Geology/Soils

Methodology for Analysis

Data used to determine existing soil conditions and projected effects to the soil resource include: the Soil Survey of the Sierra National Forest, (Giger 1993), site specific data from soil transects collected in 2007, following the Region 5 Protocol for Soil Monitoring (TenPas 2005) and past monitoring of similar projects using BMP Monitoring Protocols (USDA-FS 2002) and the Region 5 Soil Monitoring Protocol.

Effects of the proposed project will be similar to effects of recent, similar past projects implemented with current Best Management Practices and equipment that has been used in recent projects. These projects include the Cedar Valley Project, Graham Mountain Project, South of Shaver Project and several other similar projects.

Soil resource management is achieved by maintaining soil productivity using Regional Soil Quality Standard and Guidelines and management direction provided in the LRMP (USDA-FS 1991). Soil productivity is evaluated within an Activity Area. An Activity Area is the area of land dedicated to growing vegetation which soil quality standards for soil productivity are applied. It is that area within a management area where soil disturbing activities take place and is of practical size for management, sampling, and evaluation. Activity areas include timber harvest units and fuels treatment units within the Sugar Pine Project area. System roads and trails and other areas not dedicated to growing vegetation are not included as part of activity areas.

The project proposal could affect soil productivity in the Sugar Pine Project Area by reducing 1) soil porosity, 2) soil cover and 3) large woody debris and 4) displacement of surface soils.

The main soil physical property that can be affected by the proposed action is porosity, the space between individual soil particles. Soil hydrologic function is primarily dependent on the size and arrangement of soil pores, or pore geometry. Soil pore geometry also controls the transmission of air through soils, which is critical for plant growth. When porosity is decreased, the soil becomes denser, making it more difficult for roots to penetrate. Maintenance of natural soil porosity is important for maintaining healthy native plant communities and for maintaining the hydrologic function of the soil. Severe losses of porosity through soil compaction decrease the water and air available to plant roots, creating droughty and/or anaerobic conditions as well as physically inhibiting root growth. Soil hydrologic function is usually impaired as water storage capacity, infiltration, and permeability decrease, thus increasing runoff and the subsequent potential for erosion and cumulative watershed effects. Soil compaction diminishes soil porosity, and decreases the transmission of water, nutrients, and air to roots. Severe compaction can inhibit root growth when the soil becomes too dense for roots to penetrate easily. Finally, compaction decreases infiltration and hydraulic conductivity, the movement of water into and through soils, which in turn increases surface runoff and erosion potential. Severely compacted soils could take at least 50 years to recover. Bulk density (ratio of soil mass to soil volume) and soil strength (penetration resistance) are two widely accepted indirect means of measuring changes in porosity in the field. Qualitative indicators of compaction include platy soil structure, loss of soil structure (e.g. puddling), impressions or ruts in the mineral soil surface, and in some cases, redoximorphic features that indicate a recent change in soil aeration. Redoximorphic features are soil properties associated with wetness that results from reduction and oxidation of iron and manganese compounds after saturation and desaturation with water. Both quantitative and qualitative indicators will be used to describe compaction. Use of heavy equipment, especially rubber tired

skidders, for logging and tractor piling could compact soils, in the upper 12 inches of the soil profile. Soil compaction can have a detrimental effect on soil productivity on fine-textured soils that are moist or at optimal soil moisture conditions for soil compaction. Soil compaction is not a concern in coarse textured soils. In fact, soil compaction has been found to have an increase in soil productivity by increasing the available water holding capacity of the soil (Powers, et al 2008). Soils have been classified into sensitive and non-sensitive soils types for the purpose of identifying soils that are susceptible to detrimental soil compaction. *Soil porosity should be at least 90 percent of total porosity over 85 percent of an activity area (stand) found under natural conditions. A 10 percent reduction in total soil porosity corresponds to a threshold for soil bulk density that indicates detrimental soil compaction.*

Soil productivity is dependent on the amount of soil organic matter available to prevent significant short or long-term nutrient cycle deficits, and to avoid detrimental physical and biological soil conditions. Soil organic matter should include fine organic matter and large woody debris.

Fine organic matter provides soil nutrients and protects the soil by providing soil cover. Soil cover or the lack of soil cover can affect soil productivity by removal of surface soils from accelerated erosion. Accelerated erosion is erosion that occurs at a rate over and beyond normal, natural or geological erosion, primarily as a result of human activity. Soil loss should not exceed the rate of soil formation (approximately the long-term average of 1 ton/acre/year). Sufficient soil cover should be maintained to prevent accelerated soil erosion from exceeding the rate of soil formation. Ground cover will be at least 50% on ground slopes less then 35% and on slopes greater then 35%, ground cover will be determined by the interdisciplinary (ID) team. Replenishment of fine organic matter to preexisting conditions could occur in less then 10 years as forests shed their needles and leaves and accumulate on the forest floor.

Large organic matter or large woody debris, provides habitat for soil micro-organisms including fungus, soil insects and soil bacteria. All of these organisms are critical for soil health and soil productivity. The loss or reduction of large woody debris in a forest could last anywhere from 10 to 50 years, depending on the number of decadent trees or snags that are left in the stand after treatment. At least five well-distributed logs per acre, representing the range of decompositions classes, should be left on the forest floor after the proposed action is completed.

Soil productivity can be reduced or impacted from displacement of surface soils. Surface soils include valuable amounts of organic matter and nutrients that are critical for productive soils. Surface soils can be disturbed by logging and mastication equipment operating in the forest, by tractors piling slash and by construction of roads and skid roads from excavation of the soil to construct a road or skid trail prism. The surface area of new roads will result in a loss of soil productivity for that area. Disturbance of surface soils by logging and mastication equipment could result in reduced soil productivity. The Sierra NF LRMP provides direction for avoiding tractor logging on sustained slopes that exceed 35% (USDA-FS 2001a). There are no slope limitations for mastication equipment in the LRMP. Mastication equipment can operate on slopes up to 55% slopes. There has been no systematic monitoring of mastication work on slopes greater then 35% on the Sierra National Forest.

The following information addresses the affected environment or existing pre-treatment soil condition, the environmental consequences of the proposed action to soil productivity; mitigations measures proposed to reduce the impacts of the proposed action and a monitoring plan to ensure that Forest Standard and guidelines are met to maintain soil productivity.

Affected Environment

Soils in the proposed project area vary in their sensitivity to management. Soils with higher clay content and soil moisture have the highest potential to reduced soil porosity. Soil compaction can occur down to 12 inches deep.

- There is a concern that areas proposed for ground based harvest have soils that are highly susceptible to reduction of soil porosity caused from compaction by heavy equipment operating when soils are moist or wet.
- There a concern that prescribed fire and tractor piling will reduce soil cover and accelerated erosion could result in a loss of soil productivity.
- There is a concern that ground based harvest systems on slopes that are too steep will displace surface soil horizons that could result in accelerated erosion and reduced soil productivity.

The area is underlain with nine soil types that combine into nine soil map units. The most dominant soils affected by the project include: Holland family, Chaix family, Chawanakee family, Ledford family, Entic Xerumbrepts, Neuns family, Umpa family, Cagwin family and Lithix Xeropsamments. Rockout crop is secondary component of several soil map units and is located throughout the treatment areas. The soils vary in characteristics from shallow to deep, thermic to frigid temperature regimes, xeric moisture conditions and have developed in metamorphic and granitic parent materials (Giger 1993). A map of the Soil Map Units and complete unit tables are included in the Soils Report available in the project file. Table 5 displays a summarization of this information.

Table 1. Summary of Soil Map Units

MUSYM	MUNAME	Sensitive	Acres
137	Holland Family, 35 to 65 Percent Slopes	Yes	934
136	Holland Family, 5 to 35 Percent Slopes	Yes	488
123	Chaix-Chawanakee Families-Rock Outcrop Complex, 35 to 65 Percent Slopes	No	446
143	Ledford Family-Entic Xerumbrepts-Rock Outcrop Association, 10 to 45 Percent Slopes	No	265
140	Holland-Chawanakee Families Complex, 35 to 65 Percent Slopes	Yes	245
146	Neuns Family, 25 To 60 Percent Slopes	No	176
124	Chaix-Holland Families Complex, 15 to 35 Percent Slopes	Yes	155
176	Umpa Family, Deep, 20 to 60 Percent Slopes	No	75
114	Cagwin Family-Lithic Xeropsamments-Rock Outcrop Complex, 45 to 65 Percent Slopes	No	2

Some of the proposed treatment units are underlain with multiple soil types and multiple soil map units. The western part and lower elevations of the proposed project area is underlain with Holland soils. Holland family soil consists of deep, sandy loams and sandy clay loams that are well drained. Holland soil is the only soil in the Sugar Pine Project area that is a sensitive soil. Holland family soils have a moderate soil compaction hazard and high to very high maximum

erosion hazard rating. These soils are most susceptible to compaction when soils are moist and are very erosive without adequate soil cover. Holland soils occur in soil map units 124, 136, 137, and 140. Holland soils are deep (60 to 66 feet), well drained soils with a sandy, clay loam subsoil. These soil map units occur in treatment areas M2, M6, M7, M8, M9, M10, M11, M12, RX3, RX5, T16, T3, T4, T5, T6, T7, T8, T9, T10, and T11.

The middle part of the proposed project area is underlain with Soil Map Units 123 and 146. Soil types within these soil map units include Chaix, Chawanakee and Neuns family soils. Chaix family soils consist of moderately deep to deep, coarse sandy loams that are somewhat excessively drained or well drained. Chawanakee family soils consist of shallow, coarse sandy loam that is somewhat excessively drained. Neuns family soil consists of moderately deep to deep, gravelly loam and cobbly loam that is well drained. Neuns family soil has 25% pebbles and/or rock fragments. The Chawanakee soils are susceptible to loss of soil productivity from displacement of the surface soils. The Neuns family soil has a moderate erosion hazard rating and is difficult to compact because of the rock fragment content. Treatment areas M1, M4, M5, RX1, RX2, T2, and the east end of T15 are underlain with Soil map Unit 123, which includes Chaix, Chawanakee family soils and rock outcrop. Treatment area M4 is underlain with Soil map Unit 146, which includes Neuns family soil. Treatment area T3 is underlain with Soil Map Units 140 and 146, which includes Holland family soils in the lower elevations and Neuns family soil in the upper elevations of the unit. Treatment area T7 is underlain with Soil Map Units 124 and 136, which includes Chaix family soils and Holland family soils.

The eastern part of the proposed project area is underlain with Soil Map Units 143 and 176. Soil types within these soil map units include Ledford family soil, Entic Xerumbrepts, Umpa family soils and rock outcrop. A Ledford family soil consists of deep, coarse sandy loams that are somewhat excessively drained. Entic Xerumbrept soil consists of shallow, sandy loams and coarse sandy loams that are somewhat excessively drained. These Entic Xerumbrepts soils are susceptible to loss of soil productivity from displacement of the surface soils. Umpa family soil consists of deep, bouldery and stony coarse sandy loam that is well drained and moderately well drained. This area has approximately 15% rock outcrop distributed throughout the area.

Soil map units with high amounts of impervious surfaces such as rock outcrop or shallow soils are most susceptible to runoff and subsequent surface erosion of soils adjacent to the rock outcrop. Shallow soils and/or rock outcrop occur in soil map units 123, 140, and 143. Chawanakee family soils are shallow (<20 inches), somewhat excessively drained with a coarse sandy loam surface soil and subsoil. Entic Xerumbrepts soils are shallow (<18 inches), somewhat excessively drained or excessively drained with a sandy loam surface soil. The Chawanakee soils are susceptible to loss of soil productivity from displacement of the surface soils. The Chawanakee soils are also susceptible to accelerated erosion from runoff off the rock outcrop, especially if adequate soil cover is not available. Treatment areas that occur in these soil map units include: M1, M11, M-14, M-16, M-20, M5, M7, M8, RX-07, RX-08, RX1, RX2, RX3, RX5,T2, T3, T4, T5, T7, T9, T10, T15, T16, T-23, T-24, T-26, T-30, T-31, T-32, T-33, T-35, and T-37 (see Table 6).

Areas proposed for ground based harvest systems are generally less than 35%. However, some areas exist where slopes exceed 35% and tractor logging could result in soil disturbance that mixes or removes soils below the A horizon. Commercial thin units with sustained slopes greater then 35% include T2, T4, T5, T7 and T10. Mastication units with sustained slopes greater then 55% include M1, M4, M5, and M7.

Table 2. Treatment Areas with Greater than 35 Percent Slopes

> 35 Slopes > 55		Slopes > 55%	
Unit_ID	Acres	Unit_ID	Acres
M1	29	M1	8
M2	23	M2	2
M4	8	M4	2
M5	52	M5	13
M6	17	M6	1
M7	17	M7	5
M8	6	RX1	27
RX1	61	RX3	7
RX3	4	T10	3
T10	33	T2	2
T12	4	T3	3
T13	4	T4	6
T2	15	T5	3
T3	47	T6	2
T4	61	T7	1
T5	6		
T6	41		
T7	17		
T8	15		
T9	2		

Soil conditions have been reviewed in the Sugar Pine Project Area. Soil data along 12 soil transects were collected using the 20 point transect method and soil data along 6 soil transects were collected using the line transect method to characterize soil conditions using the 2005 Framework Soil Monitoring Methods Protocol and a soil monitoring protocol known as the Iron Canyon Intensive Soil Monitoring Protocol (TenPas 2005; Gallegos 2007). Data for soil cover, soil disturbance, soil compaction and large woody debris were collected along these 18 transects and summarized. This report documents baseline conditions from which to compare soil conditions in the future (see Table 7).

Table 3. Summary of Transect Data

Transect	Unit Number	Soil Cover	Slope	D1	D2	D3	Total Disturbance	LWD (acre)	Percent Unit Detrimental Comp/Dist	Core Samples
M6	SP-TR-9	96	37	5	0	0	5	18	0.00%	1
T3	SP-T1-1,SP-T1-2,SP-T1-3	94	20	27	0	0	27	102	9.67%	31
T4	SP-TR-7,SPTR--8	97	26	18	3	5	25	113	10.00%	6
T7	SP-TR-3	86	21	20	15	0	35	0	5.00%	3
T8	SP-TR-5,SP-T2-1,SP-T2-1,SP-T2-3	91	31	24	8	1	33	100	9.00%	38
T10	SP-TR-1,SP-TR-2,SP-TR-4,SP-TR-6	91	21	19	3	5	26	45	2.50%	10
T26	SP-TR-14	62	16	5	5	15	25	20	15.00%	3
T32	SP-TR-13,SP-TR-15	76	14	18	3	5	25	122	2.50%	6
Average		**87**	**23**	**17**	**4**	**4**	**25**	**65**	**6.71%**	**98**

Soil transect data indicates that soil cover and large woody debris are meeting Regional Soil Standard and Guideline thresholds. The average soil cover is 87% and the average number of large woody debris (LWD) is approximately 65. Several areas within the proposed project area are currently not meeting Regional Standard and Guideline thresholds for detrimentally disturbed soils. See Table 8 for description of soil disturbance classes. The average for detrimental disturbed soils throughout the project area is approximately 6.71%. Detrimentally disturbed soils include those areas with D3 soil disturbance or detrimentally compacted soils. Detrimentally compacted soil is where soil porosity is below 90 percent of total porosity found under natural conditions. A 10 percent reduction in total soil porosity corresponds to a threshold soil bulk density that indicates detrimental soil compaction. Some areas have soil compaction or detrimental soil disturbance as high as 15 to 20 percent.

The middle of the treatment area T3 has approximately 20% of the area with detrimentally disturbed soils. Treatment area T3 overall has approximately 9.67% of the area with detrimentally disturbed soils. Treatment area T4 has approximately 8% of the area with D2 and D3 soil disturbance and 10% of the area with detrimentally compacted soils. Treatment area T7 has approximately 15% of the area with D2 soil disturbance and 5% of the area with detrimentally compacted soils. Treatment area T8 has approximately 9% of the area with D2 and D3 soil disturbance and 9% of the area with detrimentally compacted soils. Treatment area T10 has approximately 8% of the unit with D2 and D3 soil disturbance and 2.5% of the area with detrimentally compacted soils. Treatment area T26 has approximately 20% of the area with D2 and D3 soil disturbance and 15% of the area with detrimentally compacted soils. Treatment area T32 has approximately 8% of the area with D2 and D3 soil disturbance and 2.5% of the area with detrimentally compacted soils.

Table 4. Description of Disturbance Classes

D0 – Undisturbed	D1 – Slightly Disturbed	D2 – Moderately Disturbed	D3 – Highly Disturbed
Soil Surface: - No evidence of equipment operation	Soil Surface: - Light tracks, slight depressions - Duff and litter cushion mostly in place - Topsoil in place	Soil Surface: - Clear tracks - Duff and litter displaced, or reduced - Topsoil exposed and mixed or compacted	Soil Surface: - Prominent tracks, main skid trail or landing - Duff and litter displaced - Topsoil highly compacted, and/or eroded
Compaction: - Soil has natural structure and resistance to spade	Compaction: - Soil strength increase in top 4 inches - Structure changes in top 4 inches	Compaction: - At threshold of detrimental compaction - Soil strength increase in top 4 to 8 inches - Some structure changes below 4 inches - Platy or massive structure is generally continuous	Compaction: - Soil strength and spade resistance increased to depth > 8 inches - Structure changes continuous to 8 inches - Platy or massive structure

Alternative 1 – No Action

Under the No Action alternative, current management plans would continue to guide management of the project area. No thinning, either commercial, pre-commercial and/or biomassing, of mixed conifer and pine stands, mastication of brush/shrub patches, prescribed burning to reduce natural fuel accumulations and/or treatment of infestations of noxious weeds and replanting of conifers in failed conifer plantations would be implemented to accomplish the purpose and need.

Direct Effects and Indirect Effects

Under the Alternative 1, soil conditions would not change from the existing conditions. Soil transect data indicates that soil cover and large woody debris (LWD) are meeting Regional Soil Standard and Guideline thresholds. Soil cover will increase and LWD will increase. The average soil cover is 87% and the average number of LWD is approximately 65. This is well over the guideline of five logs per acre. Several areas within the proposed project area are not meeting Regional Standard and Guideline thresholds for detrimentally disturbed soils. Some areas have 15 -20% detrimentally disturbed and compacted soils. The average throughout the project area for detrimental disturbed and compacted soils is approximately 6.71%. Compacted soils will continue to recover over time.

If vegetation is left in its current state of high fuels and high wildfire risk, it is inevitable that a wildfire will occur. Many areas within a potential wildfire area would not meet soil quality standards in terms of soil cover and surface erosion rates in a fire event. Soil cover would be less then 20% and some soils would develop hydrophobic conditions. Accelerated erosion will occur, especially during precipitation events. Soil loss could range from 10–60 tons per acre in these areas. Soil Productivity will be reduced in some areas by at least one site class. Past monitoring of wildfire areas on the nearby Stanislaus National Forest has found that bare ground averaged about 70% by spring of the first year and by spring of the second year bare ground averaged 27% (Janicki 2003). In a study conducted by Berg and Azuma (2007) bare ground and evidence of surface erosion recovered to pre-fire conditions within four to five years after a wildfire. Large woody debris would probably be consumed in a fire and long term soil productivity could be decreased without large woody debris.

Cumulative Effects

Cumulative soil effects have been addressed under the cumulative watershed effects (CWE) section under the Hydrology/Water Quality Section. Analysis of cumulative soil effects use the Equivalent Roaded Acre (ERA) Model, which is used in the CWE analysis. The ERA model quantifies disturbance based on the degree of disturbance as compared to an acre of road and measured relative to disturbance in a given watershed. ERAs reflect changes to Soil Hydrologic Function, and are an indicator of rutting potential, erosion potential and loss of water control. See Sugar Pine Adaptive Management Project CWE Analysis (Gallegos 2008) for a full description of assessment and assumptions including list of past, present and future foreseeable actions. The Forest Service Pacific Southwest Region (R5) methodology is used to determine the overall disturbed footprint. The disturbed footprint is a semi-quantitative measure of acres of detrimental soil disturbance and hence an approximation of change in Soil Quality as defined by the R5 Soil Quality Standards (USDA-FS 1995).

The Sugar Pine CWE Assessment modeled recovery from previous management actions over a 30 year time span for 12 subdrainages for the existing condition and No Action Alternative. Two of those subdrainages (501.5053 and 503.0055) are currently exceeding their lower threshold of concern for cumulative watershed effects. A detailed field assessment of those subdrainages did not find any evidence that cumulative watershed effects was occurring. Other planned actions that

are not part of this decision would still occur, but the total ERAs in the project sub-watersheds would be lower than if the project was implemented.

Alternative 2 – Proposed Action

Treatment areas within the project area were delineated to include those areas where some form of treatment was necessary to meet the purpose and need. First treatment areas were designed to create SPLATs to reduce the intensity and spread of wildfires in and around WUI. Treatment areas near key transportation corridors (for egress and ingress into the community) and within the defense zone of the WUI were designed next. These treatment areas are designed to focus on those treatments needed to meet fire and fuel objectives (lower and limited mid-level canopy treatments), but the forested stands within the project area are also considered overstocked with conifers (basal area and stand densities that are greater than can be sustained with changing environmental conditions). Treatment areas were further designed to address these areas. There would be approximately 2,920 acres treated. The acres displayed in the affected environment section are the total acres of the treatment unit polygons, including Streamside Management Zones, rock outcrop and other areas that will not be treated. Whereas the following proposed treatment acres are the estimated acres that will actually be treated.

Direct Effects and Indirect Effects

The following is a discussion of the various kinds of treatments proposed and their potential direct and indirect effects to the soil resource.

Commercial and Biomass Thinning activities (mechanical harvesters), Mastication operations, Pre-commercial Thin/Release operations, and Tractor Piling operations use equipment that includes steel tracked heavy equipment and rubber tired tractors. These activities have the potential to impact the soil resource by mechanically disturbing the soil or compact the soil. Planting and hand release operations do not effect the soil resource.

Soil Disturbance and Soil Porosity or Soil Compaction

Mechanical harvesters and rubber tired tractor skidders used for the proposed commercial and biomass thinning, tractor piling, and mastication will cause soil disturbance and their use poses increased risk of detrimental soil disturbance, detrimental soil compaction and accelerated soil erosion. Standard operating procedures such as cross ditching skid trails for erosion control will reduce the risk of erosion and promote surface soil stabilization and re-vegetation. Tractor logging is planned for areas with slopes under 35%, which will reduce excessive soil displacement. Areas of slopes in excess of 35% should be logged with a cut-to-length logging system or logs should be favorable skidded to prevent undue soil disturbance. The soils in this project area are highly productive so rapid natural re-vegetation is expected.

Holland soils are highly susceptible to soil porosity loss, due to compaction from heavy equipment, such as rubber tired skidders and mechanical harvesters operating when soils are moist or wet. Holland soils occur in treatment areas T3, T4, T5, T6, T7, T8, T9, T10, T11, and T16. These units are highly susceptible to detrimental soil compaction exceeding 15% of the treatment area. Treatment areas T3, T4, and T8 have detrimentally compacted soils at 9-10% and treatment area T26 has detrimentally compacted soils at 15%. Parts of treatment area T3 and T8 have detrimentally compacted soils at 20%. These treatment units will probably exceed 15% of the treatment unit in detrimentally compacted soils immediately after the first phase of project implementation.

In order to minimize detrimental soil compaction, soil moisture needs to be dry enough to reduce the susceptibility to compaction during thinning and biomass removal operational periods. The ideal moisture content varies between soils and should not be above 12% to prevent soil

compaction. A soil scientist or other earth scientist will be consulted prior to mechanical equipment operating on soils that have a moderate soil compaction hazard. The standard operating period from June 1 to October 15, and avoidance of operating mechanical equipment on soils with more then 12% soil moisture should minimize detrimentally compacted soils in an average rain year (See Soil Design Measure 2 and 3).

Areas with detrimentally compacted soils should be less then 15% for most of the treatment areas. Some portions of the commercial thin or biomass treatment areas (Units T3, T4, T8, and T26) will have detrimentally compacted soils in excess of 15% until subsoiling is completed in the unit. Subsoiling will occur after the last mechanical treatment is needed, generally the 2nd year after the initial commercial thinning operation or biomass treatment. Detrimentally compacted soils in excess of 15% will probably occur for at least 1 year, until after tractor piling of slash has occurred in the second year of project implementation. Subsoiling landings (BMP 1-16) and primary and secondary skid trails should result in less then 15% of the treatment areas with detrimentally compacted soils. Soil productivity will be reduced in areas with detrimentally compacted soils for 1 or 2 years.

There are no potential indirect effects of the proposed action if soil compaction is kept to less than 15% of an activity area and erosion control measures are implemented in a timely manner. There could be an occasional summer storm event that could cause accelerated erosion of bare exposed soils. In the event that this should occur soil erosion sites will be restored to pre-storm conditions.

Large Woody Debris (LWD)

Commercial thinning, biomass removal and tractor piling will probably reduce existing fuel loads to levels where fire hazards and fuels have been reduced to achieve the desired conditions for the Wildland Urban Interface. After treatment, on the ground fuel loads are expected to be no more then 5 – 10 tons/acre (see Fire/Fuel Section). This will probably reduce existing LWD to at least 25% of existing levels, which will be higher then the minimum five logs per acre that is needed to meet the Soil Standard and Guideline Threshold for LWD.

Soil Cover

In areas where tractor piling of slash is planned, it is a normal Sierra NF practice to leave at least 50 percent, well distributed soil cover for erosion protection on slopes under 35%. If slopes are greater then 35%, soil cover should be at least 70%. Past observations on the Sierra NF have found that this amount of soil cover generally prevents accelerated erosion. A buffer of 100 feet will be provided around rock outcrop to prevent accelerated erosion of the adjacent soils from rapid runoff from rock outcrops.

Mastication Treatment Areas

Areas planned for mastication pose little risk of reducing soil productivity. This includes all of the M treatment areas, including M4, which is proposed for Fuel Break Maintenance. The masticator equipment reduces erosion potential by increasing soil cover and generally causes little soil disturbance and compaction. Soil masticating equipment generally does not result in compacted soils because the equipment has lower ground pressures then conventional logging equipment and because this treatment creates a bed of chips that the masticator travels over. All mastication treatment units have slopes in excess of 35%. Most mastication treatment will be on slopes less the 35%; however some areas with slopes in excess of 35% will be treated. This will probably occur in treatment areas M1, M5 and M7. A minor amount of soil disturbance will probably occur where the masticator makes turns during the operations. Soil disturbance will be higher on steeper slopes.

Prescribed Fire

Areas planned for prescribed fire pose little risk of causing significant effects to soil productivity based on the past performance of the prescribed fire program on the Sierra National Forest. Past prescribed fires on the forest has resulted in low burn severity in most areas. Prescribed fire burns in a mosaic pattern leaving patches of unburned vegetation and patches of burned areas, where duff and litter is completely consumed. Most trees are left undamaged, except for a few small patches that have burned at a moderate burn severity. Soil quality standards have been met from past prescribed fires and are expected to be met from the proposed action. Soil cover of 50% is expected to be met in the prescribed fire treatment areas.

Road Construction

Approximately 0.7 miles of new and temporary road construction is proposed for the Sugar Pine Project. Road construction results in removal of surface soils and subsoil and complete loss of soil productivity within the road prism. The 0.7 miles of road is approximately 1.2 acres of ground with total loss of soil productivity. The direct effect of this new road construction is irreversible and irretrievable. Erosion on newly constructed roads is usually higher immediately after the road is constructed. There is potential that accelerated erosion could occur off the road prism and reduce soil productivity off site and after the road is constructed. Applicable soil and water conservation Best Management Practices (BMP) will be implemented, including erosion control measures, such as water bars, straw mulching of fills and fertilization of soils to re-vegetate the bare soils. Road reconstruction and road maintenance operate within the road prism and have little effect to the soil resource. However, there can be a positive effect to the soil resource out site of the road prism from road reconstruction by restoring proper drainage features of the road. Restoration of drainage features will result in less surface erosion and soil loss that leads to loss in soil productivity.

Cumulative Effects

Cumulative soil effects have been addressed under the cumulative watershed effects (CWE) section under the Hydrology/Water Quality Section. See the discussion in the No Action Alternative, Soil Cumulative Effects section for additional discussion on soil cumulative effects. The Sugar Pine CWE Assessment, modeled disturbance from the proposed action and recovery from previous management actions over a 30 year time span for 12 subdrainages. Five of those subdrainages (501.5006, 501.5007, 501.5053, 503.0010 and 503.0055) will exceed their lower threshold of concern for cumulative watershed effects after the project is implemented, but not their upper Threshold of Concern of 14%. A detailed field assessment for subdrainages 501.5053 and 503.0055 did not find any evidence that cumulative watershed effects was currently occurring. Implementation of Soil and Water Conservation Best Management Practices and other design measures, including subsoiling of detrimentally compacted soils will minimize effects to the soil resource. No significant impacts to soil productivity are expected if soil cover is over 50%, detrimental soil disturbance and detrimental soil compaction is limited to no more then 15% of a treatment unit; and large woody debris is at least five logs per acre.

Alternative 3

In Alternative 3, treatment areas and the types of treatments would remain the same for all areas, as in Alternative 2, except for those portions of treatment areas T-4 and T-3 that are designated within the 700-acre Pacific Fisher den site buffer (as established by SNFPA ROD 2004, S&G #85 and #86) for known den sites. Treatments would be altered within the den site buffer to treat the lower and limited mid-level canopy (surface and ladder fuels) to address fire and fuels objectives within WUI. There would be no additional treatment of the mid-level canopy (stand density) within the den site buffer. All other treatment areas would continue to have treatments similar to

those listed in Alternative 2, which includes treatment of lower and middle level canopies. There would continue to be approximately 2,920 acres treated under Alternative 3.

There is virtually no difference between Alternative 2 and Alternative 3 to the soil resource (see effects analysis for Alternative 2). The only difference between Alternative 2 and 3 is an additional limited operating period for treatment areas T3 and T4. The same acres will be treated, but fewer larger trees will be removed in treatment areas T3 and T4. These fewer trees result in fewer trips with mechanical equipment, but this will probably have no measurable effect.

Alternative 4

In Alternative 4, treatment areas would remain the same as in Alternative 2, but the treatments within these areas would include only those needed to reduce the surface and ladder fuels (within the lower and limited mid-level canopy levels) needed to achieve fire and fuels objectives. Under Alternative 4 there would be no additional treatments (i.e. additional thinning in the mid-level canopy) to fully address stand density/forest health objectives.

This alternative would, in effect, assume the entire project area as a Pacific Fisher den site, whereby, it would be treated to achieve fire and fuels objectives for the urban wildland intermix zone and limit treatments to mechanical clearing of ladder and surface fuels. As such, all design criteria and SNFPA ROD (USDA-FS 2004) standards and guidelines associated with Pacific Fisher den sites would be implemented with this alternative.

This alternative was developed to address the issue listed on page 6. As well, this alternative is being analyzed in detail to measure the effects as they relate to focusing treatments on fire and fuels objectives without additional treatment for forest health (stand density). There would be approximately 2,920 acres treated under Alternative 4.

There is no difference between Alternative 2 and Alternative 4 to the soil resource (see effects analysis for Alternative 2). The only difference between alternative 2 and 4 is an additional limited operating period for the whole project area. The same acres will be treated, but those acres that are proposed for commercial thinning in Alternative 2 will be treated for biomass removal. Fewer larger trees will be logged in the T treatment areas. The same equipment will be used to remove the biomass and the potential for disturbing soils is similar to Alternative 2.