Hydrology Report" on file in the project record). Information for the proposed treatment units was gathered for the past 25 years, but the existing condition of the soils could be a result of activities dating back further in time.

Surveyed proposed treatment units were compared to non-surveyed proposed treatment units with similar past land management activities, occurring during the same year, within similar soil map units (even though soil moisture conditions are unknown at the time of activity). Ten of the non-surveyed proposed treatment units have an existing condition that is less known because one of these factors could not be correlated. Table 1 includes the expected cumulative effects of these proposed treatment units.

Table 1: Proposed treatment units with an existing condition that is less known due to past land management activities differing from past land management activities surveyed.

Proposed Treatment Unit Number	Proposed Treatment Alternative B	Proposed Treatment Alterative C
11P	Hand cut and Pile Burn – No cumulative effects.	Same as alternative B
12P1	Hand cut and Pile Burn – No cumulative effects.	Same as alternative B
608	Group selection skyline – No cumulative effects.	Same as alternative B
649	Group selection helicopter – No cumulative effects.	Same as alterative B
900	Group selection helicopter – No cumulative effects.	Same as alterative B
903	Hand cut and Pile Burn – No cumulative effects.	Same as alterative B
910	Group selection helicopter – No cumulative effects.	Same as alterative B
911	Mastication – increases soil cover and organic matter, and does not cumulatively effects soil compaction (see "Environmental Effects" Section 7).	Same as alterative B
912	Underburn and group selection tractor and cable. Tractor methods will mostly likely decrease soil cover and organic matter and increase soil compaction. However it is expected that soil cover would exceed standards and guides and that increases in soil compaction would not effect biomass production in this unit (see "Environmental Effects" Section 7).	Same as alterative B
913	Underburn – No cumulative effects.	Same as alterative B

Surveyed proposed treatment units that did not have recorded past land management activities typically contain legacy skid trails, landings, or temporary roads. This suggests there are

past land management activities greater than 25 years within the soils effects analysis area. It is likely that past land management practices occurred within all proposed treatment units.

5.3.3 Known Soils Types

Surveys were conducted within the majority of the known soil map units and soil types contained within the proposed treatment units. Based on a Geographic Information System (GIS) analysis, there are forty-five soil map units identified within the soil effects analysis area (see the "Existing Condition" Section). An emphasis was placed on soil types that are more susceptible to detrimental compaction and surface erosion due to loss of soil cover from past and future land management activities. This information was based on soil map units identified in the Plumas National Forest Soil Resource Inventory (USDA Forest Service 1989), which is an Order 3 soil survey. These general soil map units do not delineate the exact location of each soil type. The map units usually consist of a group of soils that occupy particular portions of the landscape. A soil map unit is an association or complex of soil components and does not necessarily consist of similar soils. They consist of geographically associated soils that may be, and usually are, different in their characteristics and their suitability for use and management. Soil textures were determined in proposed treatment units surveyed to aid in soil type detection and interpreting expected effects.

Two proposed treatment units not surveyed contain soil map units that do not correlate with proposed treatment units surveyed. In these treatment units the existing condition is less known; however, proposed treatments are expected to have no cumulative effects (Table 2).

Table 2: Proposed treatment units with an existing condition less known due to soil map units differing from soil map units surveyed.

Proposed Treatment Unit Number	Proposed Treatment Alternative B	Proposed Treatment Alterative C
510	Group selection helicopter – No cumulative effects.	Same as alterative B
647	Group selection helicopter – No cumulative effects.	Same as alterative B

5.3.4 Geographic and Topographic Location

Proposed treatments that had the same past land management activity, occurring during the same year, with the same or similar soil map unit, and similar topographic location are expected to have similar existing conditions and project effects. Even though soil moisture conditions are unknown at the time of the past treatments, the same treatment prescription was applied in the same year on the proposed treatments units that were determined to have similar past management activity effects on a particular soil map unit.

Proposed treatment units that were surveyed with the similarities mentioned above do have similar existing conditions (see the "Existing Condition" Section). The proposed treatments units that were not surveyed were adjacent to surveyed proposed treatment units on similar topography. The non-surveyed units were briefly examined in the field and appeared to have similar characteristics to the surveyed units.

5.3.5 Field Surveys

Data collection included point sampling in proposed treatment units along systematic randomized transects, which were designed to sample the geographic and topographic extent and variation of those proposed treatment units. Transect randomly located using a topographic map and modified in the field to ensure collection of the necessary information. Transect length, number of sample points, distance between sample points and number of transects required for adequate sample size were determined using the topographic map scale. The data was collected systematically along each transect. The number of sample points along each transect varied between 20 to 40 sample points, depending on the unit size and variation in soil type and topography. Information on slope, soil texture, detrimental soil compaction, soil cover, soil disturbance, and large woody debris was recorded at each sample point. The following is how information was collected at each sample point.

Effective soil cover was determined by recording the following information.

1. Duff and Litter - Divided into thickness categories: (1) 0.5-1.0 inches, (2) 1-2 inches greater than 2 inches, and (3) Mix of soil and organic matter greater than 2 inches thick and less than 50 percent duff
2. Woody Debris – Divided into size categories: (1) 0.25-3 inches diameter, (2) 3-16 inches diameter, and (3) greater than 16 inches diameter.
3. Live Vegetation
4. Rock – If greater than 0.75 inches in diameter
5. Bare Soil – Described by disturbance history: Disturbed, Undisturbed, Burned, Eroded, and Deposition.

Detrimental soil compaction was determined at every sample point by inserting a spade or shovel into the soil and determined at a depth of 4 to 8 inches. If the spade was inserted without difficulty the soil was considered to be non-compacted. If the soil was resistant to insertion of spade or shovel, a shovel-full of soil was removed and soil structure examined for indications of compaction (platy or massive soil structure). Soil core samples were collected at some locations that were considered detrimentally compacted and non-compacted. Soil bulk density was determined for each soil core sample taken, and comparison of compacted and non-

compacted locations was made to verify the accuracy of the spade method determinations and "calibrate" the surveyor.

Large woody debris (LWD) was surveyed by log class at every fifth point, and conducted in a 37-foot radius, with group selection treatment units. For DFPZ treatment units LWD data is from the stand exam surveys, which follows a standard key plot. Logs had to be at least 10-feet long and 12-inches in diameter. Log classes are as follows: Class 1-Fresh, Class 2-Hard Logs, Class 3-Soft Logs, Class 4-Intact, and Class 5-Buried Cubical Wood. The following definitions apply (USDA Forest Service, 1995):

Class 1- Fresh, hard logs or green trees with little soil contact; bark and many branches intact; low moisture content; biological activity limited to penetration of outer bark by boring insects.

Class 2 – Hard logs in partial contact with the soil; few branches, but most bark intact; low to moderate moisture content; outer bark fully penetrated by boring insects; high level of biological activity in inner bark.

Class 3 – Intact, soft logs in full contact with the soil; no branches or bark; high moisture content; very high biological activity in fully penetrated sapwood; some biological activity.

Class 4 – Intact to fractured cubical heartwood and bark; log mostly buried in the soil; very high moisture content; extremely high biological activity, mostly microorganisms and sub-microscopic invertebrates; fully penetrated by mycorrhizal fungi and roots.

Class 5 – Totally buried, fractured cubical heartwood; barely perceptible as a low mound on the forest floor; often biological activity, mostly mycorrhizal fungi and sub-microscopic invertebrates; high concentration of roots.

5.3.6 Erosion Hazard Rating (EHR)

EHR is a risk assessment of specific soil factors that induce accelerated erosion (USDA Forest Service 1990) and was determined for each proposed treatment unit surveyed. The purpose of the EHR is to: (1) evaluate the likelihood of accelerated sheet and rill erosion from a specific soil disturbing activity, (2) evaluate the risk for adverse consequences, and (3) identify approximate soil cover amounts needed to achieve an acceptable risk. EHR was computed using the California Soil Survey Committee (CSSC) Erosion Hazard Rating Computation Form (CSSC 1989). The form is based on the following 4 components.

Component 1: Soil Erodibility Factors - The factors in this component are texture and aggregate stability adjustments. Soil texture was determined by site visit, taking several samples per site based on variability of the site. Aggregate stability adjustments are unique conditions in

the soil, such as presence of excesses sodium and iron. Aggregate stability adjustments are not needed in the Sugarberry Project analysis area.

Component 2: Runoff Production Factors - The factors in this component are climate, water movement in soil, permeability of the subsoil, runoff from adjacent and intermingled areas, and uniform slope length (a combination of slope length and surface variation). Site climate was determined by using the 2-year, 6-hour precipitation value maps included in the Precipitation-Frequency Atlas of the Western United States, Vol. XI-California (State of California 1973). All other information was collected in the field or obtained using the PNF Soil Resource.

Component 3: Runoff Energy Factor - Slope gradient is used to represent the relative sediment transport capacity of surface runoff. Slope gradient was measured in the field.

Component 4: Soil Cover Factors - The factors in this component include quantity and quality of and distribution of soil cover. Information was collected in the field or obtained using the PNF Soil Resource Inventory.

EHR Risk Ratings are based on the following (Table 3):

Table 3: EHR Risk Rating

Numerical Value	Risk Rating
<4	Low
4 – 12	Moderate
13 –29	High
> 30	Very High

5.3.7 Sporax Risk Assessment

To prevent the spread of Heterobasidion annosum (annosus) root disease, the use of sodium tetraborate decahydrate (a fungicide treatment) is proposed under the Sugarberry Project. Sodium tetraborate decahydrate, also know as borax, is the active ingredient and sole constituent in Sporax. Sporax is not applied as a liquid using backpack, broadcast or aerial spray methods and it is not applied directly to vegetation (USDA Forest Service 2006). Sporax is applied to freshly-cut stump surfaces and is typically applied at a rate of one pound per 50 square feet of stump surface. This is equivalent to one pound of borax on 60 twelve-inch stumps (Sporax label, Wilbur-Ellis Company).

It is presently unknown if the fungicide Sporax® has recently been applied on private land within the Sugarberry soil effects analysis area. No recent use of the product has occurred on National Forest System lands in the area. Boron is the agent of toxicological concern from Sporax and occurs naturally in soil (USDA Forest Service 2006). The use of Sporax in the control of annosum root disease does not present a significant environmental risk under most conditions of normal use, even under the highest application rate. Given the highly focused application method

for Sporax, application of granular product to cut tree stump surfaces, exposures considered for environmental risk assessments are limited to those which are expected to result in significant exposure due to spill or by runoff. According to the SERA risk assessment (USDA Forest Service 2006) the effects of Sporax to soil microorganisms essential for formation of soil organic matter have not been characterized, and there is a risk of environmental exposures effecting nontarget microorganism. However, given the atypical application method for Sporax, widespread exposures are not likely, and the risk of effects to soil indicators is minimal.

Based on the low risk from the application of this product, as described above, it is assumed that, even if the product has been used on adjacent private lands, there is a negligible likelihood of effects from Sporax or related degradates to all soil indicators as a result of the proposed Sugarberry Project. Therefore cumulative effects of sporax to soil indicators were not included in the Environmental Effects Section (Section 7).

6. Existing Condition

6.1 Soil Types and Soil Map Units

The Plumas National Forest Soil Survey was utilized to determine which soil map units occur in the soil effects analysis area. A Geographic Information System (GIS) analysis summary was performed with the soil effects analysis area to calculate acres and percent of each soil map unit (Table 4).

The Holland family (soil map unit numbers 198, 199, and 200), basic is within twelve percent of the soil effects analysis. This soil type is one of the most productive soils and one of the most unstable soils on the Plumas National Forest. The Holland family soils are prone to mass instability on steep slopes and are highly susceptible to detrimental compaction when the soil moisture content is near field capacity. Other soil map units within the soil effects analysis area that contain Holland family soils include: soil map unit 130, Clallam Holland families complex (less than one percent); soil map unit 169, Forebes Holland families complex (four percent); and soil map units 208, 209, and 210, Holland Clallam families complex (ten percent).

The Hurlbut family (soil map units 211 and 212) is located within twelve percent of the project area. For this soil group, soil cover maintenance is essential due to the erosive nature of these soils.

Twelve percent of the analysis area is composed of the Waca Woodseye families complex (soil map units 293, 294, 295, and 296). This soil map unit is prone to erosion in areas without effective soil cover and commonly has mass instability on slopes greater than 50 percent and.

Six percent of the analysis area is composed of the Smokey family (soil map units 265 and 266). In this soil family mass instability occurs in roaded areas and on slopes greater than 50 percent. Other soil map units within the soil effects analysis area that contain the Smokey family soils include: the Uvi Smokey families complex, soil map units 286 (eight percent) and 287 (five percent). Soils in the Uvi Smokey families complex are prone to surface erosion in areas without effective soil cover.

Another six percent of the analysis area contains the Gibsonville Waca families complex (soil map units 179, 180, and 181). This soil family is highly susceptible to erosion in areas without effective soil cover.

Four percent of the analysis area is composed of the Aiken family (soil map units 101 and 102) and this soil type is highly susceptible to detrimental compaction when the soil moisture content is near field capacity.

Other minor occurrences (less than one percent) within the soil effects analysis area include the Deadwood family, Dubakella family, Josephine family, Kistrin family, Mariposa family, Toiyabe family, and Portola family. All of these soil types are prone to surface soil erosion when there is lack of effective ground cover.

Table 4: Soil map units located within the soil effects analysis area.

Soil Map Unit Number	Acres	Percent of Soil Effects Analysis Area	Soil Map Unit Name	Management Concerns
101	267	2	Aiken Family	Susceptible to compaction when the soil moisture content is near field capacity.
102	209	2	Aiken Family	Susceptible to compaction when the soil moisture content is near field capacity.
126	15	less than 1	Clallam Family	Somewhat unstable in relation to road construction. Perched water tables can be observed.
127	11	less than 1	Clallam Family	Somewhat unstable in relation to road construction. Perched water tables can be observed.
128	147	1	Clallam Family, Micaceous	Known for there "greasy" road surface during wet weather. Dust production is especially high on roads in this map unit.
130	27	less than 1	Clallam Family (60 percent) Holland Family (25 percent)	Some mass instability does exist, especially on slopes of over 50%
134	71	1	Deadwood Family (55 percent)	Mass wasting can be a problem.

Soil Map Unit Number	Acres	Percent of Soil Effects Analysis Area	Soil Map Unit Name	Management Concerns
			Clallam Family (30 percent)	
135	324	3	Deadwood Family (55 percent) Clallam, Micaceous Family (30 percent)	Mass instability is a problem in many areas; even on slopes of less than 35%.
136	97	1	Deadwood Family (55 percent) Clallam Family, Micaceous (30 percent)	Mass instability is a problem in many areas; even on slopes of less than 35%.
137	2	less than 1	Deadwood Family (35 percent) Clallam Family (30 percent) Rock Outcrop (20 percent)	Surface raveling of surface stones, cobbles, and boulders is common. This process can be accelerated by clear cutting.
138	62	1	Deadwood Family (55 percent) Josephine Family (30 percent)	Mass instability is not widespread except on slopes exceeding 50%. Josephine soils are susceptible to compaction when the soil moisture content is near field capacity.
140	56	less than 1	Deadwood Family (55 percent) Kistrin Family (30 percent)	Mass instability is apparent on slopes greater than 50%.
142	6	less than 1	Deadwood Family (65 percent) Kistrin Family (20 percent)	Mass instability is apparent on slopes greater than 50%. Significant raveling of gravels, cobbles, and stones exist in this unit. Abundant scald areas, virtually devoid of vegetation.
144	6	less than 1	Dubakella Family	Instability is common place and vegetative growth potential is limited. Susceptible to compaction when the soil moisture content is near field capacity.
145	131	1	Dubakella Family	Instability is common place and vegetative growth potential is limited. Susceptible to compaction during wet periods.
149	2	less than 1	Mine Dumps	Areas disturbed by hydraulic mining and mine spoil disposal sites. Some sites are being utilized as aggregate sources as well.
151	223	2	Dystric Lithic Xerochrepts (60 percent)	Highly susceptible to erosion and mass wasting. Soil cover maintenance is critical in order to

Soil Map Unit Number	Acres	Percent of Soil Effects Analysis Area	Soil Map Unit Name	Management Concerns
			Smokey Family (25 percent)	maintain what little soil productivity there is. Recommend 50-60% minimum soil cover.
169	499	4	Forbes Family (60 percent) Holland, basic family (25 percent)	Highly productive soils and susceptible to compaction when the soil moisture content is near field capacity.
177	1	less than 1	Gibsonville Family (55 percent) and Rock Outcrop (30 percent)	These soils are highly erosive and prone to considerable mass instability. On slopes above 50%, mass instability is common place. Recommendations include soil cover retention and low road density.
179	175	1	Gibsonville Family (60 percent) Waca Family (25 percent)	Highly erosive and prone to mass wasting. Recommendations include soil cover retention and low road density.
180	490	4	Gibsonville Family (45 percent) Waca Family (40 percent)	Highly erosive and prone to mass wasting. Recommendations include soil cover retention and low road density.
181	178	1	Gibsonville Family (60 percent) Waca Family (25 percent)	Highly erosive and prone to mass wasting. Recommendations include soil cover retention and low road density.
198	5	less than 1	Holland Family	One of the most productive timber producing soils and also one of the most unstable. Mass instability is common and sheet and gully erosion is severe on steeper slopes. Susceptible to compaction during wet periods. Recommendations include leaving 40-60% soil cover.
199	1267	11	Holland Family, Basic	Prone to mass instability and compaction when the soil moisture content is near field capacity.
200	167	1	Holland Family Basic	Prone to mass instability and compaction when the soil moisture content is near field capacity.
208	752	6	Holland, Basic Family (60 percent) Clallam Family (25 percent)	Some mass wasting does occur and could pose significant problems for road construction is some areas. Regeneration potential begins to decline rapidly on slopes over 50%
209	339	3	Holland, Basic Family (60 percent)	Some mass wasting does occur and could pose significant problems for road construction is some areas.

Soil Map Unit Number	Acres	Percent of Soil Effects Analysis Area	Soil Map Unit Name	Management Concerns
			Clallam Family (25 percent)	Regeneration potential begins to decline rapidly on slopes over 50%
210	67	1	Holland, Basic Family (50 percent) Clallam Family (25 percent)	Some mass wasting does occur and could pose significant problems for road construction is some areas. Regeneration potential begins to decline rapidly on slopes over 50%
211	1274	11	Hurlbut Family	Soil cover maintenance is essential due to erosive nature of these soils.
212	104	1	Hurlbut Family	Soil cover maintenance is essential due to erosive nature of these soils.
219	107	1	Josephine Family (60 percent) Mariposa Family (25 percent	Moderately susceptible to compaction and rutting when the soil moisture content is near field capacity.

Soil Map Unit Number	Acres	Percent of Soil Effects Analysis Area	Soil Map Unit Name	Management Concerns
223	160	1	Kistrin Family (40 percent) Aiken Family (25 percent) Deadwood Family (20 percent)	Susceptible to compaction when the soil moisture content is near field capacity.
231	262	2	Pits and Quarries	Open excavations from which soil and common variety minerals have been removed, exposing either rock or other material. Pits that were opened for mining operations, gravel extraction or slash disposal are also included in this category, although quarry material is extracted for road base and surface rock is the dominant component.
243	395	3	Rock Outcrop-Rubble Land	These are areas that are dominated by exposed bedrock or soils so shallow that stones, cobbles, and gravels make up greater than 90 percent of the surface area
265	444	4	Smokey Family	Some mass instability is evident, primarily along roaded areas and slopes greater than 50%.
266	199	2	Smokey Family	Some mass instability is evident, primarily along roaded areas and slopes greater than 50%.

Soil Map Unit Number	Acres	Percent of Soil Effects Analysis Area	Soil Map Unit Name	Management Concerns
277	141	1	Toiyabe Family	Very unproductive and highly erosive. Many areas have been adversely affected by repeated wildland fires and have undergone massive surface soil loss. Soil cover retention is essential.
284	6	less than 1	Urban Land	Areas of domestic development such as towns, housing tracts. Trailer parks or landscaped areas developed for potential residential use.
286	1008	8	Uvi Family (50 percent)	Some areas of mass wasting can be seen, especially where road construction is involved. Most soils in the map unit are fairly erosive; therefore, soil cover retention is essential.
			Smokey Family (35 percent)	

6.2 Existing Condition of Indicator 1: Soil Productivity

Table 5 lists each proposed treatment unit, treatment acres, soil map unit number, identifies if the proposed treatment unit was surveyed, number of data collection points, and which units have similar characteristics based on criteria explained in the "Analysis Methods" Section.

Table 5: Correlation between surveyed proposed treatment units and non-surveyed proposed treatment units.

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	Acres						
A	8	180 (2 acres or 25%), 223 (6 acres or 75%)	None	No	13T, 118, 500, 505		
A2	2	223 (2 acres or 100%)	Portion of unit: Precommercial Thinning 2003	No	13T, 118, 500		
A3	2	180 (2 acres or 100%)	Portion of unit: Precommercial Thinning 2003	No	500, 505		
B	33	179 (2 acres or 6%), 180 (18 acres or 55%), 294 (13 acres or 39%)	None	No	13T, 118, 500, 505, 516, 628, 629		
B2	6	180 (2 acres or 33%), 294 (4 acres or 67%)	None	No	13T, 118, 500, 505, 516, 628, 629		
D	16	293 (16 acres or 100%)	None	No	533, 573, 591		
E	17	180 (8 acres or 47%), 294 (9 acres 53%)	None	No	13T, 118, 500, 505, 516, 628, 629		
F	13	179 (3 acres or 23%), 181 (10 acres or 77%)	None	No	13T, 118, 500, 505, 516, 628, 629		
LP1	6	284 (2 acres or 33%), 286 (4 acres or 67%)	None	No	14A, 20, 21, 23, 905A, 907A, 907B		
LP2	38	231 (23 acres or 61%), 284 (1 acre or 3%), 286 (14 acres or 36%)	None	No	14A, 20, 21, 23, 905A, 907A, 907B		
SBA1	2	140 (2 acres or 100%)	None	No	None		
SBA2	0.4	293 (0.4 acres or 100%)	None	No	7, 533, 573, 591		
SBA3	1	293 (1 acre or 100%)	None	No	7, 533, 573, 591		
SBA4	17	293 (17 acres or 100%)	None	No	7, 533, 573, 591		
SBA5	0.7	293 (0.7 acres or 100%)	None	No	7, 533, 573, 591		

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	**Acres**						
2	49	179 (19 acres or 39%), 293 (7 acres or 14%), 294 (23 acres or 47%)	Thinning 2004	Yes		901A, 901B	25
3	198	231 (3 acres or 2%), 284 (3 acres or 2%), 286 (142 acres or 71%), 294 (50 acres or 25%)	None	No	14A, 20, 23		
7	47	231 (33 acres or 70%), 293 (14 acres or 30%)	Past land management activities greater than 25 years.	Yes	533	SBA2, SBA3, SBA4, SBA5	25
11G	204	198 (4 acres or 2%), 199 (143 acres or 76%), 211 (40 acres or 22%)	Portion of Unit: Clearcut 1994	Yes	(originally two separate units, survey reflects original unit divisions)		25
		211 (17 acres or 100%)	None	Yes			25
11K	81	199 (81 acres or 100%)	Mastication 2004	Yes		12P3	25
11P	7	211 (7 acres or 100%)	Clearcut 1993 and 1994, Hand Cut Pile Burn 2004, Mastication 2004	No	None		
12G1	188	169 (1 acre or less than 1%), 199 (1 acre or less than 1%), 211 (163 acres or 87%), 219 (23 acres or 13%)	None	Yes	46, 128, 134	57, 58, 59, 62, 68, 140, 150a	25
12G2	41	211 (4 acres or 10%), 219 (37 acres or 90%)	Past land management activities greater than 25 years.	Yes			25
12P1	6	219 (6 acres or 100%)	Clearcut 1994	No	None		
12P2	2	211 (2 acres or 100%)	Clearcut 1993	Yes		11P	25
12P3	13	169 (13 acres or 100%)	Hand Cut Pile Burn 2004, Mastication 2004	No	11K		

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	**Acres**						
13P1	6	101 (6 acres or 100%)	Mastication 2004	No	No Proposed Treatments		
13P2	4	101 (4 acres or 100%)	Mastication 2004	No	No Proposed Treatments		
13T	87	101 (87 acres or 100%)	None	Yes		A, A2, B, B2, E, F, 15T, 15TA, 141	25
14A	268	286 (268 acres or 100%)	Past land management activities greater than 25 years.	Yes	20, 21, 23, 905A, 907A, 905B	LP1, LP2, 3, 14B, 15, 530, 904, 905A	25
14B	43	286 (43 acres or 100%)		No	14A, 20, 21, 23, 905A, 907A, 907B		
14O	136	169 (128 acres or 94%), 209 (7 acres or 5%), 212 (1 acre or 1%)	Mastication 2004	No	150B		
15	85	200 (2 acres or 2%), 266 (25 acres or 29%), 286 (58 acres or 69%)	None	No	14A, 20, 21, 23, 905A, 907A, 907B		
15OS	28	101 (6 acres or 21%) and 210 (22 acres 79%)	None	No	No Proposed Treatments		
15P1	5	101 (5 acres or 100%)	Clearcut 1986	Yes	15P2		25
15P2	3	101 (3 acres or 100%)	Clearcut 1986	Yes	15P1		25
15T	40	101 (40 acres or 100%)	None	No	13T, 147		
15TA	54	101 (54 acres or 100%)	None	No	13T, 147		
15TS	43	101 (10 acres or 23%), 209 (4 acres or 9%), 210 (29 acres 68%)	None	No	No Proposed Treatments		
18	16	208 (16 acres or 100%)	None	No	128		
19	41	286 (15 acres or 37%) 287 (26 acres or 63%)	None	No	21, 23, 33, 907a		

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	**Acres**						
20	14	286 (14 acres or 100%)	Past land management activities greater than 25 years.	Yes	14A, 21, 23, 905A, 907A, 907B	LP1, LP2, 3, 14B, 15, 530, 904, 905A	22
21	123	102 (26 acres or 21%), 286 (71 acres or 57%), 287 (27 acres or 22%)	Past land management activities greater than 25 years.	Yes	14A, 20, 23, 905A, 907A, 907B	LP1, LP2, 14B, 15, 32, 526, 905B	25
23	11	286 (11 acres or 100%)	Past land management activities greater than 25 years.	Yes	14A, 20, 21, 33, 907A	LP1, LP2, 14B, 15, 19, 526, 530, 601	24
27	173	128 (11 acres or 6%), 151 (75 acres or 43%), 208 (19 acres or 11%), 231 (14 acres or 8%), 243 (18 acres or 10%), 287 (36 acres or 21%)	Past land management activities greater than 25 years.	Yes (27 and 29 surveyed together)		28, 30, 35, 53, 79i, 539, 544, 550, 601, 610, 612, 613, 614, 615, 619, 634, 636, 637	25
29	325	135 (56 acres or 17%), 151 (6 acres or 2%), 200 (51 acres or 16%), 208 (146 acres or 45%), 243 (29 acres or 9%), 287 (37 acres or 11%)					
28	7	231 (7 acres or 100%)	None	No	27, 29		
30	17	135 (8 acres or 47%), 208 (9 acres or 53%)	None	No	27, 29		
32	13	102 (8 acres or 62%), 287 (5 acres or 38%)	None	No	21, 33		
33	308	102 (46 acres or 15%), 199 (11 acres or 3%), 208 (5 acres or 2%), 287 (246 acres or 80%)	Portion of Unit: Pile Burning 1985 and Precommercial Thinning 1988	Yes	21	32, 905B	25

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	**Acres**						
35	52	200 (48 acres or 92%), 212 (4 acres 8%)	None	No	27, 29		
37	73	135 (4 acres or 5%) 199 (61 acres or 84%), 200 (2 acres or 3%), 287 (6 acres or 8%)	Portion of Unit: Pile Burning 1985 and Precommercial Thinning 1988	No	33		
41	12	212 (12 acres or 100%)	None	No	44, 45, 46		
42	27	127 (9 acres or 33%), 211 (18 acres or 66%)	None	No	44, 45, 46		
43	59	127 (1 acre or 2%), 211 (58 acres or 98%)	Portion of Unit: Sanitation Salvage in 2007.	Yes			24
44	8	211 (8 acres or 100%)	Past land management activities greater than 25 years.	Yes (44, 45, 46 surveyed together)	12G1, 128	41, 42, 57, 58, 59, 61, 62, 68, 107, 130	25
45	12	211 (12 acres or 100%)					
46	414	126 (3 acres or 1%), 128 (57 acres or 14%), 208 (50 acres or 12%), 209 (8 acres or 2%), 211 (296 acres or 71%)					
53	72	135 (20 acres or 28%), 200 (10 acres or 14%), 209 (7 acres or 9%), 287 (35 acres or 49%)	None	No	27, 29		
55	19	291 (19 acres or 100%)	None	No	573, 591, 628, 629		
57	81	128 (10 acres or 12%), 149 (1 acre or 1%), 208 (1 acre or 1%), 209 (60 acres or 74%), 211 (9 acres or 11%)	None	No	12G1, 46, 128		

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	Acres						
58	24	149 (1 acre or 4%), 209 (23 acres or 96%)	None	No	12G1, 46, 128		
59	32	136 (11 acres or 34%), 209 (21 acres or 66%)	None	No	12G1, 46, 128		
61	44	209 (30 acres or 68%), 211 (14 acres or 32%)	None	No	44, 45, 46, 72		
62	66	136 (3 acres or 5%), 211 (63 acres or 95%)	None	No	12G1, 46, 128		
65	45	212 (45 acres or 100%)	None	No	72, 147		
68	23	209 (20 acres or 87%), 211 (3 acres or 13%)	None	No	12G1, 46, 128		
70	153	135 (27 acres or 18%), 136(48 acres or 32%), 209 (50 acres or 33%), 211 (28 acres or 18%)	None	No	72, 79iii		
72	23	211 (23 acres or 100%)	Past land management activities greater than 25 years.	Yes	147	61, 65, 70, 97, 98, 107, 626	25
79i	143	136 (8 acres or 5%), 169 (2 acres or 1%), 199 (14 acres or 10%), 208 (101 acres or 71%), 291 (18 acres or 13%)	None	No	27, 29		
79iii	188	136 (27 acres or 14%), 199 (161 acres or 86%)	Past land management activities greater than 25 years.	Yes	90	72, 92, 612, 619, 638	25
87	17	126 (10 acres or 59%), 199 (7 acres or 41%)	Past land management activities greater than 25 years.	Yes		638	25

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	**Acres**						
90	23	199 (23 acres or 100%)	Past land management activities greater than 25 years.	Yes	79iii	92	25
92	28	199 (27 acres or 96%) 211 (1 acre or 4%)	None	No	79iii, 90		
97	12	211 (12 acres or 100%)	None	No	72, 134		
98	29	199 (3 acres or 2%), 200 (15 acres or 52%), 211 (11 acres or 43%)	None	No	72, 134		
100	33	199 (11 acres or 33%). 211 (22 acres or 67%)	Past land management activities greater than 25 years.	Yes	102, 103, 118, 119, 127	117	25
102	49	199 (49 acres or 100%)	Past land management activities greater than 25 years.	Yes	100, 103, 118, 119, 127	117	25
103	38	126 (2 acres or 5%), 199 (36 acres or 95%)	Past land management activities greater than 25 years.	Yes	100, 102, 118, 119, 127	117	25
107	20	212 (5 acres or 26%), 266 (14 acres or 84%)	None	No	44, 45, 46, 72, 556, 558		
108	8	169 (1 acre or 12.5%) 199 (1 acre or 12.5%), 212 (2 acres or 25%), 266 (4 acres or 50%)	None	No	109, 111		
109	15	169 (10 acres or 67%) 199 (5 acres or 33%)	Past land management activities greater than 25 years.	Yes	111	108, 111	25
110	7	199 (5 acres or 71%) 212 (2 acres or 29%)	None	No	109, 111		

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	**Acres**						
111	167	169 (1 acre or 0.5%) 199 (153 acre or 92%), 208 (1 acre or 0.5%), 212 (12 acres or 7%)	Past land management activities greater than 25 years.	Yes	109, 123	108, 111, 113, 120, 154	25
113	10	169 (2 acres or 20%) 199 (8 acres or 80%)	None	No	111, 123		
117	120	102 (23 acres 19%) 199 (98 acre 81%)	None	No	118, 119, 127		
118	8	102 (8 acres or 100%)	Past land management activities greater than 25 years.	Yes	100, 102, 103, 119, 127	A, A2, B, B2, E, F, 117	25
119	47	102 (46 acres or 100%)	Past land management activities greater than 25 years.	Yes (119 and 127 surveyed together)	100, 102, 103, 118	117, 624, 626, 627	24
127	55	102 (29 acres or 53%), 211 (26 acres or 47%)					
120	28	102 (10 acres or 36%), 199 (18 acres or 64%)	None	No	111, 123		
123	6	199 (6 acres or 100%)	Hydraulic mining and past land management activities greater than 25 years.	Yes	111	113, 120, 154	25
128	46	199 (3 acres or 7%), 208 (13 acres or 28%), 211 (30 acres or 65%)	Past land management activities greater than 25 years.	Yes	12G1, 46, 134	18, 57, 58, 59, 62, 68, 130, 140, 150a, 154, 544, 550	25
130	32	102 (2 acres 6%), 208 (30 acres 94%)	None	No	44,45, 46, 128, 147		
134	21	199 (3 acres or 14%), 211 (18 acres or 86%)	Past land management activities greater than 25 years.	Yes	12G1, 128	97, 98, 140, 150a	25

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	**Acres**						
140	29	130 (7 acres or 24%), 199 (3 acres or 10%), 200 (1 acre or 3%), 211 (18 acres or 62%)	None	No	128, 134		
141	201	101 (52 acres or 26%), 102 (11acres or 5%), 130 (20 acres or 10%), 199 (38 acres or 20%), 208 (53 acres or 26%), 243 (27 acres or 13%)	None	No	13T, 147		
147	11	211 (11 acres or 100%)	Past land management activities greater than 25 years.	Yes	13T, 72	15T, 15TA, 65, 130, 141, 626	25
150A	62	199 (2 acres or 3%), 211 (60 acres 97%)	None	No	12G1, 128, 134		
150B	263	142 (3 acres or 1%), 169 (196 acres or 75%), 209 (3 acres or 1%), 211 (39 acres or 15%), 243 (22 acres or 8%)	None	Yes		14O, 161	25
154	133	142 (3 acres or 2%), 199 (78 acres or 59%), 208 (28 acres or 21%), 219 (24 acres or 18%)	None	No	111, 123		
161	79	169 (40 acres or 51%), 209 (35 acres or 44%), 243 (4 acres or 5%)	None	No	150B		

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	Acres						
500	325	134 (7 acres or 2%), 180 (82 acres or 25%), 181 (35 acres or 11%), 243 (10 acres or 3%), 277 (141 acres or 43%), 293 (2 acres or 1%), 296 (48 acres or 15%)	Portion of Unit: Single-Tree Selection Cut 1992	Yes		A, A2, A3, B, B2, E, F	25
504	19	243 (4 acres or 21%) 265 (15 acres or 79%)	None	No	556, 558		
505	63	180 (29 acres or 46%), 296 (34 acres 54%)	Past land management activities greater than 25 years.	Yes		A, A3, B, B2, E, F, 615	25
506	24	265 (24 acres or 100%)	None	No	556, 558		
507	33	151 (4 acres or 12%), 243 (2 acres or 6%), 265 (27 acres or 82%)	None	No	556, 558		
508	15	243 (5 acres or 33%), 265 (10 acres or 67%)	None	No	556, 558		
510	25	134 (23 acres or 92%), 243 (2 acres 8%)	None	No	None		
513	32	134 (8 acres or 25%), 243 (1 acre or 3%), 265 (23 acres or 72%)	None	No	556, 558		
516	10	294 (10 acres or 100%)	Portion of Unit: Precommercial Thinning 1992	Yes		B, B2, E, F	25
519	9	151 (7 acres or 78%), 265 (2 acres or 23%)	None	No	533, 556, 558		
523	18	243 (3 acres or 17%), 265 (15 acres or 83%)	None	No	556, 558		

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	**Acres**						
524	9	243 (3 acres or 33%), 265 (6 acres or 67%)	None	No	556, 558		
526	146	140 (15 acres or 10%), 151 (73 acres or 50%), 243 (26 acres or 18%), 287 (32 acres or 22%)	None	No	21, 23, 27, 29, 533, 556, 558		
530	36	231 (14 acres or 39%), 243 (3 acres or 8%), 287 (19 acres or 53%)	None	No	14A, 20, 23, 905A, 907a, 907b		
533	352	140 (1 acre or >1%), 151 (25 acres or 7%), 231 (34 acres or 10%), 265 (32 acres or 9%) 293 (196 acres or 56%), 294 (64 acres or 18%)	Past land management activities greater than 25 years.	Yes	7, 556	D, SBA2, SBA3, SBA4, SBA5, 519, 526, 535, 543, 552, 566, 590, 599, 601	60
535	84	144 (6 acres or 7%), 151 (22 acres or 26%) 231 (25 acres or 30%), 243 (31 acres or 37%)	None	No	533, 556		
539	10	151 (4 acres or 40%), 208 (4 acres or 40%), 243 (2 acres or 20%)	None	No	27, 29		
540	42	151 (2 acres or 5%), 208 (36 acres or 86%), 243 (4 acres or 9%)	Single Tree Selection Cut 1992	Yes		542	25
542	250	140 (38 acres or 15%), 151 (6 acres or 2%), 208 (93 acres or 37%), 243 (23 acres or 9%), 265 (5 acres or 2%), 293 (85 acres or 34%)	Portion of Unit: Precommercial Thinning 1992	No	540		

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	Acres						
543	143	231 (56 acres or 39%), 243 (87 acres or 61%)	Portion of Unit: Precommercial Thinning 1998 and Seed-Tree Cut 1998	No	533, 556		
544	24	208 (21 acres or 88%), 266 (3 acres or 12%)	None	No	27, 29, 128, 556, 558		
547	8	294 (8 acres or 100%)	None	No	573, 591, 628, 629		
550	12	265 (5 acres or 42%), 266 (7 acres or 58%)	None	No	27, 29, 128, 556, 558		
552	31	231 (12 acres or 39%), 243 (5 acres or 16%), 266 (14 acres or 45%)	Portion of Unit: Precommercial Thinning 1998	No	533, 556		
556	244	231 (23 acres or 9%), 265 (187 acres or 77%), 294 (34 acres or 14%)	Past land management activities greater than 25 years.	Yes	533, 558	72, 504, 506, 507, 508, 513, 519, 523, 524, 526, 535, 543, 544, 550, 552, 566, 584, 585, 587, 590, 599, 601	24
558	18	180 (4 acres or 22%). 265 (14 acres or 78%)	Past land management activities greater than 25 years.	Yes	556	72, 504, 506, 507, 508, 513, 519, 523, 524, 526, 544, 550, 615	25
563	18	265 (18 acres or 100%)	Commercial Thinning 1998	Yes			25
566	9	265 (5 acres or 56%), 293 (4 acres or 44%)	None	No	533, 556		
573	28	293 (28 acres or 100%)	Past land management activities greater than 25 years.	Yes	591, 628, 629	D, SBA2, SBA3, SBA4, SBA5, 55, 547, 584, 585, 587, 601	25

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	**Acres**						
577	147	180 (3 acres or 2%), 138 (62 acres or 42%), 266 (24 acres or 16%), 294 (58 acres or 40%)	None	No	902		
579	93	180 (1 acre or 1%), 266 (68 acres or 73%), 294 (24 acres or 26%)	None	No	902		
584	50	231 (5 acres or 10%), 266 (4 acres or 8%), 293 (41 acres or 82%)	None	No	556, 573, 591, 628, 629		
585	19	180 (1 acre or 5%) 294 (18 acres or 95%)	None	No	556, 573, 591, 628, 629		
587	9	180 (1 acre or 11%), 265 (8 acres or 89%)	None	No	556, 573, 591, 628, 629		
590	158	128 (10 acres or 6%), 243 (25 acres or 16%), 265 (36 acres or 23%), 266 (31 acres or 20%), 293 (56 acres or 35%)	None	No	533, 556		
591	8	293 (8 acres or 100%)	Past land management activities greater than 25 years.	Yes	573, 628, 629	D, SBA2, SBA3M SBA4, SBA5, 55, 547, 584, 585, 587, 601	25
599	31	128 (8 acres or 26%), 231 (4 acres or 13%), 293 (14 acres or 45%), 294 (5 acres or 16%)	None	No	533, 556		
601	34	137 (2 acres or 5%), 223 (5 acres or 15%), 293 (6 acres or 18%), 296 (21 acres or 62%)	None	No	23, 27, 29, 533, 556, 573, 628, 629		

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	**Acres**						
608	92	135 (26 acres or 28%), 208 (2 acres or 2%), 209 (20 acres or 22%), 287 (44 acres or 48%)	Portion of Unit: Underburn 2007	No	None		
610	26	128 (1 acre or 4%), 208 (21 acres or 81%), 287 (4 acres or 15%)	None	No	27, 29		
612	16	135 (16 acres or 100%)	None	No	27, 29, 79iii		
613	54	128 (1 acre or 2%), 208 (2 acres or 4%), 287 (42 acres or 78%), 294 (9 acres or 16%)	None	No	27, 29		
614	42	135 (4 acres or 10%), 145 (21 acres or 50%), 287 (17 acres or 40%)	None	No	27, 29, 905A, 907A, 907B		
615	183	135 (131 acres or 72%), 145 (6 acres or 3%), 179 (1 acre or 1%), 210 (16 acres or 9%), 243 (28 acres or 15%)	None	No	27, 29		
618	35	145 (19 acres or 54%), 179 (4 acres or 11%), 243 (12 acres or 34%)	None	No	505, 558, 902		
619	6	135 (6 acres or 100%)	None	No	27, 29, 79iii		
624	107	180 (13 acres or 12%), 223 (82 acres or 77%), 243 (12 acres or 11%)	None	No	119, 127		
626	31	212 (16 acres or 52%), 223 (11 acres or 35%), and 243 (4 acres or 13%)	None	No	72, 119, 127, 147		

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	**Acres**						
627	25	180 (6 acres or 24%), 294 (16 acres or 64%), 296 (3 acres or 12%)	None	No	119, 127		
628	44	294 (21 acres or 48%), 296 (23 acres or 52%)	Past land management activities greater than 25 years.	Yes	573, 591, 629	B, B2, E, F, 55, 547, 584, 585, 587, 601	25
629	13	181 (1 acre or 8%), 294 (2 acres or 15%), 296 (10 acres or 77%)	Past land management activities greater than 25 years.	Yes	573, 591, 628, 902	B, B2, E, F, 55, 547, 584, 585, 587, 601, 914A, 914B, 914C, 915	25
633	21	179 (6 acres or 29%), 209 (15 acres or 71%)	None	No	No Proposed Treatments		
634	14	208 (14 acres or 100%)	None	No	27, 29		
636	58	169 (4 acres or 7%), 208 (54 acres or 93%)	None	No	27, 29		
637	13	208 (13 acres or 100%)	None	No	27, 29		
638	275	179 (2 acres or 1%), 135 (26 acres or 9%), 169 (75 acres or 27%), 199 (117 acres or 43%), 208 (18 acres or 7%), 209 (36 acres or 13%), 231 (2 acres or 1%)	None	No	79iii, 87, 639		
639	29	169 (26 acres or 90%), 231 (3 acres or 10%)	Past land management activities greater than 25 years.	Yes		638	25
647	35	134 (34 acres or 97%) 243 (1 acre or 3%)	None	No	None		

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	Acres						
649	46	180 (5 acres or 11%), 181 (18 acre or 39%), 243 (1 acre or 2%), 294 (9 acres or 20%), 295 (13 acres or 28%)	Half of unit Hand Cut and Pile Burn 2005	No	None		
650	55	108 (11 acres or 20%), 181 (15 acres or 27%), 243 (1 acre or 2%), 294 (28 acres or 51%)	Hand Cut and Pile Burn 2005	No	None		
900	151	180 (68 acres or 45%), 181 (83 acres or 55%)	Precommercial Thinning 2003, Hand Cut and Pile Burn and Underburn 2005	No	None		
901A	160	180 (32 acre or 20%), 293 (123 acres or 77%), 294 (5 acres or 3%)	Portion of Unit: Precommercial Thinning 2003 and Hand Cut and Pile Burn 2004	No	2		
901B	66	180 (1 acre or 2%), 231 (4 acres or 6%), 294 (61 acres or 92%)	Portion of Unit: Precommercial Thinning 2003 and Hand Cut and Pile Burn 2004	No	2		
901GHWK	20	294 (20 acres or 100%)	None	No	No Proposed Treatments		
902	122	179 (41 acres or 34%), 208 (1 acre or 1%), 286 (38 acres or 31%), 293 (23 acres or 19%), and 294 (17 acres or 14%)	Past land management activities greater than 25 years.	Yes	629	577, 579, 618, 914A, 914B, 914C, 915	25
903	3	208 (1 acre or 33%), 286 (2 acres or 67%)	Clearcut 1990	No	None		
904	149	286 (149 acres or 100%)	None	No	14A, 20, 23, 905A		

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	**Acres**						
905A	53	286 (53 acres or 100%)	Past land management activities greater than 25 years.	Yes (surveyed with 907B)	14A, 20, 21, 23, 907A, 907B	LP1, LP2, 3, 14B, 15, 530, 614, 904, 905B	25
905B	115	199 (7 acres or 6%), 200 (33 acres or 29%), 266 (3 acres or 2%), 286 (23 acres or 20%), 287 (49 acres or 43%)	None	No	14A, 20, 21, 23, 33, 907A		
906	148	128 (50 acres or 34%), 199 (87 acres or 59%), 200 (4 acres or 3%), 211 (4 acres or 3%), 287 (3 acres or 1%)	Clearcut 1985 and Mastication 2004	Yes			24
907A	93	286 (80 acres or 97%), 287 (19 acre or 20%)	Past land management activities greater than 25 years.	Yes	14A, 20, 21, 23, 905A, 907B	LP1, 14B, 15, 530, 614	25
907B	30	286 (30 acres or 100%)	Past land management activities greater than 25 years.	Yes (surveyed with 905A)	14A, 20, 21, 23, 907A, 907B	LP1, LP2, 3, 14B, 15, 530, 614, 904, 905B	25
908	161	127 (1 acre or 1%), 211 (156 acres or 97%), 212 (4 acres or 2%)	Clearcut 1989, Hand Pile Burn, Mastication, and Hand Thinning 2004, and Sanitation Salvage 2007	Yes			25
909	80	211 (80 acres or 100%)	Part of Unit: Sanitation Salvage in 2007 and Hand Cut Pile Burn 2004	Yes			25
910	80	181 (6 acres or 8%), 264 (2 acres or 2%), 294 (72 acres or 90%)	Mastication 2004 and Hand Cut and Pile Burn 2005	No	None		

Alternative B		Soil Map Unit Number	Past Land Management Activities on the Plumas National Forest	Soil Condition Survey (Yes or No)	Proposed Treatment Unit(s) Surveyed With Similar Conditions	Proposed Treatment Unit(s) Not Surveyed With Similar Conditions	Total Number of Data Points Collected During Survey
Unit Number	**Acres**						
911	81	180 (13 acres or 16%), 293 (67 acres or 83%), 296 (1 acre or 1%)	Portions of unit hand cut and pile burn 2005	No	None		
912	170	180 (61 acres or 36%), 223 (16 acres or 9%), 293 (48 acres or 28%), 294 (29 acres or 17%), 296 (16 acres or 9%)	Mastication 2004 and Hand Cut and Pile Burn 2005	No	None		
913	69	180 (31 acres or 45%), 223 (38 acres or 55%)	Most of Unit: Hand Cut and Pile Burn 2005	No	None		
914A	51	145 (2 acres or 4%), 180 (49 acres or 96%)	None	No	629, 902		
914B	37	179 (4 acres or 11%), 180 (33 acres or 89%)	None	No	629, 902		
914C	100	145 (34 acres or 34%), 180 (16 acres or 16%), 231 (1 acre or 1%), 287 (5 acres or 5%), 294 (44 acres or 44%)	None	No	629, 902		
915	152	145 (51 acres or 34%), 179 (93 acres or 60%), and 181 (9 acres or 6%)	Portion of Unit: Hand Cut and Pile Burn 2005	No	629, 902		

6.2.1 Existing Condition – Measure 1: Soil Cover

Percent of effective soil cover was measured through field surveys and the EHR system is used to determine the kind, amount, and disturbance of soil cover necessary to avoid detrimental accelerated soil erosion (USDA Forest Service 1995). Table 6 displays the existing condition of effective soil cover and the calculated EHR for proposed treatment units.

Standards and guides for effective soil cover are listed on page 4-44 of the Forest Plan (see "Regulatory Framework" Section). Under the existing condition all of the proposed treatment units have an EHR rating with a numerical value below 8. According the Forest Plan standards and guides the PNF can conduct normal activities during this project. Under the existing condition all of the proposed treatment units meet or exceed Forest Plan standards and guides for percent effective soil cover.

Table 6: Existing Condition of Measure 1: Soil Cover

Alternative B: Proposed Treatment Unit Number	Surveyed Proposed Treatment Unit(s) With Similar Conditions	Non-Surveyed Proposed Treatment Unit(s) With Similar Conditions	Percent Effective Soil Cover	Erosion Hazard Rating		Percent Minimum Effective Soil Cover*
				Numerical	Adjective	
2		901A, 901B	76	1	Low	40
7	533	SBA2, SBA3, SBA4, SBA5	100	0	Low	40
11G			100	0	Low	40
			100	0	Low	40
11K		12P3	84	1	Low	40
12G1	46, 128, 134	57, 58, 59, 62, 68, 140, 150A	96	0	Low	40
12G2			100	0	Low	40
12P2		11P	84	0	Low	40
13T		A, A2, B, B2, E, F, 15T, 15TA, 141	92	0	Low	40
14A	20, 21, 23, 905A, 907A, 905B	LP1, LP2, 3, 14B, 15, 530, 904, 905A	92	0	Low	40
15P1	15P2		76	3	Low	40
15P2	15P1		80	5	Moderate	50
20	14A, 21, 23, 905A, 907A, 907B	LP1, LP2, 3, 14B, 15, 530, 904, 905A	95	0	Low	40
21	14A, 20, 23, 905A, 907A, 907B	LP1, LP2, 14B, 15, 32, 526, 905B	100	0	Low	40
23	14A, 20, 21, 33, 907A	LP1, LP2, 14B, 15, 19, 526, 530, 601	100	0	Low	40
27		28, 30, 35, 53, 79i, 539, 544, 550, 601,	88	2	Low	40

Alternative B: Proposed Treatment Unit Number	Surveyed Proposed Treatment Unit(s) With Similar Conditions	Non-Surveyed Proposed Treatment Unit(s) With Similar Conditions	Percent Effective Soil Cover	Erosion Hazard Rating		Percent Minimum Effective Soil Cover*
				Numerical	Adjective	
29		610, 612, 613, 614, 615, 619, 634, 636, 637				
33	21	32, 905B	96	0	Low	40
43			96	0	Low	40
44, 45, 46	12G1, 128	41, 42, 57, 58, 59, 61, 62, 68, 107, 130	96	0	Low	40
72	147	61, 65, 70, 97, 98, 107, 626	100	0	Low	40
79iii	90	72, 92, 612, 619, 638	100	0	Low	40
87		638	96	0	Low	40
90	79iii	92	96	0	Low	40
100	102, 103, 118, 119, 127	117	100	0	Low	40
102	100, 103, 118, 119, 127	117	96	0	Low	40
103	100, 102, 118, 119, 127	117	100	0	Low	40
109	111	108, 111	92	0	Low	40
111	109, 123	108, 111, 113, 120, 154	96	0	Low	40
118	100, 102, 103, 119, 127	A, A2, B, B2, E, F, 117	96	0	Low	40
119, 127	100, 102, 103, 118	117, 624, 626, 627	92	0	Low	40
123	111	113, 120, 154	88	3	Low	40
128	12G1, 46, 134	18, 57, 58, 59, 62, 68, 130, 140, 150a, 154, 544, 550	80	2	Low	40
134	12G1, 128	97, 98, 140, 150A	100	0	Low	40
147	13T, 72	15T, 15TA, 65, 130, 141, 626	92	0	Low	40
150B		14O, 161	96	0	Low	40
500		A, A2, A3, B, B2, E, F	84	2	Low	40
505		A, A3, B, B2, E, F, 615	96	0	Low	40
516		B, B2, E, F	96	0	Low	40
533	7, 556	D, SBA2, SBA3, SBA4, SBA5, 519, 526, 535, 543, 552, 566, 590, 599, 601	98	0	Low	40
540		542	92	0	Low	40

Alternative B: Proposed Treatment Unit Number	Surveyed Proposed Treatment Unit(s) With Similar Conditions	Non-Surveyed Proposed Treatment Unit(s) With Similar Conditions	Percent Effective Soil Cover	Erosion Hazard Rating		Percent Minimum Effective Soil Cover*
				Numerical	Adjective	
556	533, 558	72, 504, 506, 507, 508, 513, 519, 523, 524, 526, 535, 543, 544, 550, 552, 566, 584, 585, 587, 590, 599, 601	92	0	Low	40
558	556	72, 504, 506, 507, 508, 513, 519, 523, 524, 526, 544, 550, 615	88	2	Low	40
563			96	0	Low	40
573	591, 628, 629	D, SBA2, SBA3, SBA4, SBA5, 55, 547, 584, 585, 587, 601	92	0	Low	40
591	573, 628, 629	D, SBA2, SBA3M SBA4, SBA5, 55, 547, 584, 585, 587, 601	96	0	Low	40
628	573, 591, 629	B, B2, E, F, 55, 547, 584, 585, 587, 601	94	0	Low	40
629	573, 591, 628, 902	B, B2, E, F, 55, 547, 584, 585, 587, 601, 914A, 914B, 914C, 915	92	0	Low	40
639		638	92	0	Low	40
902	629	577, 579, 618, 914a, 914b, 914c, 915	96	0	Low	40
905A	14A, 20, 21, 23, 907a, 907b	LP1, LP2, 3, 14B, 15, 530, 614, 904, 905b	96	0	Low	40
906			83	0	Low	40
907A	14A, 20, 21, 23, 905A, 907A	LP1, 14B, 15, 530, 614	100	0	Low	40
907B	14A, 20, 21, 23, 907A, 907B	LP1, LP2, 3, 14B, 15, 530, 614, 904, 905B	96	0	Low	40
908			68	12	Moderate	50
909			84	2	Low	40

*Percent Minimum Effective Ground Cover is based on Forest Plan standards and guides.

6.2.2 Existing Condition – Measure 2: Soil Porosity

Detrimental soil compaction was determined at each sample point along transects. Table 7 displays the existing condition of detrimental soil compaction determined in proposed treatment

units. Detrimental compaction was not measured in 49 percent (27 out of 55) of the proposed treatments surveyed. The majority of the Sugarberry Project Area has had past land management activities, and locations of landings, skid trails, and temporary roads are still visible on the landscape. Most areas with previous disturbance were not found to be detrimentally compacted for the following reasons: low risk soil type (soil types that do not compact due to a low clay content or high rock fragment content occurs throughout the project area); operations probably occurred during dry soil periods; have had sufficient time since the last disturbance to naturally recover; or have been subsoiled to reduce impacts from detrimental compaction. However, based on data collection, there are areas within proposed treatment units that are detrimentally compacted and have not fully recovered since the stand was last entered. The areal extent of detrimental compaction ranges from four to twenty percent. In some cases recovery has not occurred because recreational uses such as camping on landings or off-highway vehicle traffic (ATV's, four wheeled drive vehicles, etc.) on the skid trails and temporary roads.

Standards and guides on page 4-44 of the Forest Plan state "to avoid land base productivity loss due to soil compaction, dedicate no more than 15% of timber stands to landings and permanent skid trails". The Feather River Ranger District has not dedicated landings and permanent skid trails during past timber harvesting projects. The Forest Plan does not establish a threshold standard for detrimental soil compaction (compaction of soil at a depth of 4 to 8 inches). The R5 Soil Management Handbook defines a ten percent reduction in total soil porosity corresponds to a threshold for soil bulk density that indicates detrimental soil compaction (USDA Forest Service 1995). This analysis threshold is for site specific measurements and does define an areal extent threshold for detrimental compaction of activity areas.

Table 7: Existing Condition Measure 2: Soil Porosity (areal extent of detrimental soil compaction).

Alternative B: Proposed Treatment Unit Number	Soil Texture from Surveys	Proposed Treatment Unit Surveyed with Similar Conditions	Proposed Treatment Units Not Surveyed with Similar Conditions	Areal Extent of Detrimental Soil Compaction (Percent)
2	Loam		901A, 901B	8
7	Sandy Loam and Loam	533	SBA2, SBA3, SBA4, SBA5	0
11G	Sandy Loam			0
	Sandy Clay (very rocky)			4
11K	Sandy Clay		12P3	16
12G1	Silty Clay Loam	46, 128, 134	57, 58, 59, 62, 68, 140, 150A	16
12G2	Loam			4
12P2	Sandy Clay Loam and Silty Clay Loam		11P	4

Alternative B: Proposed Treatment Unit Number	Soil Texture from Surveys	Proposed Treatment Unit Surveyed with Similar Conditions	Proposed Treatment Units Not Surveyed with Similar Conditions	Areal Extent of Detrimental Soil Compaction (Percent)
13T			A, A2, B, B2, E, F, 15T, 15TA, 141	16
14A	Clay Loam	20, 21, 23, 905A, 907A, 905B	LP1, LP2, 3, 14B, 15, 530, 904, 905A	4
15P1	Silty Clay Loam and Sandy Clay Loam	15P2		16
15P2	Silty Clay Loam	15P1		20
20	Sandy Clay Loam	14A, 21, 23, 905A, 907A, 907B	LP1, LP2, 3, 14B, 15, 530, 904, 905A	9
21	Loam	14A, 20, 23, 905A, 907A, 907B	LP1, LP2, 14B, 15, 32, 526, 905B	4
23	Sandy Clay and Sandy Clay Loam	14A, 20, 21, 33, 907A	LP1, LP2, 14B, 15, 19, 526, 530, 601	4
27	Silty Clay Loam		28, 30, 35, 53, 79i, 539, 544, 550, 601, 610, 612, 613, 614, 615, 619, 634, 636, 637	8
29				
33	Loam	21	32, 905B	0
43	Silty Clay Loam			0
44	Clay	12G1, 128	41, 42, 57, 58, 59, 61, 62, 68, 107, 130	8
45				
46				
72	Silty Clay	147	61, 65, 70, 97, 98, 107, 626	0
79iii	Sandy Clay Loam	90	72, 92, 612, 619, 638	4
87	Clay (Rocky), Clay Loam, and Loamy Sand		638	0
90	Loam and Sandy Loam	79iii	92	0
100	Loam	102, 103, 118, 119, 127	117	0
102	Clay Loam	100, 103, 118, 119, 127	117	0
103	Sandy Loam	100, 102, 118, 119, 127	117	0
109	Silt Loam	111	108, 111	8
111	Loam	109, 123	108, 111, 113, 120, 154	0
118	Sandy Clay with High Rock Content	100, 102, 103, 119, 127	A, A2, B, B2, E, F, 117	0
119	Loamy Sand	100, 102, 103, 118	117, 624, 626, 627	4
127				
123	Silty Clay Loam	111	113, 120, 154	0
128	Silty Loam	12G1, 46, 134	18, 57, 58, 59, 62, 68,	4

Alternative B: Proposed Treatment Unit Number	Soil Texture from Surveys	Proposed Treatment Unit Surveyed with Similar Conditions	Proposed Treatment Units Not Surveyed with Similar Conditions	Areal Extent of Detrimental Soil Compaction (Percent)
			130, 140, 150A, 154, 544, 550	
134	Silty Clay Loam	12G1, 128	97, 98, 140, 150A	0
147	Loam	13T, 72	15T, 15TA, 65, 130, 141, 626	8
150B			14O, 161	0
500	Loam and Sandy Loam		A, A2, A3, B, B2, E, F	4
505	Loam		A, A3, B, B2, E, F, 615	0
516	Silty Loam and Clay Loam		B, B2, E, F	0
533	Silty Clay Loam, Loam, Silt Loam, and Sandy Loam	7, 556	D, SBA2, SBA3, SBA4, SBA5, 519, 526, 535, 543, 552, 566, 590, 599, 601	0
540	Clay Loam and Sandy Clay Loam		542	0
556	Sandy Loam	533, 558	72, 504, 506, 507, 508, 513, 519, 523, 524, 526, 535, 543, 544, 550, 552, 566, 584, 585, 587, 590, 599, 601	0
558	Sandy Clay Loam	556	72, 504, 506, 507, 508, 513, 519, 523, 524, 526, 544, 550, 615	4
563	Loam and Sandy Loam			20
573	Sandy Clay Loam and Sandy Loam	591, 628, 629	D, SBA2, SBA3, SBA4, SBA5, 55, 547, 584, 585, 587, 601	0
591	Silty Clay Loam to Clay Loam	573, 628, 629	D, SBA2, SBA3M SBA4, SBA5, 55, 547, 584, 585, 587, 601	8
628	Loam and Sandy Loam	573, 591, 629	B, B2, E, F, 55, 547, 584, 585, 587, 601	2
629	Silt Loam	573, 591, 628, 902	B, B2, E, F, 55, 547, 584, 585, 587, 601, 914A, 914B, 914C, 915	0
639	Sand and Sandy Clay Loam with High Rock Content		638	0
902	Silty Clay Loam	629	577, 579, 618, 914A, 914B, 914C, 915	4

Alternative B: Proposed Treatment Unit Number	Soil Texture from Surveys	Proposed Treatment Unit Surveyed with Similar Conditions	Proposed Treatment Units Not Surveyed with Similar Conditions	Areal Extent of Detrimental Soil Compaction (Percent)
905A	Silty Clay Loam	14A, 20, 21, 23, 907A, 907B	LP1, LP2, 3, 14B, 15, 530, 614, 904, 905B	0
906	Silty Loam and Clay Loam			0
907A	Silt Loam and Silty Clay	14A, 20, 21, 23, 905A, 907A	LP1, 14B, 15, 530, 614	0
907B		14A, 20, 21, 23, 907A, 907B	LP1, LP2, 3, 14B, 15, 530, 614, 904, 905B	0
908	Silty Clay Loam			4
909	Clay Loam			4

6.2.3 Existing Condition – Measure 3: Soil Organic Matter

Percent of fine organic matter and the amount of large woody debris (LWD) per acre was calculated based on measurements from field surveys (Table 8). Down wood standards and guides for HFQLG projects are listed in Table 2 in the Record of Decision for the 2004 Sierra Nevada Forest Plan Amendment. The standard and guide states "Determine retention levels of down woody material on an individual basis. Within Westside vegetation types, generally retain an average over the treatment unit of 10-15 tons of large down wood per acre… Consider the effects of follow-up prescribed fire in achieving desired retention levels of down wood." It further recommends that large woody material presence may be reduced to meet fuel management objectives in strategic fuel treatment areas, such as fuel breaks. The R5 Soil Management Handbook lists recommend thresholds for fine organic matter and large woody debris (LWD) (see the "Management Direction" Section).

Under the existing condition fine organic matter meets or exceeds the recommend threshold in the majority of the proposed treatment units. However, proposed treatments units 12P2, 123 and 904 are below the recommended threshold under the existing condition (Summary Table S-1).

Summary Table S-1: Proposed treatment units below the R5 recommended threshold for fine organic matter.

Proposed Treatment Unit Number	Non-Surveyed Proposed Treatment Unit(s) with Similar Conditions	Percent Fine Organic Matter	Reason for Treatment Unit Below Standards
12P2	11P	40	This unit does have an effective soil cover of 84 percent and is a plantation. There were several points where vegetation occurred with bare soil underneath the vegetation.

Proposed Treatment Unit Number	Non-Surveyed Proposed Treatment Unit(s) with Similar Conditions	Percent Fine Organic Matter	Reason for Treatment Unit Below Standards
123	113, 120, 154 (These units are also similar to unit 111, which contains 72% fine organic matter).	48	This unit does have an effective soil cover of 88 percent. The unit had several points that contained large woody debris. Also this unit had hydraulic mining activities and evidence of past land management activities.
908		48	This unit does have an effective soil cover of 68 percent and is a plantation. This unit is part of a DFPZ with past management activities (thinning, mastication, and pile burning) occurring during 2004.

Large woody debris material meets or exceeds the recommended threshold in the majority of the proposed treatment units surveyed under the existing condition. However, proposed treatment units 15, 15P1, 21, 42, 55, 57, 70, 72, 92, 102, 107, 109, 130, 638, 639, and 907A are below the recommended threshold (Summary Table S-2).

Summary Table S-2: Proposed treatment units below the R5 recommended threshold for large woody debris.

Proposed Treatment Unit Number	Proposed Treatment Units Not Surveyed with Similar Conditions	Total Large Woody Debris (Down Logs) per Acre
15		4
15P1		4
21	LP1, LP2, 14B, 526, 905B	1
42		0
55		3
57		3
70		3
72	626	1
92		3
102		4
107		0
109		3
130		0
639	638	2
907A		1

Proposed treatment units 15P1 and 907A are plantations. Plantations in the Sugarberry Project area range in age from 15 to 30 years old. Most of the plantations were established from previous clearcuts or wildfires. Previous management activities had different large woody debris requirements than the R5 Soil Management Handbook recommended thresholds. Trees in these plantations have not yet reached suitable diameters at breast height (dbh) or heights for the

development of large woody material (desired logs are at least 20 inches in diameter and 10 feet long, but need to be at least 12 inches in diameter).

Continued management of plantations as part of the Sugarberry Project would accelerate the diameter and height growth of residual trees, provide periodic inputs of woody debris from thinning operations, and provide for future opportunities for recruitment of snags and down woody material. Precommerical thinning, especially by mastication, would generate shredded woody material to be left on the soil surface, which may have long-term beneficial effects to soil moisture, temperature, and nutrient cycling. Subsequent commercial thinning would also generate woody material from tops and limbs, which could be piled and burned or some of the piles could be left unburned to meet wildlife and soil requirements. Once trees in the plantations reach diameters of at least 20 inches (expected after approximately 40 years of growth; Oliver 1997), these 20 inch dbh and greater trees could be used during subsequent harvests to create snag and large down logs in areas where they are deficit.

For proposed treatments that are not plantations, high quantities of large woody material are not expected to exist equally across the landscape. Overall, less productive soil types, such as exposed sites including ridgetops or south-facing slopes, serpentine sites, and areas with shallow or erosive soils, are expected to have less downed large woody material due to more open forest cover and slower growth rates of vegetation. Productive sites are capable of growing vegetation more quickly and producing high tree densities associated with mortality.

Management of forestlands over the last 150 years has affected the quantity of large woody material. In some areas, historical logging, grazing, fires, and mining created very open forests. These areas were naturally regenerated and vegetation is now reaching the diameter size classes and densities high enough to begin to create large woody material. The process can be slowed further, however, due to protected medium to high canopy conditions limiting blowdown of standing dead wood, or snags. Snags may stand for many years before falling and consequently becoming large woody material. Additionally, past thinning projects across the project area would have limited potential density-related mortality by removing trees in dense conditions to create growing space for residual healthy trees.

Table 8: Existing Condition Measure 3: Organic Matter

Alternative B: Proposed Treatment Unit Number	Soil Condition Survey (Yes or No)	Unit Surveyed With Similar Conditions	Units Not Surveyed With Similar Conditions	Fine Organic Matter (Percent)	Average amount of Large Woody Material (Down Logs) Per Acre (Source FIA Data)					
					Class 1	Class 2	Class 3	Class 4	Class 5	Total
2	Yes		901A, 901B	52	0	5	20	5	0	30
3	No	14A, 20, 23			1	3	2	7	0	14
7*	Yes	533	SBA2, SBA3, SBA4, SBA5	96	0	3	13	13	0	28
11G*	Yes			92	0	8	4	4	0	16
	Yes			92	0	2	2	2	2	8
11K*	Yes		12P3	64	0	0	16	8	6	30
12G1*	Yes	46, 128, 134	57, 58, 59, 62, 68, 140, 150A	92	2	0	4	2	0	8
12G2*	Yes			80	8	8	8	3	0	25
12P2*	Yes		11P	40	12	0	0	0	0	12
13T*	Yes		A, A2, B, B2, E, F, 15T, 15TA, 141	68	6	8	2	0	0	16
14A	Yes	20, 21, 23, 905A, 907A, 905B	LP1, LP2, 3, 14B, 15, 530, 904, 905A	76	0	0	0	1	2	3
15	No	14A, 20, 21, 23, 905A, 907A, 907B			0	0	0	0	4	4
15P1*	Yes	15P2		56	0	2	2	0	0	4
15P2*	Yes	15P1		64	10	6	0	2	0	18
18	No	128			0	0	5	8	0	13
19	No	21, 23, 33, 907A			0	2	0	4	2	8
20*	Yes	14A, 21, 23, 905A, 907A, 907B	LP1, LP2, 3, 14B, 15, 530, 904, 905A	73	0	10	0	0	0	10
21	Yes	14A, 20, 23, 905A, 907A, 907B	LP1, LP2, 14B, 15, 32, 526, 905B	84	0	0	1	0	0	1
23	Yes	14A, 20, 21, 33, 907A	LP1, LP2, 14B, 15, 19, 526, 530, 601	88	3	3	0	0	0	5
28	No	27, 29			0	8	0	0	0	8

Alternative B: Proposed Treatment Unit Number	Soil Condition Survey (Yes or No)	Unit Surveyed With Similar Conditions	Units Not Surveyed With Similar Conditions	Fine Organic Matter (Percent)	Average amount of Large Woody Material (Down Logs) Per Acre (Source FIA Data)					
					Class 1	Class 2	Class 3	Class 4	Class 5	Total
27	Yes (surveyed together)		28, 30, 35, 53, 79i, 539, 544, 550, 601, 610, 612, 613, 614, 615, 619, 634, 636, 637	72	0	0	2	3	5	10
29					0	2	2	1	2	7
35	No	27, 29			0	0	3	2	0	5
37	No	33			0	0	2	8	0	10
41	No	44, 45, 46			0	0	12	0	0	12
42	No	44, 45, 46			0	0	0	0	0	0
43	Yes			71	0	0	2	5	0	7
44	Yes (44, 45, 46 surveyed together)	12G1, 128	41, 42, 57, 58, 59, 61, 62, 68, 107, 130	64	0	0	0	8	0	8
45										
46										
53	No	27, 29			0	4	2	2	2	10
55	No	573, 591, 628, 629			0	0	3	0	0	3
57	No	12G1, 46, 128			0	0	3	0	0	3
58	No	12G1, 46, 128			0	3	27	3	0	33
59	No	12G1, 46, 128			0	2	8	1	0	11
61	No	44, 45, 46, 72			2	0	8	12	0	22
62	No	12G1, 46, 128			0	4	18	4	0	26
65	No	72, 147			0	0	8	0	0	8
70	No	72, 79iii			0	3	0	0	0	3
72	Yes	147	61, 65, 70, 97, 98, 107, 626	100	0	0	1	0	0	1
79iii	Yes	90	72, 92, 612, 619, 638	80	1	0	11	4	0	16
87	Yes		638	84	0	4	8	2	0	14
90	Yes	79iii	92	76	0	3	5	3	0	11
92	No	79iii, 90			0	0	3	0	0	3
97	No	72, 134			0	0	5	5	0	10
98	No	72, 134			0	3	8	3	3	17

Alternative B: Proposed Treatment Unit Number	Soil Condition Survey (Yes or No)	Unit Surveyed With Similar Conditions	Units Not Surveyed With Similar Conditions	Fine Organic Matter (Percent)	Average amount of Large Woody Material (Down Logs) Per Acre (Source FIA Data)					
					Class 1	Class 2	Class 3	Class 4	Class 5	Total
100	Yes	102, 103, 118, 119, 127	117	84	0	3	11	0	0	14
102	Yes	100, 103, 118, 119, 127	117	76	0	0	0	0	4	4
103	Yes	100, 102, 118, 119, 127	117	84	0	0	3	2	0	5
107	No	44, 45, 46, 72, 556, 558			0	0	0	0	0	0
108	No	109, 111			0	8	8	4	0	20
109	Yes	111	108, 111	72	0	3	0	0	0	3
110	No	109, 111			0	0	12	4	0	16
111	Yes	109, 123	108, 111, 113, 120, 154	72	0	1	6	2	0	10
117	No	118, 119, 127			0	0	8	2	0	10
118	Yes	100, 102, 103, 119, 127	A, A2, B, B2, E, F, 117	76	0	0	16	4	0	20
119	Yes (119 and 127 surveyed together)	100, 102, 103, 118	117, 624, 626, 627	75	0	0	12	8	0	20
127										
120	No	111, 123			0	0	5	0	3	8
123	Yes	111	113, 120, 154	48	0	0	12	0	0	12
128	Yes	12G1, 46, 134	18, 57, 58, 59, 62, 68, 130, 140, 150A, 154, 544, 550	64	0	2	8	0	0	10
130	No	44,45, 46, 128, 147			0	0	0	0	0	0
134	Yes	12G1, 128	97, 98, 140, 150a	80	0	3	26	5	0	33
141	No	13T, 147			0	3	4	2	0	9
147*	Yes	13T, 72	15T, 15TA, 65, 130, 141, 626	72	2	0	8	2	0	12
150B	Yes		14O, 161	84	0	1	7	2	0	10
154	No	111, 123			0	0	10	2	0	12

Alternative B: Proposed Treatment Unit Number	Soil Condition Survey (Yes or No)	Unit Surveyed With Similar Conditions	Units Not Surveyed With Similar Conditions	Fine Organic Matter (Percent)	Average amount of Large Woody Material (Down Logs) Per Acre (Source FIA Data)					
					Class 1	Class 2	Class 3	Class 4	Class 5	Total
161	No	150B			0	0	6	5	0	11
500*	Yes		A, A2, A3, B, B2, E, F	80	0	3	8	5	0	15
505*	Yes		A, A3, B, B2, E, F, 615	88	0	5	10	0	0	15
516*	Yes		B, B2, E, F	76	0	6	6	0	0	12
533*	Yes	7, 556	D, SBA2, SBA3, SBA4, SBA5, 519, 526, 535, 543, 552, 566, 590, 599, 601	90	0	4	10	0	0	14
540*	Yes		542	60	0	12	16	2	0	30
556*	Yes	533, 558	72, 504, 506, 507, 508, 513, 519, 523, 524, 526, 535, 543, 544, 550, 552, 566, 584, 585, 587, 590, 599, 601	67	15	8	5	0	0	28
558*	Yes	556	72, 504, 506, 507, 508, 513, 519, 523, 524, 526, 544, 550, 615	76	4	2	0	2	0	8
563*	Yes			80	18	10	4	0	0	32
573*	Yes	591, 628, 629	D, SBA2, SBA3, SBA4, SBA5, 55, 547, 584, 585, 587, 601	52	0	15	18	5	5	43
591*	Yes	573, 628, 629	D, SBA2, SBA3M SBA4, SBA5, 55, 547, 584, 585, 587, 601	68	6	6	2	2	0	16
628*	Yes	573, 591, 629	B, B2, E, F, 55, 547, 584, 585, 587, 601	65	10	4	3	1	0	19

Alternative B: Proposed Treatment Unit Number	Soil Condition Survey (Yes or No)	Unit Surveyed With Similar Conditions	Units Not Surveyed With Similar Conditions	Fine Organic Matter (Percent)	Average amount of Large Woody Material Per Acre (Source FIA Data)					
					Class 1	Class 2	Class 3	Class 4	Class 5	Total
629*	Yes	573, 591, 628, 902	B, B2, E, F, 55, 547, 584, 585, 587, 601, 914A, 914B, 914C, 915	92	8	6	6	2	0	22
639*	Yes		638	92	0	2	0	0	0	2
902	Yes	629	577, 579, 618, 914A, 914B, 914C, 915	76	2	2	12	4	2	21
904	No	14A, 20, 23, 905A			0	0	3	3	4	9
905A	Yes (surveyed with 907b)	14A, 20, 21, 23, 907A, 907B	LP1, LP2, 3, 14B, 15, 530, 614, 904, 905B	72	0	1	10	2	1	14
906*	Yes			71	10	8	2	0	2	22
907A	Yes	14A, 20, 21, 23, 905A, 907B	LP1, 14B, 15, 530, 614	96	0	0	1	0	0	1
907B	Yes (surveyed with 905A)	14A, 20, 21, 23, 907a, 907b	LP1, LP2, 3, 14B, 15, 530, 614, 904, 905B	72	0	1	10	2	1	14
908*	Yes			48	8	8	0	2	0	18
909	Yes			72	6	6	2	0	0	14

*Source of large woody material data is from 2006 soil survey, not FIA.

6.3 Existing Condition Indicator 2: Soil Hydrologic Function

The majority of soil map units in the soil effects analysis area (57 percent) have water movement in soil ratings (infiltration and permeability) of eight. These soil map units have a slow to very slow infiltration rate under natural conditions which indicates a higher level of risk of accelerated runoff if sufficient levels of effective soil cover are not present, as discussed in the "Soil Types and Soil Map Units" Section.

Under the existing condition all proposed treatment units meet or exceed Forest Plan standards and guide for effective soil cover. In the majority of the proposed treatment unit surveyed, detrimental compaction has occurred in locations of landings, skid trails, and temporary roads. However, there does not appear to be significant changes in the soil hydrologic function within a timber stand. Increased surface runoff and erosion only occurs in site specific locations, such as skid trails and temporary roads where vegetation has not recovered and functioning waterbars do not exist. Typically this occurs in areas with high recreational uses.

6.4 Existing Condition Indicator 3: Soil Buffering Capacity

The soil buffering capacity of soils within the project area is not known. Soil buffering capacity is a function of soil pH and cation exchange capacity (CEC), and changes in these properties could affect soil chemistry, reaction, and nutrient availability. No large wildfires or widespread applications of chemicals that might affect soil pH, cation exchange capacity, or nitrogen availability have occurred within most of the Sugarberry project area. Fire can produce pulse nitrogen inputs into the soil, which are short-lived and generally considered beneficial to nutrient supply for vegetation. Boron is the agent of toxicological concern from the use of sporax, which occurs naturally in soil (USDA Forest Service 2006).

7. Environmental Effects

Forest stands in the project area have unnaturally dense understories of shade tolerant hardwoods and conifers. These crowded stands are less fire resilient and are more susceptible to insect and disease attack due to stress from competition for water, light, and nutrients. The purpose of the DFPZ treatments is to create fuel breaks by breaking up the fuel strata (the vertical and horizontal continuity of both live and dead vegetation that affects the way fuels burn) primarily along ridge tops. Treatments would reduce the risk of large and intense wildfire and enhance firefighting capabilities by providing improved access for suppression crews and increasing the amount of fireline the crew can establish in a given time period. For more information refer to the Sugarberry "Vegetation, Fire, and Fuels Analysis" on file in the project

record. The purpose of group selection treatments is to regenerate fire-resilient species using an uneven-aged management strategy. These treatments provide seral stage diversity by adding patches of the youngest seral stages to portions of larger CWHR class (stage) 4 and 5 stands. The purpose of individual tree selection treatments is to reduce overstocking and prevent the spread of insect and disease. By removing the diseased and suppressed trees immediately around group selections, the stand would become more vigorous. The desired condition is having fire and insect resilient stands, including a higher proportion of shade intolerant species in the overstory and reduced crowding in the understory. This condition would also allow plant species that do not germinate in a dense stand the opportunity to grow and provide greater floral biodiversity.

The purpose of treatment in black oak stands is to reduce competing vegetation by hand thinning treatments. Due to past management activities, in many parts of the project area, black oak remains only as scattered remnants in mixed conifer forests. Oak seedlings, particularly those stressed by competing vegetation, grow slowly and many often die before developing characteristics of value to wildlife. Crowding also causes stands to become more flammable. This is a concern because black oaks are vulnerable to crown fires, which kill oaks of all ages. Black oak stands provide food, as well as nest sites for species such as the California spotted owl and its prey, and the northern flying squirrel.

Lack of disturbance is limiting aspen regeneration. Aspen clones depend on disturbances such as fire to regenerate both vegetatively (clonal root sprouts or suckers) and sexually. Due to a lack of periodic burning, aspen stands throughout northern California are largely senescent (growing old; decaying by time) and are rapidly declining in number and size. Conifer invasion into aspen stands is a symptom of minimal recent disturbance. Aspen clones in temperate regions of the Northern Hemisphere are up to 12,000 years old and may help provide long-term soil stability in areas with frequent disturbance and short growing seasons. Aspen stands allow filtered sunlight to reach the forest floor, therefore resulting in more diverse and different understory vegetation than the surrounding forest. This provides nesting and foraging habitat for a variety of species, such as songbirds, raptors, and deer. Proposed aspen enhancement would remove encroaching conifers to increase water, growing space, and light available for young aspen.

Proposed transportation system improvements provide access for completion of timber harvest and fuel reduction activities and contribute to watershed restoration, meadow enhancement, fish passage improvement, and streambank stabilization. Watershed restoration projects are designed to improve aquatic habitat connectivity, restore stream and meadow hydrologic function, and improve aquatic and riparian habitat quality.

Table 9 includes a summary of proposed treatments by unit number for each action alterative. For more detailed information on proposed treatments by alternative refer to the Sugarberry "Vegetation, Fire, and Fuels Analysis" on file in the project record.

Table 9: Summary of proposed treatments by unit for each action alternative (Note: GS = Group Selection, ITS = Individual Tree Selection, UB = Underburn).

Alternative B		**Alternative C**	
Proposed Treatment Unit Number	**Proposed Treatment**	**Proposed Treatment Unit Number**	**Proposed Treatment**
A	Oak Enhancement - Hand	same as alternative B	
A2	Oak Enhancement - Hand	same as alternative B	
A3	Oak Enhancement - Hand	same as alternative B	
B	Oak Enhancement - Hand	same as alternative B	
B2	Oak Enhancement - Hand	same as alternative B	
D	Oak Enhancement - Hand	same as alternative B	
E	Oak Enhancement - Hand	same as alternative B	
F	Oak Enhancement - Hand	same as alternative B	
LP1	DFPZ - Hand Cut and Pile Burn	same as alternative B	
LP2	DFPZ - Mastication	same as alternative B	
SBA1	Aspen - Helicopter	same as alternative B	
SBA2	Aspen - Hand	same as alternative B	
SBA3	Aspen - Helicopter	same as alternative B	
SBA4	Aspen - Helicopter	same as alternative B	
SBA5	Aspen - Hand	same as alternative B	
2	GS - Tractor	same as alternative B	
3	GS - Tractor	3	reduced GS - Tractor
7	ITS and GS - Tractor	7	reduced ITS and GS - Tractor
11G	DFPZ - Mastication, UB and GS - Tractor and Cable	same as alternative B	
11K	GS - Tractor and Cable	same as alternative B	
11P	DPFZ – Hand Cut and Pile Burn	same as alternative B	
12G1	DFPZ - Mastication and GS - Tractor	same as alternative B	
12G2	DFPZ - UB and GS - Cable	same as alternative B	
12P1	DFPZ - Hand Cut and Pile Burn	same as alternative B	
12P2	DFPZ - Hand Cut and Pile Burn	same as alternative B	
12P3	DFPZ - Mastication and Hand Cut and Pile Burn	same as alternative B	
13P1	DFPZ - No Treatment	No Treatment	
13P2	DFPZ - No Treatment	No Treatment	
13T	DFPZ - UB - Tractor	same as alternative B	
14A	GS - Tractor	same as alternative B	
14B	DFPZ - Mastication and GS - Tractor	same as alternative B	
14O	GS - Tractor	same as alternative B	
15	GS - Tractor	same as alternative B	

Alternative B		Alternative C	
Proposed Treatment Unit Number	**Proposed Treatment**	**Proposed Treatment Unit Number**	**Proposed Treatment**
15OS	DFPZ - No Treatment	No Treatment	
15P1	DFPZ - No Treatment	No Treatment	
15P2	DFPZ - Mastication	same as alternative B	
15T	DFPZ - Hand Cut and Tractor Pile	same as alternative B	
15TA	DFPZ - Hand Cut and Tractor Pile	same as alternative B	
15TS	DFPZ - No Treatment	No Treatment	
18	GS - Tractor	same as alternative B	
19	GS - Tractor	same as alternative B	
20	No Treatment	No Treatment	
21	GS - Tractor	No Treatment	
23	No Treatment	No Treatment	
27	GS - Tractor and Cable	same as alternative B	
29	GS - Tractor and Cable	same as alternative B	
28	GS - Tractor	No Treatment	
30	GS - Tractor and Cable	same as alternative B	
32	GS - Tractor	same as alternative B	
33	ITS and GS - Tractor	same as alternative B	
35	GS - Tractor and Cable	same as alternative B	
37	GS - Tractor	same as alternative B	
41	GS - Tractor	same as alternative B	
42	GS - Tractor	same as alternative B	
43	GS - Tractor	same as alternative B	
44	GS - Tractor	same as alternative B	
45	GS - Tractor	same as alternative B	
46	GS - Tractor and Cable	same as alternative B	
53	GS - Cable	same as alternative B	
55	GS - Helicopter	same as alternative B	
57	GS - Cable	same as alternative B	
58	GS - Cable	same as alternative B	
59	GS - Cable	same as alternative B	
61	GS - Tractor and Cable	same as alternative B	
62	GS - Cable	same as alternative B	
65	GS - Cable and Helicopter	same as alternative B	
68	GS - Cable	same as alternative B	
70	GS - Tractor and Cable	same as alternative B	
72	GS - Tractor and Cable	same as alternative B	
79i	GS - Tractor and Cable	same as alternative B	
79iii	GS - Tractor and Cable	same as alternative B	
87	GS - Tractor	same as alternative B	
90	GS - Cable	same as alternative B	
92	GS - Tractor and Cable	same as alternative B	
97	GS - Tractor	same as alternative B	
98	GS - Tractor and Cable	same as alternative B	
100	GS - Tractor and Cable	same as alternative B	
102	GS - Cable	same as alternative B	
103	GS - Tractor and Cable	same as alternative B	

Alternative B		Alternative C	
Proposed Treatment Unit Number	**Proposed Treatment**	**Proposed Treatment Unit Number**	**Proposed Treatment**
107	GS - Cable	same as alternative B	
108	GS - Cable	same as alternative B	
109	GS - Tractor	same as alternative B	
110	GS - Tractor	same as alternative B	
111	GS - Tractor	same as alternative B	
113	GS - Tractor	same as alternative B	
117	GS - Tractor and Cable	same as alternative B	
118	GS - Tractor	same as alternative B	
119	GS - Tractor and Cable	same as alternative B	
127	GS - Tractor and Cable	same as alternative B	
120	GS - Tractor and Cable	same as alternative B	
123	No Treatment	No Treatment	
128	GS - Tractor and Cable	same as alternative B	
130	GS - Tractor	same as alternative B	
134	GS - Tractor	same as alternative B	
140	GS - Cable	same as alternative B	
141	GS - Tractor and Cable	same as alternative B	
147	GS - Tractor and Cable	same as alternative B	
150A	GS - Tractor	same as alternative B	
150B	GS - Tractor and Cable	same as alternative B	
154	GS - Cable	same as alternative B	
161	GS - Cable	same as alternative B	
500	GS - Tractor	same as alternative B	
504	GS - Tractor	same as alternative B	
505	GS - Tractor	same as alternative B	
506	GS - Helicopter	same as alternative B	
507	GS - Helicopter	same as alternative B	
508	GS - Helicopter	same as alternative B	
510	GS - Helicopter	same as alternative B	
513	GS - Helicopter	same as alternative B	
516	GS - Tractor	same as alternative B	
519	GS - Tractor	same as alternative B	
523	GS - Tractor	same as alternative B	
524	GS - Tractor	same as alternative B	
526	GS - Tractor	same as alternative B	
530	GS - Tractor	same as alternative B	
533	GS - Tractor	same as alternative B	
535	GS - Tractor	same as alternative B	
539	GS - Tractor	same as alternative B	
540	GS - Tractor	same as alternative B	
542	GS - Tractor	542	reduced GS - Tractor
543	GS - Tractor and Cable	same as alternative B	
544	GS - Tractor	same as alternative B	
547	GS - Tractor	same as alternative B	
550	GS - Cable	same as alternative B	
552	GS - Tractor and Cable	same as alternative B	
556	GS - Tractor	same as alternative B	
558	GS - Helicopter	same as alternative B	

Alternative B		Alternative C	
Proposed Treatment Unit Number	**Proposed Treatment**	**Proposed Treatment Unit Number**	**Proposed Treatment**
563	GS - Tractor	same as alternative B	
566	GS - Tractor	same as alternative B	
573	GS - Tractor	573	No Treatment
577	GS - Tractor and Cable	same as alternative B	
579	ITS and GS - Tractor and Cable	same as alternative B	
584	ITS and GS -Tractor	reduced ITS and GS and changed to Helicopter	
585	GS - Cable	reduced GS and changed to Helicopter	
587	GS - Helicopter	same as alternative B	
590	GS - Tractor and Cable	same as alternative B	
591	No Treatment	No Treatment	
599	GS - Tractor and Cable	same as alternative B	
601	GS - Tractor	same as alternative B	
608	GS - Cable	same as alternative B	
610	GS - Tractor	same as alternative B	
612	GS - Tractor and Cable	same as alternative B	
613	ITS and GS - Tractor	same as alternative B	
614	GS - Tractor	same as alternative B	
615	GS - Tractor and Cable	same as alternative B	
618	GS - Tractor	same as alternative B	
619	GS - Tractor	same as alternative B	
624	GS - Tractor and Cable	same as alternative B	
626	GS - Cable	same as alternative B	
627	GS - Tractor	same as alternative B	
628	GS - Tractor	same as alternative B	
629	No Treatment	No Treatment	
633	No Treatment	same as alternative B	
634	GS - Cable	same as alternative B	
636	ITS and GS - Tractor	same as alternative B	
637	GS - Tractor	same as alternative B	
638	No Treatment	No Treatment	
639	No Treatment	No Treatment	
647	GS - Helicopter	same as alternative B	
649	GS - Helicopter	same as alternative B	
650	GS - Helicopter	same as alternative B	
900	DFPZ - GS - Cable	same as alternative B	
901A	DFPZ - Hand Cut and Tractor Pile and GS - Tractor	901A	Portion of unit changed from Hand Cut and Tractor Pile to Hand Cut and Pile Burn and reduced GS - Tractor
901B	DFPZ - GS- Tractor	901B	DFPZ – reduced GS- Tractor
901GHWK	DFPZ - No Treatment	No Treatment	
902	DFPZ - Hand Cut and Tractor Pile and GS - Tractor	same as alternative B	
903	DFPZ - Hand Cut and Pile Burn	same as alternative B	
904	DFPZ - Mastication	same as alternative B	

Alternative B		Alternative C	
Proposed Treatment Unit Number	**Proposed Treatment**	**Proposed Treatment Unit Number**	**Proposed Treatment**
905A	DFPZ - Thinning and GS - Tractor	same as alternative B	
905B	DFPZ - Thinning and GS - Tractor	same as alternative B	
906	DFPZ - GS - Cable	same as alternative B	
907A	DFPZ - Thinning, Mastication, and GS - Tractor	same as alternative B	
907B	DFPZ - Thinning, Mastication, and GS - Tractor	same as alternative B	
908	DFPZ - GS - Tractor and Cable	same as alternative B	
909	DFPZ - Thinning, UB, and GS - Tractor	same as alternative B	
910	GS - Helicopter	same as alternative B	
911	DFPZ - Mastication	same as alternative B	
912	DFPZ - UB and GS - Tractor and Cable	same as alternative B	
913	DFPZ - UB - hand	same as alternative B	
914A	DFPZ - Mastication	same as alternative B	
914B	DFPZ - Mastication	same as alternative B	
914C	GS - Tractor and Cable	same as alternative B	
915	DFPZ - Mastication	same as alternative B	

7.1 Alternative A – No Action

7.1.1 Indicator 1: Soil Productivity

Under Alternative A, the proposed Sugarberry project would not be implemented, and there would be no fungicide treatments. Thus, no environmental effects associated with the application of sporax would occur to long term soil productivity. The benefits from the use of sproax would not occur, which is would help prevent the spread of Heterobasidion annosum (annosus) root disease.

7.1.1.1 Measure 1: Effective Soil Cover

Direct, Indirect, and Cumulative Effects: The no-action alternative would allow effective soil cover to remain and develop at its current rate in the Sugarberry Project area. The continued accumulation of soil cover would contribute to increased ground and surface fuel loads, which may lead to increased fire severity and intensity during a fire event. If soil cover is reduced to bare soil following a wildfire, the soil type in this area would be more susceptible to erosion. This bare soil condition was observed on more than 40% (over 25,000 acres) of the 2007 Moonlight Fire on the Plumas National Forest. In addition, a high-intensity fire could induce the

formation of hydrophobic soil layers (soils resistant to water adsorption and infiltration), thus increasing runoff, and erosion in the short term. Immediately following a high intensity wildfire, the affected stands would not likely meet the Forest Plan standards and guides for effective soil cover.

The benefits from proposed fuel reduction, individual tree selection, and group selection treatments, watershed restoration, and aspen and black-oak stand enhancement would not occur. In the event of a future wildfire effective soil cover would be reduced in larger quantities than expected with the proposed project.

7.1.1.2 Measure 2: Soil Porosity

Direct, Indirect, and Cumulative Effects: Under the no-action alternative, no new soil compaction or displacement would occur as a consequence of activities proposed in the Sugarberry Project. In areas where there had been a decrease in soil porosity as a result of past land management activities, soil porosity may continue to slowly recover to pre-disturbance levels. The benefits from proposed fuel reduction, individual tree selection, and group selection treatments, watershed restoration, and aspen and black-oak stand enhancements would not occur. In the event of a future wildfire, severe soil heating may cause physical changes in soils, including a reduction in soil porosity (Clark 1994).

7.1.1.3 Measure 3: Soil Organic Matter

Direct, Indirect, and Cumulative Effects: Accumulation of organic matter would continue at current rates, and not be affected by harvest or prescribed fire. Increased organic matter would contribute to ground and surface fuel loads, which may lead to increased fire severity and intensity during a fire event. Fires instantaneously combust organic matter and cause the rapid acceleration of decomposition rates and nutrient cycling processes that are essential for plant growth and soil organisms. The effects of fire have short-term and long-term adverse effects (Neary et al. 2005). When organic matter burns, essential nutrient loss can occur during a fire in the following ways: nutrients are transferred to the atmosphere through volatilization and ash convection or surface runoff (erosion) of deposited nutrients in the surface ash layer (Neary et. al 2005 and Raison et al. 1984). Nutrients at a greater depth in the soil profile may be immediately lost following a fire due to leaching (Boerner 1982 and Neary et. al. 2005). Compared to the pre-burn condition, a large reduction in the organic matter covering the soil would reduce the insulating effect this layer has on soil temperature. Under a reduced organic layer, soils would experience greater temperature extremes. In addition, a blackened surface, due to partially

combusted organic materials, would absorb more light and become warmer than a soil without a dark surface (Ahlgren and Ahlgren 1960). Soil temperatures may be elevated for months or years depending on the degree of organic matter consumption (Neary et al. 1999). Such changes in the soil temperature regime would affect the rates of biological activity in the soil, resulting in altered nutrient cycling regimes (Neary et. al 2005). These effects would adversely affect long term soil productivity.

The benefits from proposed fuel reduction, individual tree selection, and group selection treatments, watershed restoration, and aspen and black-oak stand enhancement would not occur. In the event of a future wildfire effective soil organic matter would be reduced in larger quantities than expected with the proposed project.

7.1.2 Indicator 2: Soil Hydrologic Function

Direct, Indirect, and Cumulative Effects: Under Alternative A, the proposed Sugarberry project would not be implemented, and there would be no fungicide treatments. Thus, no environmental effects associated with the application of sporax would occur to long term soil productivity. The benefits from the use of sproax would not occur, which is would help prevent the spread of Heterobasidion annosum (annosus) root disease. Also infiltration and permeability rates would not be reduced by management activities. Ground and surface fuel loads would not be treated, which could lead to increased fire severity and intensity during a fire event. If hydrophobic conditions were caused by a high intensity wildfire, the infiltration and permeability rates would change. This could result in slowed plant growth, impeded root development, and increased overland flow during high precipitation events. The benefits from proposed fuel reduction, individual tree selection, and group selection treatments, watershed restoration, and aspen and black-oak stand enhancement would not occur.

7.1.3 Indicator 3: Soil Buffering Capacity

Under Alternative A, the proposed Sugarberry project would not be implemented, and there would be no fungicide treatments. Thus, no environmental effects associated with the application of sporax would occur to soil buffering capacity. The benefits from the use of sproax would not occur, which is would help prevent the spread of Heterobasidion annosum (annosus) root disease.

7.2 Alternative B – Proposed Action

7.2.1 Indicator 1: Soil Productivity

7.2.1.1 Measure 1: Effective Soil Cover

Direct and Indirect Effects: Direct and indirect effects on this measure include partial removal of effective soil cover. It is difficult to predict precise treatment effects on forest floor materials; however, general trends are well established. Group selection, thinning, and ITS treatments typically decrease effective soil cover due to felling and skidding operations which tend to displace duff and litter along the equipment tracks (Westmoreland and McComb 2005). Mastication treatments typically increase soil cover and organic matter as materials are broadcast away from the machine. Pile burning and underburning could reduce effective soil cover. Pile burning would remove forest floor at numerous small sites that would total a small percentage of a stand area. In the majority of the proposed underburning treatment units, treatments are expected to occur under prescribed conditions that would not result in complete combustion of the duff and litter layers. Typically the duff layer is thick, and fire and fuels specialists have observed that only small quantities of the duff layer is burned, especially on steep slopes where underburning is the only proposed treatment. However, proposed underburning treatment units 912 and 913 contain naturally hydrophobic and highly erosive soils and have an thin duff and litter layer. BMP monitoring of the Upper Slate DFPZ project has occurred in underburn treatment areas with similar soil types and existing conditions (thin duff and litter layer). Underburn treatments occurred when fuel moisture was to dry and a moderate to high intensity fire resulted. During this fire some treatment areas had little to no consumption of the duff and litter layer. Other areas had complete consumption of the duff and litter layer and exposed bare soil, causing rilling and erosion of the surface soils. To prevent a medium to high intensity fire in proposed treatment units 912 and 913, burning would occur during cool conditions to prevent loss of effective soil cover below standards and guides.

A reduction in forest floor cover would increase the risk of surface soil erosion temporarily in affected areas. The removal of forest material is most likely to occur in areas where most soil cover is removed in areas such as landings, skid roads, temporary roads, and equipment tracks. The quantity and type of soil erosion depends on the character of the area. For example, patches of forest floor material across a large area would be more effective at intercepting surface water than large areas devoid of effective soil cover. Soil erosion will be minimized by the installation of erosion control structures (cross ditches, waterbars) which is a standard timber sale contract practice. In thinned areas, litter fall from the residual trees will add

to soil cover in disturbed areas. Soil monitoring across the HFQLG Pilot Project has verified that management mitigation measures are effective at minimizing soil erosion potential and soil cover usually meets standards and guides following project completion (see "Cumulative Effects" discussion below)

The goal of road decommissioning, as described in the proposed action, is to restore the designated land base to natural conditions and allow natural revegetation to restore soil cover on the decommissioned road bed surfaces. Through time an increase in soil cover would occur on the existing roadbed and reduce surface erosion. Fish passage improvements and meadow restoration would not affect soil cover in areas where ground-based mechanical equipment would not be used. If ground-based mechanical equipment is used for these improvement activities, soil cover would be maintained with the use of standards, guidelines, mitigation measures, and BMPs (refer to appendix A and the Sugarberry "Hydrology Report"). Streambank restoration would increase soil cover on unstable streambanks. Stabilization of streambanks would require the enhancement of an effective soil cover (e.g., planting willow, large boulders, logs, etc.) to prevent further erosion.

Cumulative Effects: The implementation of this alternative has important positive cumulative effects for long term soil productivity, which is the reduction of future wildfire risk or a modification of future wildfire behavior and intensity. Wildfire, typically occurring under conditions of high heat and low humidity, would result in nearly complete combustion of soil cover, and a significant increase in the risk of erosion. The proposed DFPZ (mastication, thinning, and prescribed burning), group selection, and individual tree selection treatments are designed to reduce the risk of wildfire and behavior of a wildfire by modifying the arrangement of fuels and regenerate disease free and fire-resilient species.

Cumulative effects of proposed mastication treatments are expected to increase the existing soil cover and as a result increase fine organic matter for both soil protection and nutrient cycling. Under the existing condition all of the proposed mastication treatment units surveyed meet or exceed Forest Plan standards and guides for percent effective soil cover. Appendix A lists several mitigation requirements that would be used to reduce the potential of loss of soil cover from mastication treatments. The mitigation requirements included equipment specifications, equipment use, and soil wetness conditions.

Cumulative effects of thinning, group selection, and ITS treatments proposed in alternative B are expected to temporarily reduce effective soil cover from the existing condition. Under the existing condition all proposed group selection, thinning, and ITS treatment units exceed Forest Plan standards and guides. A quantifiable reduction in soil cover is difficult to

determine. Quantifiable reductions were reported in the 2004, 2005, and 2006 HFQLG Soil Monitoring Reports (Westmoreland and McComb). Since 2001 pre- and post-treatment soil monitoring has been conducted across the HFQLG Pilot Project in group selection and thinning treatment units. While no statistical analysis has been performed on this data, general trends and expected ranges of effects are established. In 2004 post treatment effective soil cover was determined in nine thinning treatment units. On average effective soil cover decreased from 90 to 81 percent, with a nine percent total reduction (Westmoreland and McComb 2004). In 2005 post treatment effective soil cover was collected in eleven group selection treatments units and 20 thinning treatment units. On average effective soil cover decreased from 91 to 64 percent, with a 27 percent total reduction (Westmoreland and McComb 2005). In 2006 post treatment effective soil cover was collected for in eleven thinning treatment units and three group selection treatment units. On average soil cover decreased from 93 to 83 percent, a 10 percent total reduction (Westmoreland and McComb 2006). All reductions of effective soil cover measured in post treatment units during the monitoring study are within Forest Plan standards and guides.

Reductions in soil cover following implementation of group selection, thinning, and ITS treatments are expected to be within the ranges found during the HFQLG soil monitoring. Conservatively assuming the largest observed reduction, the average 27 percent reduction in soil cover from the 2005 HFQLG Soil Monitoring Report was applied as the methodology to calculate cumulative effects. Reductions in effective soil cover are expected to be short-term and effective soil cover is expected to meet or exceed Forest Plan standards and guides in all proposed thinning, group selection, and ITS treatment units (Table 10).

Proposed treatment unit 908 is at high risk for a reduction in effective soil cover (41 percent) below Forest Plan standards and guides following proposed group selection treatments (Summary Table S-3). Proposed treatment 908 has had the following past land management activities: plantation created in 1989, DFPZ treatments 2004 (hand cut and pile burn and mastication), and sanitation salvage in 2007. In proposed treatment unit 908, under the existing condition effective soil cover exceeds the Forest Plan standards and guides at 68 percent. This proposed treatment contains soil map units 211 and 212, and soil cover maintenance is essential due to erosive nature of these soils. To mitigate for the reduction of effective soil cover and associated soil erosion C Clause C6.601 would be required in the Timber Sale Contract. This C clause requires the seeding and mulching in areas of disturbed bare ground such as landings and skid trails (see Appendix A).

Summary Table S-3: Proposed treatment unit(s) at high risk for reductions in effective soil cover below Forest Plan Standards and Guides.

Proposed Treatment Unit Number	Proposed Treatment(s)	Existing Condition Effective Soil Cover	Cumulative Effects of Alternative B Effective Soil Cover
908	DFPZ – GS-Tractor and Cable	68 percent	41 percent

Table 10: Alternative B Cumulative Effects Measure 1 – Soil Cover in proposed treatment units with thinning, group selection, and individual tree selection treatments (see Table 9 for proposed treatments).

Alternative B: Proposed Treatment Unit Number	Unit Surveyed With Similar Conditions	Units Not Surveyed With Similar Conditions	Existing Condition Effective Soil Cover (Percent)	Maximum Erosion Hazard Adjective Rating	Forest Plan Standards and Guides for Minimum Effective Soil Cover (Percent)	Cumulative Effects of Soil Cover with a 27% Reduction (Percent)
2		901B	76	Low	40	49
7	533		100	Low	40	73
11G			100	Low	40	73
			100	Low	40	
11K			84	Low	40	57
12G1	46, 128, 134	57, 58, 59, 62, 68, 150A	96	Low	40	69
13T		141	92	Low	40	65
14A	21, 905A, 907A, 905B	3, 14B, 15, 530, 905A	92	Low	40	65
20	14A, 905A, 907A, 907B	3, 14B, 15, 530, 905A	95	Low	40	68
21	14A, 905A, 907A, 907B	14B, 15, 32, 526, 905B	100	Low	40	73
23	14A, 33, 907A	14B, 15, 19, 526, 530, 601	100	Low	40	73
27		28, 30, 35, 79i, 539, 544, 601, 610, 612, 613, 614, 615, 619, 636, 637	88	Low	40	61
29						
33	21	32, 905B	96	Low	40	69
43			96	Low	40	69
44	12G1, 128	41, 42, 61, 68, 130	96	Low	40	69

Alternative B: Proposed Treatment Unit Number	Unit Surveyed With Similar Conditions	Units Not Surveyed With Similar Conditions	Existing Condition Effective Soil Cover (Percent)	Maximum Erosion Hazard Adjective Rating	Forest Plan Standards and Guides for Minimum Effective Soil Cover (Percent)	Cumulative Effects of Soil Cover with a 27% Reduction (Percent)
45						
46						
72	147	61, 70, 97, 98	100	Low	40	73
79iii		72, 92, 612, 619	100	Low	40	73
87			96	Low	40	69
90	79iii	92	96	Low	40	69
100	103, 118, 119, 127	117	100	Low	40	73
102	100, 103, 118, 119, 127	117	96	Low	40	69
103	100, 118, 119, 127	117	100	Low	40	73
109	111	111	92	Low	40	65
111	109	111, 113, 120	96	Low	40	69
118	100, 103, 119, 127	117	96	Low	40	69
119	100, 103, 118	117, 624, 627	92	Low	40	65
127						
123	111	113, 120	88	Low	40	61
128	12G1, 46, 134	18, 130, 150A, 544	80	Low	40	53
134	12G1, 128	97, 98, 150A	100	Low	40	73
147	72	130, 141	92	Low	40	65
150B		14O	96	Low	40	69
500			84	Low	40	57
505		615	96	Low	40	69
516			96	Low	40	69
533	7, 556	519, 526, 535, 543, 552, 566, 590, 599, 601	98	Low	40	71
540		542	92	Low	40	65
556	533	72, 504, 519, 523, 524, 526, 535, 543, 544, 552, 566, 584, 590, 599, 601	92	Low	40	65

Alternative B: Proposed Treatment Unit Number	Unit Surveyed With Similar Conditions	Units Not Surveyed With Similar Conditions	Existing Condition Effective Soil Cover (Percent)	Maximum Erosion Hazard Adjective Rating	Forest Plan Standards and Guides for Minimum Effective Soil Cover (Percent)	Cumulative Effects of Soil Cover with a 27% Reduction (Percent)
558	556	72, 504, 519, 523, 524, 526, 544, 550, 615	88	Low	40	61
563			96	Low	40	69
573	628	547, 584, 601	92	Low	40	65
591	573, 628	547, 584, 601	96	Low	40	69
628	573	55, 547, 584, 601	94	Low	40	67
629	573, 591, 628, 902	55, 547, 584, 601, 914C	92	Low	40	65
902	629	577, 579, 618, 914C	96	Low	40	69
905A	14A, 21, 907A, 907B	3, 14B, 15, 530, 614, 905B	96	Low	40	69
907A	14A, 21, 905A, 907A	14B, 15, 530, 614	100	Low	40	73
907B	14A, 21, 907A, 907B	3, 14B, 15, 530, 614, 905B	0	Low	40	96
908			68	Moderate	50	41
909			84	Low	40	57

7.2.1.2 Measure 2: Soil Porosity

Direct and Indirect Effects: Direct and indirect effects on this measure occurs when soil porosity decreases and detrimental soil compaction increases. The use of heavy forestry equipment and re-entry of stands would increase the potential for detrimental soil compaction (Powers 1999). The degree of detrimental soil compaction varies with soil texture, soil moisture content at the time the activity takes place, the weight or ground pressure of the equipment used, and whether woody material remains in place to cushion the weight of the equipment while the operation is occurring. Increases in detrimentally compacted areas are expected in proposed group selection and thinning treatment units due to the need for new skid trails, landings, or temporary roads. Increases in detrimental compaction have been documented in group selection and thinning treatment units within the HFQLG Pilot Project (Westmoreland and McComb 2006). Results of HFQLG soil monitoring are used as the basis for the cumulative effects discussion presented below.

It is expected there would be no direct and indirect effects from proposed mastication treatments units since landings and skid trail are not re-used or created. Appendix A lists equipment specifications used to mitigate for potential detrimental soil compaction in mastication treatment units. There is a high risk for detrimental soil compaction to occur in proposed treatment units with high clay content, if operations occur when clay soils have a moisture content that is near field capacity. To reduce the risk of mastication treatments causing detrimental compaction, a Limited Operation Period (LOP) would be applied to the entire Sugarberry Project. The LOP would allow ground-based harvest equipment to operate only when soils are considered dry. Soil is defined as “dry” when the upper 8 inches is not sufficiently moist to allow a soil sample to be squeezed and hold its shape, or crumbles when the hand is tapped. Dryness would be determined by the sale administrator upon the recommendation of a soil scientist.

Improvements to the transportation system described in the proposed action would help alleviate the overall extent of detrimental compaction within the project boundary. Road decommissioning would reduce the total area of compacted roadbed, and return these areas to the productive forest land base. Fish passage improvements and meadow restoration would not increase soil compaction where ground-based mechanical equipment would not be used. Where ground-based mechanical equipment is used standards would be met by applying standards, guides, mitigation measures, and BMPs listed in the Regulatory Framework section and Appendix A. Removal of streamside roads during streambank restoration would reduce

detrimental soil compaction on unstable streambanks. Stabilization of streambanks would include enhancements of riparian vegetation, and these measures would reduce compaction as well.

Cumulative Effects: Cumulative effects due to detrimental soil compaction could occur if project activities, combined with past or future foreseeable actions, were to result in an unacceptable proportion of the landscape experiencing detrimental soil compaction that would adversely affect long term soil productivity.

Since 2001 pre- and post treatment soil monitoring has been conducted across the HFQLG Pilot Project in group selection and thinning treatment units. A total 52 treatment areas have been examined post treatment. The findings reported to date are included in the 2004, 2005, and 2006 HFQLG Soil Monitoring Reports (Westmoreland and McComb 2004, Westmoreland and McComb 2005, and Westmoreland and McComb 2006). The monitoring method has been mostly visual examination of soil porosity and structure using a tile spade, with some quantifiable soil core sampling to corroborate the visual examination determination (same method used for determining detrimental soil compaction for the Sugarberry Project). The monitoring method calls for the observer to determine whether or not (yes or no) the sample point meets or exceeds the threshold stated in the R5 Soil Management Handbook (Westmoreland and McComb 1995). This monitoring protocol method does not determine the actual degree of change in soil bulk density or porosity at the sample point. In general, the findings indicate that legacy detrimental compaction occurs in the majority of the monitored sites. Post treatment monitoring between 2004 and 2006 has shown a total of 25 out of 52 (about 50 percent) treatment units have had an increase in detrimental soil compaction (Westmoreland and McComb 2006). Within these 25 treatment units, the areal extent of detrimental compaction increased between 2 and 40 percent with an average of 13.5 percent increase (Westmoreland and McComb 2006). A decrease in detrimental compaction was observed in the post treatment monitoring in 2005 (Westmoreland and McComb 2005). Decreases occurred in nine group selection treatment area (1 to 2 acre treatment area) and seven thinning treatment units with subsoiling occurring after project completion. Of the group selection treatment units, one treatment unit had the landing subsoiled, six treatment units were completely subsoiled and replanted, and two treatment units the skid trail system was subsoiled. In the units completely subsoiled, compaction only increased an average of five percent. In the two treatment units with the skid trail system subsoiled, overall the compaction level increased from 14 to 19 percent. In the thinning treatment units the skid trails were subsoiled and had an average decrease of seven percent in detrimental soil compaction. The 2006 HFQLG Soil Monitoring Report concludes within group selection treatment areas, not subsoiled, there is a statistically significant increase in detrimental soil compaction

(Westmoreland and McComb 2006). These treatments are one to two acres in size with concentrated ground disturbing activities. The increase in detrimental soil compaction for group selection treatments were not analyzed on the timber stand as a whole. The current findings also concluded that when subsoiling is used as mitigation measure post-treatment, the mean amount of detrimental compaction is less than the pre-treatment mean. However the decrease in compaction was not statistically significant (Westmoreland and McComb 2006).

Ongoing research has been published on the effects of soil compaction to long term soil productivity. Powers et al (2005) recently published the ten year results of The Long Term Soil Productivity (LTSP) study. This is a national and international study initiated in 1989 and is comprised of 62 study sites, including sites in the Sierra Nevada. The goals of the study are to gain understanding of a site's potential soil productivity and effects of land management activities. The study focuses on two key components readily affected by management, soil porosity and soil organic matter. The LTSP study has 1-acre study plots with 3 levels of compaction (none, intermediate, and severe- similar to a landing), in factorial combination with 3 levels of organic matter removal (bole only, whole tree, whole tree and all forest floor). All plots were clearcut and planted with native species. In addition, to investigate the role of understory vegetation in compaction recovery, vegetation was allowed to naturally return on half of each plot, controlled on the other half by manual or chemical methods. The national ten year results indicate that soil compaction effects on total biomass productivity (all vegetation within a site, not just tree growth) differs depending upon the soil particle size or soil texture, along with other factors such as initial bulk density, rock content, and climate. On soils characterized as Sandy, compacted plots had greater biomass productivity than uncompacted plots; on soils characterized as Loamy, compaction resulted in little change in biomass productivity; and on soils characterized as Clayey, compaction resulted in up to a 50% reduction in biomass productivity at particular sites in the Southern Coastal plains, primarily in areas with poor soil drainage or high water table. This ten-year publication incorporated results from 6 of the 12 California sites.

Recently in June 2007, during the National LTSP Conference, additional results were presented by David Young (R5 North Zone Soil Scientist) incorporating 9 of the 12 California sites to reach ten years; these sites include all study sites within the Sierra Nevada (including Challenge Experiential Forest located on the Feather River Ranger District of the Plumas National Forest). The following information from recent findings is based on personal communications with David Young (June through July 2007), again reflecting total vegetation biomass in addition to trees. For the clay loam sites (Challenge and Brandy City), there is no statistical difference in total biomass production between the no, moderate, and severe

compaction levels. On sites with soils characterized as Loam (Lowell Hill and Blodgett), there is no statistical difference in total biomass production between the no, moderate, and severe compaction levels. The are five study sites with soils characterized as Sandy Loam (Rogers, Wallace, Vista, Central Camp, and Owl); on three of the sites there is no statistically significant difference in total biomass production between the no, moderate, and severe compaction levels. At the Rogers site (parent material decomposing granite) there was an increase in biomass production in the moderate and severe compaction levels compared to no compaction. At the Owl site, there was a decrease in biomass production in the moderate and severe compaction levels, attributed to a rise in water table after harvest, so aeration porosity was limited by compaction. The latest results have concluded that soil compaction, even above degrees considered detrimental by Regional analysis standards, has little effect on soil productivity at most sites, at least at ten years of growth. These results will be revisited and published after ten year data is available for all 12 California LTSP sites.

It is important to note that LTSP compaction treatments were experimental- as much plot area as possible was compacted (90+ %) and to greater severity than normally encountered during operational practices. Therefore, treatments represent a “worst case scenario” when compared with current operational practices, and resulting effects would presumably be much greater. Despite this, no significant effects of compaction on soil productivity have been discovered at most sites.

Conclusions: Results from the HFQLG Soil Monitoring study are inconclusive for quantifying the cumulative increases or decreases in detrimental soil compaction in timber stands with thinning and group selection treatments. Within the Sugarberry soil analysis area legacy detrimental compaction was observed in the majority of the proposed treatment units surveyed in the Sugarberry Project area. It is expected that Sugarberry project would cumulatively increase the level of detrimental soil compaction in thinning and group selection treatment units. . Most of the analysis area contains soils classified as loam or sandy loam, with some occurrence of clay loams. The current LTSP study suggests that soil compaction does not affect soil productivity, except with poorly drained or perennially wet soils (unusual occurrence for general forest soils). Regardless, project design mitigations have been included to decrease the level of detrimental soil compaction that would occur as a result of proposed treatments.

Mitigations: To reduce the increase of detrimental compaction, a Limited Operation Period (LOP) would be applied to the entire Sugarberry Project. The LOP would allow ground-based harvest equipment to operate only when soils are considered dry. Soil is defined as “dry” when the upper 8 inches is not sufficiently moist to allow a soil sample to be squeezed and hold

its shape, or crumbles when the hand is tapped. Dryness would be determined by the sale administrator with available consultation by a soil scientist. In addition to the LOP, subsoiling would occur on all landings used, 200 feet of the main skid trail approach to the landing, and temporary roads (Appendix A). When properly designed and implemented, subsoiling is effective at reducing soil compaction (Kolka and Schmidt 2004). When subsoiling is used to mitigate for detrimental soil compaction, increases in group selection and thinning treatments would be less (Westmoreland and McComb 2005). Subsoiling on skid trails would not exceed a 25 percent slope, to prevent unacceptable risks of soil erosion and to tree health. Subsoiling creates loose soil material that is susceptible to erosion, and erosion is more likely to occur on steeper slopes. Also there is some risk of root damage to plants during subsoiling. In addition Brent Roath (Region 5 Soil Scientist) recommends not subsoiling on skid trails within harvest units on coarse textured soils (USDA texture classes: sands; loamy coarse sands; and coarse sandy loams with less than 5% clay) that have developed from granitic parent material (Regional Office Subsoiling Review letter June 29, 2006). These soils lack structure, aggregation and are cohesionless in their natural state because of the low clay and very high sand content. These characteristics appear to make subsoiling ineffective, given the results observed during this review. Likewise, these soils are highly erosive. The subsoiling results observed during June 12-14, 2006 indicated that narrow channels were formed where the tines were pulled through the soil, and in-between the furrow marks the soil was still compacted or crusted. This situation resulted in the channeling and concentration of runoff water in the furrows which caused unacceptable erosion levels. The erosion potential and its control must be carefully evaluated before subsoiling landings or temporary roads with coarse textured granitic soils. All areas to be subsoiled are finalized by sale administer and the sivilculturist and soil scientist are available for consultation.

7.2.1.3 Measure 3: Soil Organic Matter

Direct and Indirect Effects: Direct and Indirect effects on this indicator include the removal of soil organic matter, potential short-term reduction of soil nutrients, and loss of habitat for organisms inhabiting soil organic matter. The R5 Soil Management Handbook is concerned with maintaining soil organic matter in the amounts sufficient to prevent significant short or long-term nutrient cycle deficits, and to avoid detrimental physical and biological soil conditions. The R5 Soil Management Handbook provides recommend indicators and thresholds for determining sufficient amounts of soil organic matter. Indicators include fine organic matter and large woody material.

Fine organic material includes plant litter, duff, and woody material less than 3 inches in diameter. Large woody material consists of down logs that are least 20 inches in diameter and 10 feet long. Down logs decay slowly over time and provide structural habitat for organisms that produce nitrogen and are an excellent growth medium for mycorrhizal fungi. Fine organic matter and large woody material are components of soil cover. Therefore, the direct and indirect effects to fine organic matter are the same as the effects to soil cover (Section 7.2.1.1).

Cumulative Effects: On going research has been published on the effects of the removal of soil organic matter to long term soil productivity. Powers et al (2005) recently published the ten year results of The Long Term Soil Productivity (LTSP) study. This is a national and international study initiated in 1989 and is comprised of 62 study sites, including sites in the Sierra Nevada. The goals of the study are to gain understanding of a site's potential soil productivity and effects of land management activities. The study focuses on two key components readily affected by management, soil porosity and soil organic matter. The LTSP study has 1-acre study plots with 3 levels of organic matter removal (bole only, whole tree, whole tree and all forest floor), in factorial combination with 3 levels of compaction (none, intermediate, and severe). The national ten year results indicate that bole only and whole tree OM removals have had no detectable effects on soil nutrition or biomass productivity. At whole tree plus complete removal of all surface organic matter, there was a decline in soil Carbon concentration to 20 cm depth and reduced nutrient availability, due to the loss of the forest floor. In 4 of the California sites (spanning the range of textures) investigated for Nitrogen availability, there was a decline in Nitrogen availability at the whole tree plus forest floor removal level (personal communication with David Young, graduate research work conducted by Terry Craigg). In regards to biomass productivity with the California sites: (1) in clay loam sites there is a slight but significant decline in biomass productivity at the extreme OM removal level, (2) in loam sites there is no difference in biomass productivity between treatments, and (3) in sandy loam sites there is a slight increase in biomass productivity at progressive levels of OM removal (personal communication with David Young).

The HFQLG 2004, 2005, and 2006 soil monitoring data reports included data collection on large woody material. In 2004 nine thinning treatments were post monitored and large down woody material decreased form 10.5 logs per acre to 4 logs per acre (Westmoreland and McComb 2004). In 2005 20 thinning treatment units and 11 group selection units were post monitored and large woody material decreases from an average of 10 logs per acre to 2 logs per acre, usually due to follow-up fuels treatments (Westmoreland and McComb 2005). Typically, prescribed underburning treatments reduce the quantity of large woody material, but do not entirely

eliminate it. In 2006 three group selection treatment units and 11 thinning treatment units were post monitored and large woody material decreased from an average of 9 logs per acre to 4 logs per acre. The reduction was most likely caused during follow-up fuel treatments (prescribed burning) (Westmoreland and McComb 2006).

The majority of proposed treatment units expected to have follow up prescribed burning. The HFQLG soil monitoring reports show a trend in reduction of large woody material in burning treatment units. However no statistical analysis has been performed to determine confidence interval. There are proposed treatments units under the existing condition that are below the R5 recommended threshold for large woody material, and several proposed treatment units could be below recommended threshold following proposed treatments. The R5 guidelines allow for the adjustment of this threshold when fuel management treatments are needed. It has been determined that the Sugarberry Project is needed for fuel management and the utilization of both mechanical and fire treatment methods is documented as the most effective treatment to modify potential fire behavior and severity, see Vegetation, Fire, and Fuels Analysis" on file in the project record for further information.

Recently there have been new research presentations by PSW on the importance of large woody material to soil nutrients (personel communication with David Young, research conducted by Robert Powers). One study occurred on the Blacks Mountain Experimental Forest in northeast California in eastside pine ecotypes. Conclusions from the study include: Organic carbon and nitrogen concentrations are much higher in decaying wood material than mineral soil. However, soil beneath all log decay classes has no greater carbon or nitrogen content than beneath other cover types, so large woody material is not considered important for nutrient storage or cycling with respect to soils. Even when very high amounts of coarse large woody material occur, annual inputs of nitrogen from nonsymbiotic fixation are very low. Large woody material does provide habitat for fungi, and retain plant available water.

Conclusions: Results from the HFQLG Soil Monitoring study are inconclusive for quantifying the decreases in large woody material in timber stands with thinning and group selection treatments. Recent research demonstrates that organic carbon and nitrogen concentrations are much higher in decaying wood material than mineral soil and concludes that large woody material is not considered important for nutrient storage or cycling with respect to soils (personal communication with Robert Powers). However large woody material plays a large role for wildlife habitat, and retention of large down logs would be mitigated for wildlife Forest Plan standards and guides (refer to Sugarberry "Wildlife Biological Evaluation/Biological Assessment for more information). The cumulative quantity of fine organic matter was estimated

using the analysis for soil cover, see Section 7.1.1.1. Soil cover is expected to meet Forest Plan standards and guides in all proposed treatment areas. Effects of the removal of soil organic matter are expected to be short-term and have no effects to long term soil productivity.

7.2.2 Indicator 2: Soil Hydrologic Function

Direct, Indirect, and Cumulative Effects: Infiltration rates and permeability rates can be reduced by various management activities. Compaction, puddling, and hydrophobic conditions caused by fire can change infiltration rates and permeability. Effects include slowed plant growth, impeded root development, and increased overland flow during high precipitation events. The Erosion Hazard Rating (EHR) is used to asses the project effects to soil hydrologic function. Under all action alternatives soil hydrologic function is not expected to be altered by proposed management activities. Soil cover is expected to meet or exceed Forest Plan standards and guides in all proposed treatment units following management activities. Mitigation measures have been designed to decrease the risk of detrimental soil compaction and puddling. Prescribed burning treatments are expected to use low intensity fires, which typically do not result in hydrophobic conditions. For these reasons, there are no anticipated cumulative effects to soil hydrologic function.

7.2.3 Indicator 3: Soil Buffering Capacity

It is not expected that soil buffering capacity within the Sugarberry Project area would be changed by proposed management activities. No chemicals or materials would be added to the soil that would alter reaction classes, buffering or exchange capacity.

7.3 Alternative C

7.3.1 Indicator 1: Soil Productivity

Direct, indirect, and cumulative effects of soil productivity under Alternative C are expected to be the same or similar compared to Alternative B (see Section 7.2.1). Under alternative C there are 20 acres less of group selection treatments and 5 acres less of ITS treatments. Since there is a reduction of proposed treatments, a reduction in effects to soil cover, soil porosity, soil organic matter are expected to be less under Alterative C compared to Alternative B. The same mitigation measures under Alterative B apply to proposed treatment units under Alterative C.

7.3.2 Indicator 2: Soil Hydrologic Function

Direct, indirect, and cumulative effects to soil hydrologic function under Alternative C would be the same as Alternative B (see Section 7.2.2).

7.3.2 Indicator 3: Soil Buffering Capacity

Direct, indirect, and cumulative effects to soil buffering capacity under Alternative C would be the same as Alternative B (see Section 7.2.2).

7.4 Alternative G

Direct, indirect, and cumulative effects of soil productivity under Alternative G are expected to be the same or similar compared to Alternative C (see Section 7.2.1). Under alternative G there are additional roads proposed for decommissioning. The goal of road decommissioning, as described in the proposed action, is to restore the designated land base to natural conditions and allow natural revegetation and restore soil productivity.

8. Reasonable Foreseeable Future Actions

The proposed DFPZ treatments for the Sugarberry project would eventually be connected to other DFPZ projects currently being implemented.

9. Irreversible, Irretrievable Effects

There are no irreversible or irretrievable effects associated with Alternatives A, B, and C. Disturbances to soil productivity would short term and recover through natural processes and/or mitigation. To minimize effects from Alternatives B and C standards, guides, mitigation measures, and BMPs listed in the Regulatory Framework Section and Appendix A would be used.

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11. The Author

Kelly Whitsett has the following degrees: B.S. in Geology and Geophysics from the University of Missouri-Rolla and M.S. in Hydrogeology from the University of Arkansas-Fayetteville. Kelly has had numerous geology classes where soil science was a topic, including soil classifications. The watershed staff on the Feather River Ranger District received the following soil science training: (1) two days of training by Jeff TenPas (former Region 5 Central Zone Soil Scientist) on the proper techniques for soil transects field surveys in 2004, (2) Region 5 Soils Conference June 2007, and (3) Field Soil training for HFQLG Forests June 2007. The Feather River Ranger District watershed staff has been conducting soil condition surveys for three field seasons. The data collected for this report was performed by summer field employees (college students that are working towards a degree in natural science fields). These employees received two weeks of training by the district watershed staff. Through out the field season random field visits occurred to ensure collection sampling had continued to be performed properly. Field data was reviewed weekly for accuracy, and if information was incorrect, the field employees would re-survey. During the development of HFQLG projects Kelly consulted with experienced Forest Service soil scientists to ensure the analysis was being performed properly. The following soil scientists have been consulted: Emily Moghaddas (Plumas National Forest, Forest Soil Scientist), Randy Westmoreland (Tahoe National Forest East Zone Watershed Program Manger), Brent Roath (Region 5 Soil Scientist), and David Young (Region 5 North Zone Soil Scientist).