Salt Timber Harvest and Fuel Hazard Reduction Project

Fire/Fuels Report

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For:

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2-6-09

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Introduction

Purpose and Need

The Salt Timber Harvest and Fuels Hazard Reduction Project is intended to contribute to an ecosystem restoration strategy that identified a range of prioritized landscape treatments contributing to healthy forests and watersheds. The Salt project area is an integral part of this larger ecosystem restoration strategy and links to other similar projects in the area. These other projects include East Fork I and II (Texas Spider Timber Sale Project), Jones Thin, and Upper Dubakella all to the south of Salt; Gemmill and Knob Peak to the east of Salt; and, Post Mountain Stewardship Project to the north-west of Salt

The project area is characterized by overly dense, decadent, overstocked mixed conifer stands, and both commercial and pre-commercial sized conifer plantations. The area has been logged in previous years, primarily during the 1970's and 1980's, with various levels of activity fuel treatments being implemented with the timber sales. In general, clearcuts received the most extensive treatments, due to reforestation requirements. Untreated slash generated from select tree harvest remains on the site today in various stages of decomposition, contributing to current fire hazard.

One of the three objectives of the Salt project is to: Reduce hazardous fuels conditions to reduce the potential for adverse impacts from wildfire to the National Forest and neighboring land.

The fuel hazard occurring in this project area needs to be lowered by removing the number of trees growing in dense stands. Thinning will lower the density of overstocked conifer stands, reducing moisture competition for residual trees, lowering fuel total fuel loading, and reducing the negative impact of wildfire effects. Fuel hazard reduction will be accomplished through breaking up the horizontal and vertical continuity of fuel and fuel ladders, raising crown base heights, and reducing canopy bulk densities, which will assist in reducing crown fire potential.

Regulatory Direction

National Fire Plan

The National Fire Plan, 10-Year Comprehensive Strategy (USDI/USDA 2001) and National Fire Plan 10-Year Comprehensive Strategy Implementation Plan (USDI/USDA 2002, 2005) provide national direction for hazardous fuels reduction, restoration, rehabilitation, monitoring, applied research, technology transfer and established the framework for a 10-Year Comprehensive Strategy. The four principle goals and implementation outcomes of the 10-Year Comprehensive Strategy pertaining to the National Fire Plan include:

- Improve Fire Prevention and Suppression—Losses of life are eliminated, and firefighter injuries and damage to communities and the environment from severe, unplanned, and unwanted wildland fire are reduced.
- Reduce Hazardous Fuels—Hazardous fuels are treated, using appropriate tools, to reduce the risk of unplanned and unwanted wildland fire to communities and to the environment.
- Restore Fire-Adapted Ecosystems—Fire-adapted ecosystems are restored, rehabilitated and maintained, using appropriate tools, in a manner that will provide sustainable environmental, social, and economic benefits.

- Promote Community Assistance—Communities at risk have increased capacity to prevent losses from wildfire and the potential to seek economic opportunities resulting from treatments and services.

Federal Policy

The Federal Wildland Fire Policy (USDI et al. 2001) guiding principles of the National Wildland Fire Policy include:

- Ensure firefighter and public safety is the first priority; recognize and incorporate the role of wildland fire as an essential ecological process and natural change agent into the planning process; base fire management plans and activities on the best available science; and incorporate public health and environmental quality considerations into fire management plans and activities.

Healthy Forest Initiative and Healthy Forest Restoration Act

The Healthy Forest Restoration Act (Healthy Forests Initiative 2002; Healthy Forests Restoration Act 2003) directs agency personnel to improve forest conditions through fuels reduction activities. The Healthy Forest Initiative provides administrative reform to aid in accomplishing this task.

Land Management Direction and Desired Condition

The project area resides within the Hayfork Adaptive Management Area and Management Area 19, Indian Valley/Rattlesnake, of the Shasta-Trinity Land and Resource Plan. The Forest Plan identifies a desired condition for each of these management areas. The majority of the project area is within the Matrix land allocation.

Applicable Goals, Standards, and Guides Pertaining to Fire and Fuels:

- **Forest wide:** Restore fire to its natural role in the ecosystem when establishing the desired future condition of the landscape.[1] Activity fuels that remain after meeting wildlife, riparian, soil, and other environmental needs will be considered surplus and a potential fire hazard.[2] Plan and implement fuel treatments emphasizing those treatments that will replicate fire's natural role in the ecosystems.[3]
- **Matrix Lands Roaded Recreation**: Maintain an average of 10 tons of unburned dead/down material per acre on slopes less than 40 percent. Preference is to have a portion of this tonnage in large material (i.e., 4-6 logs over 10 feet long at the largest diameter available).[4]
- **Matrix Lands Commercial Wood Products Emphasis**: Maintain an average of 5 tons of unburned dead/down material per acre on slopes less than 40 percent. Preference is to have a portion of this tonnage in large material (i.e., 4-6 logs over 10 feet long at the largest diameter available).[5]

[1] U.S. Department of Agriculture, Forest Service, 1995. *Shasta Trinity National Forest Land and Resource Management Plan* page 4-4
[2] USDA Forest Plan Service 1995 (see footnote 1) page 4-17
[3] USDA Forest Plan Service 1995 (see footnote 1) page 4-18
[4] USDA Forest Plan Service 1995 (see footnote 1) pages 4-65-66
[5] USDA Forest Plan 1995 (see foot note 1) page 4-67

Issues Addressed

The following key issue, related to fire and fuels was identified through the scoping process and was considered in this analysis. This issue, along with other key issues, drove the development of Alternative 3.

- Regeneration Harvest - green tree retention in the proposed action may:
    - Increase the risk from fire

Additionally, two analysis issues, related to fire and fuels were identified through the scoping process and were considered in this analysis.

- Canopy removal may increase fuel hazard issues.
- Decommissioning roads can have negative impacts on future fire suppression and vegetation management.

Evaluation Criteria Measures

The following evaluation criteria were used to assess the effects of each alternative and their effectiveness in meeting project objectives.

- Reduction of Crown Fire Potential Reduced chance of crown fire expressed as acres of Low moderate or high rated crown fire potential
- Flame length -Flame lengths generally less than 4 feet are desired allowing for safe direct attack by handcrews. Flame lengths greater than 4 feet generally require equipment to be employed such as dozers and aircraft; beyond 8 feet torching, crowning and spotting can occur.

Methodology

Please see Appendix A of this specialist's report for information about the methodology used in the fire fuels analysis. The Appendix includes information, assumptions and limitations for FlamMap, the fire behavior mapping and analysis program used for this analysis. The area of analysis for this report was the Salt project area, unless otherwise noted.

Existing Condition and Affected Environment

Fire History and Occurrence

There have been 15 fire starts within the approximately 4,300 acre project area, 11 lightning caused fires and 4 human caused fires. The largest fire on record was approximately ¼ acre. Fire size limitations can be attributed primarily to swift detection and successful initial attack fire suppression tactics. Plummer Peak Lookout is approximately 4.5 air miles to the north of the project area. Initial attack forces from Hayfork, Forest Glen, Post Mountain, and Harrison Gulch can easily access most of the area in less than an hour. If available, air attack fire suppression forces dispatch from Redding, Ca. are able to attack the fire in less than ½ hour.

In 2008, a wildfire, the Telephone fire occurred outside but directly adjacent to the northeast edge of the project area. Even though this is outside of the analysis area it is considered in the cumulative effects analysis of this report.

Fire Regime and Condition Class

A fire regime is a generalized description of the role fire plays in an ecosystem. It refers to the pattern and variability of fire occurrence and its effect on vegetation. Fire regime typically is a description of fire frequency, predictability, intensity, seasonality, and size characteristics of fire in a particular ecosystem.

Coarse scale definitions for natural (historical) fire regimes have been developed by Hardy et al. (2001) and Schmidt et al. (2002) and interpreted for fire and fuels management by Hann and Bunnell (2001). The five natural (historical) fire regimes are classified based on average number of years between fires (fire frequency) combined with the severity (amount of replacement) of the fire on the dominant overstory vegetation (see text box).

Fire Regimes

I – 0 to 35-year frequency and low- (surface fires most common) to mixed-severity (less than 75% of the dominant overstory vegetation replaced);

II – 0 to 35-year frequency and high (stand-replacement) severity (greater than 75% of the dominant overstory vegetation replaced);

III – 35 to 100+-year frequency and mixed-severity (less than 75% of the dominant overstory vegetation replaced);

IV – 35 to 100+-year frequency and high (stand replacement) severity (greater than 75% of the dominant overstory vegetation replaced);

V – 200+-year frequency and high (stand-replacement) severity.

Historically the Salt project area is best described as having a moderate to low intensity, frequent interval (1-25 years) regime with large fires. This places the area primarily in Fire Regime I as described above. In more recent history, fire exclusion has played a significant role in vegetation successional patterns throughout this area. The current condition of the project area is characterized by infrequent interval (greater than 25 years), moderate to high severity fires.

Condition Classes

Condition classes are a way of categorizing how much key ecosystem components such as species composition, structural stage, and stocking level, have changed in an area due to changing fire regimes. One or more activities such as fire exclusion, insects and disease, and past management activities can cause a change in fire regimes (Schmidt et al. 2002).

There are three condition classes:

- **Condition Class 1:** Fire regimes are within an historical range and the risk of losing key ecosystem components is low. Vegetation attributes (species composition and structure) are intact and functioning within their historical range.
- **Condition Class 2:** Fire regimes have been moderately altered from their historical range. The risk of losing key ecosystem components is moderate. Fire frequencies have

departed from historical frequencies by one or more return intervals (either increased or decreased), resulting in moderate changes to one or more of the following: fire size, intensity and severity and landscape patterns. Vegetation attributes have been moderately altered from their historic range.

- **Condition Class 3:** Fire regimes have been significantly altered from their historical range. The risk of losing key ecosystem components is high. Fire frequencies have departed from historical frequencies by multiple return intervals. This results in dramatic changes to one or more of the following: fire size, intensity, severity, and landscape patterns. Vegetation attributes have been significantly altered from their historical range.

Fire frequency has decreased markedly in California's conifer forests. The lack of fire has brought about changes in stocking levels and species composition in the montane conifer forests (Minnich et al. 1995). These changes in vegetation conditions, which have occurred throughout much of California, have also occurred in and around the Salt project area. Consequently, wildfires in the project area today could potentially be larger, more intense, and more severe than in the past.

Vegetation attributes in the Salt Project area have changed over time from historic conditions. Based on recorded fire history, only a small proportion of the project area has burned under wildfire conditions since active fire suppression started. Most of the project area has missed one or more wildfire return intervals. Understory stocking has increased with small- and medium-diameter trees and shade-tolerant species. Conditions such as these, which lead to larger wildfire size, intensity, and severity, have increased throughout the western states (Graham et al. 2004, Healthy Forests Initiative 2002).

As mentioned above, the historic fire regime for the majority of the Salt Project area was one of frequent low-intensity fires. In low-severity fire regimes fires are frequent (1-25 years) low-intensity fires with few overstory effects. Frequent fires prevented the build-up of ground fuel as well as understory fuel ladders, thus high intensity crown fires were rare, and generally small in size. Pre-fire suppression era stands consisted of fewer trees and were healthier than today's stands that are overstocked, and have to compete for available moisture, sun light, and nutrients. Almost a century of fire exclusion through successful fire suppression has altered the historical fire regime from frequent low-to-moderate intensity fires to one of infrequent high intensity fires. An analysis conducted by the California Department of Forestry and Fire Protection, Fire and Resource Assessment Program (FRAP), was examined to determine the fire regime and condition class for the project area (California Department of Forestry and Fire Protection 2003). This data was compared to photos from field reconnaissance to determine if the typing was reasonable. A large percentage of the area is classified as condition class 2 or 3 in the FRAP assessment. Although there is some variability within the project area, it was felt that most of the area was not in condition class 1. This data was compared to photos and field reconnaissance in 2008 conducted specifically for the Salt project to determine if the typing was reasonable, and the FRAP assessment was determined to be representative of current conditions on the ground.

Historic Fires

Fire records show that there have been 15 fire starts within the project area. Of these fires 11 were caused by lightning and 4 were human caused. The fires that have been recorded have all been relatively small. Rapid detection from the nearby Plummer Peak lookout and relatively quick response times to the project area have contributed to keeping fire size small. There have been numerous other fires adjacent to the project area as well.

Fire Hazard

Fire Hazard identifies the availability of fuels to sustain a fire and using fire modeling results in varied intensity levels of fire behavior prediction. Fire behavior is the manner in which a fire reacts to available fuels, weather, and topography. A change in any of these components results in a change in fire behavior (DeBano et al 1998). Fire behavior is complex, with many contributing factors in the categories of topography (slope, aspect, elevation), weather (climate, air temperature, wind, relative humidity, atmospheric stability) and fuels (size, type, moisture content, total loading, arrangement) (Agee 1993). These three elements comprise the fire environment, surrounding conditions, influences, and modifying forces that determine fire behavior (NWCG 1994).

Topography and weather at a given location are beyond the ability of management to control. Fuel hazard is the only controllable factor. Weather conditions such as drought, high temperature, low humidity, and high wind play a major role in the spread of wildfires and are influenced by topography and location of mountains as well as global influences such as La Niña and El Niño. Weather conditions are a major factor in the initiation and spread of all wildfires, but Omi and Martinson (2002) found that stands with prior fuel treatments experienced lower wildfire severity than untreated stands burning under the same weather and topographic conditions. Fuel management modifies fire behavior, ameliorates fire effects, and reduces fire suppression costs and danger (DeBano et al 1998). Manipulating fuels reduces fire intensity and severity, allowing firefighters and land managers more control of wildland fires by modifying fire behavior in the fire environment (Pollet and Omi 2000).

Fuel management can include reducing the loading of available fuels, lowering fuel flammability, or isolating or breaking up large continuous bodies of fuels (DeBano et al 1998). Fuels contribute to the rate of spread of a fire, intensity/flame length, fire residence time, and the size of the burned area (Rothermel 1983, Agee et al. 2000). For these reasons, the comparison of alternatives in this analysis focuses on the reduction of important fuels, fire behavior indicators, and relative rating of fuel hazard within ½ mile of private property.

A wildfire hazard assessment should analyze the hazard of crown fires as well as surface fire. Crown fires normally are highly destructive, difficult to control, and present the greatest safety hazard to firefighters and the public. Therefore, fuel management must emphasize the factors that contribute to the initiation and spread of crown fires. These factors include height of the forest canopy above the ground, density of the canopy, stand density, and basal area (Omi and Martinson 2002). In general, crown fires burn hotter and result in more severe effects than surface fires. Crown fires generally spread at least two to four times faster than surface fires (Rothermel 1983). Fires that spread quickly and at higher intensities can pose a greater risk to firefighters and the public when they occur. Agee (1996) states that crown fire potential can be managed through prevention of the conditions that initiate crown fires and allow crown fires to spread. Three main factors contributing to crown fire behavior can be addressed through fuels management: initial surface fire behavior, canopy base height, and canopy bulk density.

Surface Fuels

Fire behavior is described by flame length, rate of spread, and fireline intensity (Rothermel 1983). Surface fuels are an important factor in determining how fast a surface fire will spread and how hot it will burn. Surface fuels consist of needles, leaves, grass, forbs, branches, logs, stumps, shrubs, and small trees. Surface fire factors are also important to the initiation and spread of crown fires.

Anderson (1982) identifies surface fuels that are up to 3 inches in diameter as those that used in the Fire Behavior Model. Surface fuels greater than 3 inches contribute towards intensity, resistance to control and spotting but are not part of the fire behavior model. Fuel models as defined by Anderson (1982) were used to model general changes in fuel profiles by vegetative cover type. Fuel models were chosen after site visits in order to most accurately represent fuels for the project area.

Canopy Fuels

Crown fire and crown fire initiation is related to several conditions that must be met. First the intensity of the surface fire must be high, then foliar moisture content of the live vegetation must be low, crown base heights be low enough to interact with the surface fire and the crown bulk density must be high enough to sustain the fire once it gets into the crowns. Canopy Base Height (CBH) is the lowest height above the ground at which there is a sufficient amount of canopy fuel to propagate fire vertically into the canopy (Scott and Reinhardt 2001). CBH incorporates ladder fuels such as shrubs and understory trees as well as the lower branches of mature trees. It is often measured at the lowest height above ground where at least 30 pounds per acre per foot (or .010 kilograms per cubic meter) of available canopy fuels is present. The lower the canopy base height, the easier it is for a given surface fire to initiate a crown fire. Low canopy base heights provide the “ladder” which allows a surface fire to become a crown fire. Figure 1 displays the CBH as it relates to critical flame length.

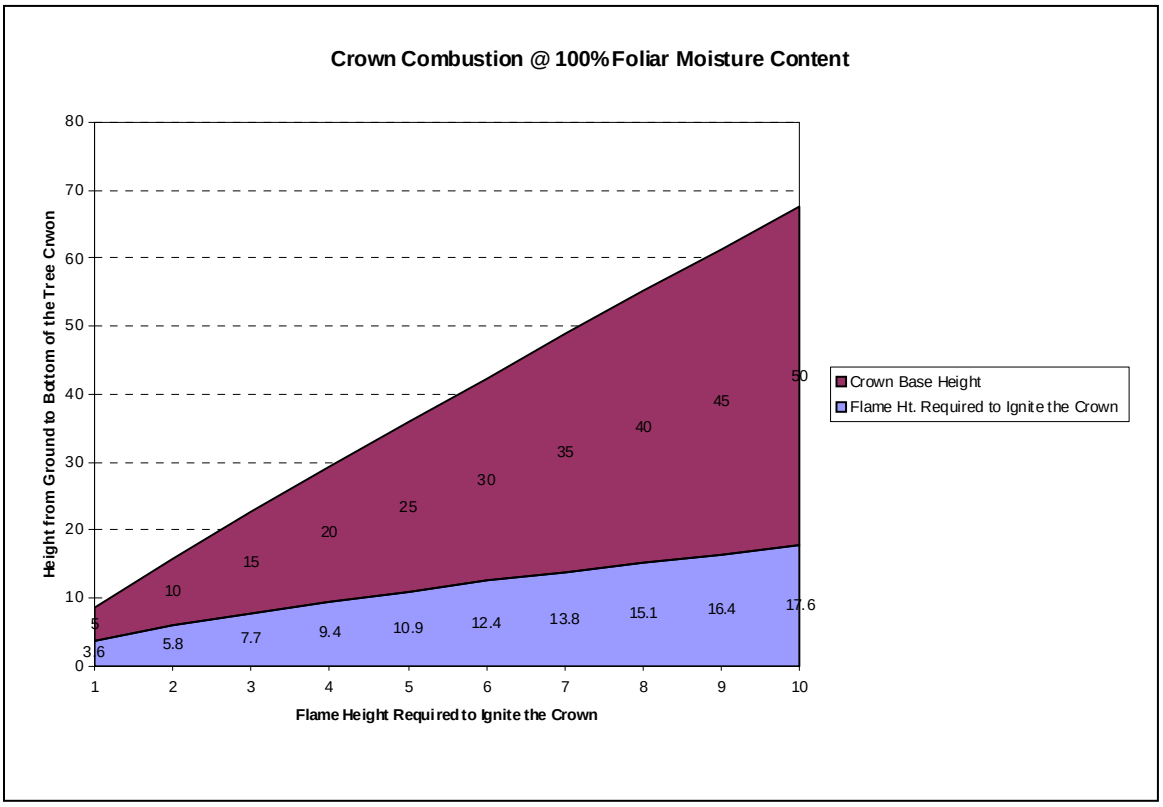

Figure 1: Canopy Base height as it relates to critical flame length.

In order for a crown fire to initiate, a surface fire must be intense enough, with long enough flame lengths, to ignite the lowest level of branches that will propagate fire to the upper levels of the canopy (Figure 1). When the height from the surface fuels to the bottom of the tree crown is low,

for example only 5 feet, a relatively short flame length will ignite the crown. A greater height from the ground would require a larger flame length to ignite.

In order for the initiated crown fire to persist, the canopy must be dense enough for the fire to spread from one tree's branches to another tree which is determined by the Canopy Bulk Density (CBD). Canopy Bulk Density (CBD) is defined as the mass of available canopy fuel per unit canopy volume. It is a bulk property of a stand, not an individual tree, and is represented as the available canopy fuel load divided by canopy depth (Scott and Reinhardt 2001). For any given species, more widely spaced trees have a lower canopy bulk density, which makes it more difficult to maintain crown fires.

Once a fire begins burning in the crowns of the trees, whether that crown fire ignition is sustained or not is determined by surface fire rate of spread, and crown bulk density. (Alexander 1988, Van Wagner 1977). Wind and slope are important factors in potential crown fire spread (Rothermel 1991), and species composition and structure control crown bulk density. Stands with high CBDs can sustain a crown fire that initiated outside the stand, even when surface fire intensity and CBH are such that fires that start within the stand itself will not transition into a crown fire.

Defining a set of critical conditions that may be influenced by management activities can be difficult. At least two alternative methods can define conditions such that crown fire will likely be low. One is to calculate critical windspeeds for given levels of crown bulk density (Scott and Reinhart 2001) and the other is to define empirically derived thresholds of crown fire rate of spread so that critical levels of crown bulk density can be defined (Agee 1996). Crown bulk densities of 0.2 kg m/3 are common in mixed conifer forests that burn (Agee 1996), levels below 0.10 kg/m3 crown fire spread was unlikely, but no definitive single "threshold" is likely to exist (Agee et. al. 2000)."

Reducing stand density can increase surface fire behavior, however overall fire behavior is more significant. "Modifying canopy fuels as prescribed in this method may lead to increased surface fire intensity and spread rate under the same environmental conditions, even if surface fuels are the same before and after canopy treatment. Reducing CBD to preclude crown fire leads to increases in the wind adjustment factor (the proportion of 20-ft windspeed that reaches midflame height). Also, a more open canopy may lead to lower fine dead fuel moisture content. These factors increase surface fire intensity and spread rate. Therefore, canopy fuel treatments reduce the potential for crown fire at the expense of slightly increased surface fire spread rate and intensity. However, critical levels of fire behavior (limit of manual or mechanical control) are less likely to be reached in stands treated to withstand crown fires, as all crown fires are uncontrollable. Though surface intensity may be increased after treatment, a fire that remains on the surface beneath a timber stand is generally controllable." (Scott 2003)

Managing Risk to Communities

The Salt Project area is in an area identified by the Trinity County Community Wildfire protection plan as an area important for the protection of communities at risk, such as the community of Peanut located approximately 3 miles north of the project area and Post Mountain, located 1 mile to the north east.

Recent research by (Cohen and Butler 1998) has shown that structures with typical ignition characteristics (wood sided, wood framed, asphalt composition roof) are at risk of catching on fire from one of three sources. The first method is direct flame contact to the structure. Another method is aerial transport of burning materials to a structure from vegetation or other burning

sources. The third is exposure to intense flames from a nearby source, which could be intensely burning vegetation or another structure. His research shows that the structures may be at risk if the flame front is less than approximately 100 feet away. Structures may also be ignited from less intense sources against or close to the side of the structure. This can occur if firewood or other flammable material next to the structure is ignited by a ground fire or firebrands. In addition, firebrands falling directly on roofs can ignite the structure if the roof is flammable, or if flammable debris is present.

An important difference between the behaviors of fires in urban areas from those in wildlands is that structures, homes, garages, and other buildings, are part of the fuel conditions. Research by Dr. Cohen and others have provided information on how structures catch on fire, and how once on fire they contribute to the spread of the fire. Once a structure ignites, the fire can spread to other nearby structures, sometimes without igniting the surrounding vegetation.

Fuel treatments around and within communities are performed to reduce fire hazard, and thus reduce the potential damage to community resources and increase the safety of the public and of firefighters, should a fire occur. Fires burning through a community can damage and destroy homes and other structures, and damage other public and private property, such as vehicles, urban trees and shrubs. The goals of Wildland/Urban interface treatments are to reduce flammability, reduce fire intensity, reduce the potential for creating firebrands and crown fires, and increasing firefighter safety and effectiveness.

In order to effectively protect a community located in a high fire hazard environment, it is desirable to perform fuel treatment projects at a range of distances from homes. Treatments at some distance from the developed portion of a community (a few to several miles) can reduce the direct risk to the community when conditions that support the initiation and spread of crown fires that can reach the community are managed, or where a large or intense fire may cause indirect damage to the community (such as a water source or erosion hazard).

Treatments near developed portions of a community (a hundred to thousands of feet from structures, for example) can add to the protection of the community infrastructure and local environmental resources. They can increase the safety of escape routes for residents and access routes from firefighters. Reducing spotting potential and the production of fire brands from this zone can reduce the risk to structures, although spotting can occur over much longer distances when burning intensity is high. It is generally true however; that the greater distance that a given point is from a fire, the less pronounced spot fires at that location become. If treatments are applied in areas to create or link areas which could act as firebreaks, they could be effective in some circumstances at allowing fires to be kept outside a community. For fires that might originate in or near these areas, treatments that are effective at reducing spread rates or decreasing resistance to control can increase to opportunity for containing the fire before it damages structures.

Treatments of natural fuels within and around developed areas are not sufficient to insure protection of neighborhoods and individual, privately owned structures. Firebrands from crown fires may be carried long distances, and fires that start from firebrands in or immediately around homes can ignite structures. The construction details and the materials used in homes, the removal of flammable material on and adjacent to the homes, and the treatment of vegetation on the property itself is important to individual structure protection. Ideally, each homeowner would engage in this kind of protection for their homes, including inflammable roofs and other areas on which firebrands might collect and ignite flammable home materials. However, it is still important to have room in which firefighters can work safely from to protect the structure, since

except for an exceptionally well designed structure; firefighter intervention is needed during the passage of a wildland fire to suppress incipient ignitions (Scott 2003). There must be an area large enough for these firefighters to work safely in because even with full wildland protective gear, radiant heat will injure a firefighter or homeowner before untreated wood siding would ignite (Scott 2003 Cohen and Butler 1998).

Treatments that center on high value and strategic locations also make sense in managing fire spread across the landscape. Since treatment of every acre is improbable due to both ecologic and economic concerns, it is logical to concentrate the bulk of treatments in these locations.

Fire Weather

Historic weather data from the Yolla Bolla Remote Automated Weather Station (RAWS) was obtained for fire behavior modeling. The 90th percentile weather was chosen because it is the normally accepted weather parameters used for Fuels planning. Modeling at the most extreme end of atmospheric and fuel moisture conditions are not normally used for fuels planning. Table 1 displays the weather parameters used for modeling potential fire behavior using weather parameters that represent the “average worst” conditions that can be expected on 90 percent of all the days that fires occur. More severe conditions would likely result in more severe fire behavior and fire effects to the site. This weather data was used to model potential fire behavior for the project area for both existing and post treatments vegetation and fuels.

Table 1: 90th Percentile Weather for Yolla Bolla RAWS, California.

Fuel/Weather Variable	90th Percentile Values
1 Hour Fuel Moisture, %	4
10 Hour Fuel Moisture, %	5
100 Hour Fuel Moisture, %	8
1000 Hour Fuel Moisture, %	10
Herbaceous Fuel Moisture, %	30
Woody Fuel Moisture, %	70
20 Foot Wind Speed, MPH	20
Dry Bulb Temperature, Degrees F	85

Flame length has significance for suppression strategy and tactics, and is also an indicator of intensity at the head of the fire (fireline intensity). Table 2 displays fireline intensity and flame length as it relates to suppression difficulty (Rothermel 1983). Table 4 shows the existing condition for flame length in the Salt project area.

Table 2: Fireline intensity interpretations

Intensity	Flame length (feet)	BTU/feet/second	Interpretations
Low	<4	<100	Direct attack at head and flanks with hand crews, handlines should stop spread of fire
Low–Moderate	4–8	100–500	Employment of engines, dozers, and aircraft needed for direct attack, too intense for persons with hand tools
Moderate	8–11	500–1,000	Control problems, torching, crowning, spotting; control efforts at the head are likely ineffective
High	>11	>1,000	Control problems, torching, crowning, spotting; control efforts at the head are ineffective

Vegetation and Fuel Loading

The composition and structure of forest vegetation as well as the arrangement of dead material within the forest are major factors in influencing the frequency and intensity of wildfire activity.

The Salt project area consists primarily of mixed conifer sites with Ponderosa Pine, Douglas Fir, White fir and other conifer species. Random sampling plots, using the Photo Series for Quantifying Natural Forest Residues In Common Vegetation Types of the Pacific Northwest - USDA FS Technical Report PNW-105, were taken to determine existing fuel loadings within the project area. Existing dead and down fuel loadings range from less than 7 tons-per-acre to over 68 tons-per-acre, with an overall average of approximately 37 tons-per-acre on most of the project area. Fuel loading in the project area is largely a product of successful fire suppression activity that has allowed natural fuel loadings to accumulate and past untreated logging slash, most of which is from harvesting in the 1970's and 80's. Although some slash deterioration is evident, remaining slash loadings and natural fuels are of sufficient quantities and condition that high intensity fire is possible under adverse weather conditions.

Existing Fuels Conditions and Fire Behavior

The fire behavior potential was modeled for the project area. The results were categorized in low, moderate and high for both crown fire behavior and flame length. For the purposes of analysis, crown fire was rated as high when active crown fire was predicted, moderate for passive crown fire, and low for surface fire. The results are displayed in Table 3.

Table 3: Existing Fire Potential Expected Throughout the Project Area

Existing Fire Potential			
	Low	**Moderate**	**High**
Crown Fire Potential Acres (and percentage of area)	525 (12%)	3710 (85%)	70 (2%)

Although the model shows the amount of high crown fire danger is limited, the amount of passive crown fire is a concern. If the wind speed is increased, as is common in a wildfire situation, many areas would be classified as high.

Table 4: Existing Flame Length Expected Throughout the Project Area

Flame Length Class Existing Condition				
	0-4 Feet	**4-8 Feet**	**8-11 feet**	**11+ feet**
Existing Acres (and percentage of area) in each Flame Length Class	1030 (24%)	290 (6%)	1,075 (25%)	1910 (44%)

Desired Fuels Conditions and Fire Behavior

Desired fuels conditions include reduction of ladder, crown, and surface fuels to lower the potential for crown fire and stand mortality, while providing for diversity within the stands. Stands would be converted from high and moderate fire potential to low, where surface fuels are light, ladder fuels are not widespread, and canopy density is reduced. Fuel loading would be reduced in fire-prone forests to protect people and sustain resources as directed by the Healthy Forests Restoration Act of 2003, the National Fire Plan, and A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10-Year Comprehensive Strategy Implementation Plan. This would result in lower flame lengths, with the ideal being 4 feet or less. It would also reduce the number of acres that are likely to have crown fire activity (either passive or active).

Desired fuels conditions can be achieved by: 1) Treating surface and small ladder fuels, raising canopy base height and reducing the potential for crown fire initiation and spotting. 2) Thinning the canopy from below to decrease canopy bulk density, which would result in higher wind speeds and more severe weather needed for active crown fire spread. 3) Pile burning of surface and residual activity fuels, or masticating surface fuels. Reduction of surface fuel loads would result in decreased rates-of-spread, flame lengths, fireline intensities, and stand mortality in the event of wildfire.

Environmental Consequences

Alternative 1: No Action (Existing Condition)

Direct and Indirect Effects on Fire Behavior and Fuels

The fire behavior effects of the no action alternative is considered the same as described under the existing condition and summarized in Tables 3 and 4.

Surface, ladder, and crown fuels would continue to accumulate in the absence of fire or treatment. With no modification of forest structure and fuels, fire behavior under 90th percentile conditions would persist as described under the existing condition, threatening resources within the project area. Eighty eight percent of the area would continue to be susceptible to crown fire activity and 69% of the project area would continue to have control problems (flame length 8 feet or greater) with torching, crowning, and spotting. Control efforts at the head of a fire would likely be effective in only 24% of the project area and would be ineffective in 44% of the area.

Fires that escape initial attack, usually those burning under severe conditions are likely to become large and damaging crown fires. Direct suppression tactics would not be effective in most circumstances.

In the absence of any kind of human-caused or natural disturbance, indirect effects would occur from the natural progression of forest growth and change. The result would be increased surface and ladder fuels that affect flame length, reduced canopy base heights that affect torching of trees, and increased crown density that make crown fire probable (Peterson et al. 2005, Graham et al. 2004). Fire risk in the project analysis area would likely increase and contribute to severe wildfires that could destroy important resources and habitat.

No progress would be made towards initiating the restoration of ecological processes that include the natural fire regimes, moderate to low intensity, frequent interval (1-25 years) regime. Stands would continue to shift in species composition from pine to cedar and fir increasing the risk of loss due to wildfire because cedar and fir are more susceptible to fire caused mortality than pine due to their branch characteristics and bark qualities.

The no action alternative would not be consistent with the Forest Plan direction and other regulatory direction outlined in this document. It would not contribute to the desired condition, purpose and need, or respond to the National Fire Plan goals of reducing hazardous fuels to modify current fire behavior that would improve suppression operations. Suppression operations would continue to occur. The ability of firefighters to safely and effectively suppress wildland fire would become more difficult as fire behavior intensifies.

Alternative 2: Proposed Action

Direct and Indirect Effects on Fire Behavior and Fuels

Ladder and crown fuels would be reduced through thinning of the stands. Activity fuels (slash generated from harvest and thinning activities) would be treated through a variety of methods including yarding methods, mastication, biomass, and piling and burning. The reduction of surface fuels would reduce the potential flamelength with in the proposed treatment units (Table 6). This when combined with the raising of the canopy base heights by reducing the ladder fuels would in turn, reduce the ability of a fire to transition into a crown fire (Table 7). The reduction in potential flame length would reduce the area that would likely to have control problems (flame length 8 feet or greater) from 69% of the project area, with no action, down to 51% of the area (Table 6). The percentage of the project area where efforts at the head of a fire would be ineffective would be reduced from 44% of the area, with no action to 35% of the area (Table 7).

A key issue was that the regeneration harvest-green tree retention units, Units 37 and 40, may increase the risk from fire. Under Alternative 2, substantial changes to post treatment fire behavior potential were predicted. For unit 37 the predicted fire type went from mostly passive crown fire to surface fire following treatment. Also for Unit 37, flame lengths went from being classified as ineffective to control efforts from direct attack to direct attack being effective. For Unit 40, much of the unit has relatively low flamelengths prior to treatment so only portions of the unit show reduced flame length. However, the lower canopy base heights within the unit predict passive crown fire for most of the unit with some active crown fire. Following treatment, the unit is predicted to have only surface fire.

Thinning of overstocked small-diameter understory stands would reduce the ladder fuels allowing fire to remain in the surface fuels, and reducing the potential for crown fire. Suppression operations would continue to occur, however, fire behavior modeling indicates the proposed action would keep the fuels profile at a level that reduces fireline intensity allowing suppression resources to more safely use direct suppression tactics on 48% of the project area. With no action direct suppression tactics could safely be used on only 30% of the area.

Fire modeling results show a significant decrease in fire behavior as compared with Alternative 1 (existing condition). All treated units would have reduced flame lengths, less crown fire activity, and less severe fire effects. The overall fire hazard would be reduced across the treatment units. Treatments would result in predicted fire behavior that is not likely to cause severe effects to forested stands.

The proposed fuelbreak along the edge of the project would provide firefighters with a strategic place to defend against an oncoming fire. Maintenance treatments would be required to keep fire intensity within the desired range and to maintain the integrity of the fuelbreak. Mechanical treatments and low-intensity prescribed fire would be the likely methods used to maintain fuelbreaks and reduced understory vegetation. The need for maintenance would be monitored by district fire personnel and performed as needed.

The following are types of treatments that are planned under alternative 2 to treat both existing and activity generated fuels within the treatment units. A table displaying the treatments by unit is located in Chapter 2 of the EIS.

Treat on Site (TOS) on an estimated 1,306 acres: This activity includes the removal, chipping, or bunching of concentration for burning within treatment units of sub-merchantable material. The objective of this treatment is to reduce fuel loading and reduce fire/fuel ladders;

Handpile (HP) Burn Piles (BP) on an estimated 152 acres: The objective of this treatment is to reduce fuel loading, while minimizing damage to the residual trees on steeper ground;

Tractor Jackpot Pile (TJP) Burn Piles (BP) on an estimated 103 acres: The objective of this treatment is to reduce concentrated fuel loading, and reduce fire/fuel ladders within fuelbreak;

Tractor Site Prep (TSP), Burn Piles (BP) on an estimated 58 acres, to occur within GTR units for site-preparation and hazard reduction.

Pre-commercial Thin & Masticate 481 acres of existing plantations.

A public comment expressed concern that decommissioning roads could have a negative impact on future fire suppression and vegetation management. Alternative 2 would decommission approximately 13.8 miles of road not needed for management at the completion of this project. The need for future use of roads for both fire suppression and vegetation management was considered in determining which roads could be decommissioned after use for this project (RAP Sept. 2007, p. 11-26 to 16-26). The benefit that each road provides for fire protection, and fuels management was ranked with a score from “0”benefit to a score of “5”. All of the roads that will be closed with this alternative were ranked as 0 for benefit for fire protection, meaning there will be no effect to fire suppression efforts from closing these roads. A ranking of 0 was given to 9.2 miles of the roads for benefit to fuels management a rank of 1 was given to 0.8 miles and a rank of 3 was given to only 3.8 miles. This means that there would be very little impact to fuel management from these closures.

Table 5: Reduction in Hazardous Fuel Conditions - Comparison by Alternative of Meeting Purpose and Need for Project

Purpose & Need	Alt 1	Alt. 2	Alt. 3	Difference between 2 & 3
Reduce Hazardous Fuel Conditions				
Reduction in acres of Active Crown Fire Potential	0	5	5	**0**
Reduction in acres of Passive Crown Fire Potential	0	1,110	1,060	**50**
Reduction in acres requiring indirect fire attack methods (Flame length reduced to 8 feet or less)	0	780	770	**10**
Increase in acres that could be direct attacked with hand crews	0	900	870	**20**

Fuels (surface, ladder and canopy) will begin to accumulate after treatment. This is due to the growth of the forest over time. Historic fire regimes show that the area likely burned much more often than the current fire return interval (see discussion of fire regime above). While there will be some variability in how rapidly fuels accumulate throughout the project, it is anticipated that it will take approximately 20 years before fuels have accumulated to the extent that the treatments are no longer effective. The exceptions will be areas such as the Fuelbreak due to the shrub the heavier shrub component. Such areas would likely need some maintenance in approximately 10 years.

Alternative 3: Modified Proposed Action

Direct and Indirect Effects on Fire Behavior and Fuels

The effects on the fuels profile, loading and fire behavior on treated stands are similar to Alternative 2, with less area converted to lower flame length classes and reduced crown fire activity. Under this alternative approximately 48% of the project area would be in the low flamelength category (8 feet flame length or less) compared to 48% with Alternative 2. With Alternative 3, 37% of the area would be in the low crown fire behavior category following treatment compared to 38% with Alternative 2.

Alternative 3 would decommission the same roads as Alternative 2 so the effects would be the same.

While the length of time that treatments would be effective may be slightly shorter under alternative 3 than alternative 2, they are not anticipated to be of sufficient scale or intensity to make an appreciable difference over the span of 20 years.

Cumulative Effects – All Alternatives

The cumulative effects area was determined to be the project analysis boundary because collective activities within this area can modify fire behavior. Although the effects outside this boundary could notably influence fire behavior, the spatial magnitude (size) of this boundary was determined quite adequate from a fire management perspective.

The cumulative effects area has been managed through activities such as logging, most notably from the 1970’s and 80’s. Past activities include a variety of prescriptions associated with several projects such as commercial thinning, pre-commercial thinning, regeneration cutting, site

preparation, and planting. A variety of treatment methods have included, mechanical piling, hand piling, and prescribed burning.

Within the project boundary, the existing condition reflects the effects of past activities, including fire suppression. Fuel models and stand conditions modeled reflect the changes associated with activities affecting fire behavior and hazard up to present.

In 2008, a wildfire occurred directly adjacent to the project area on the Northeast edge. The Telephone fire burned under varying conditions and as a result had variable effects to the area. The fire reduced fuels in the short term adjacent to the project area and therefore would reduce fire behavior. This would also reduce the likelihood that high intensity fire would enter the Salt project are from this area, at least in the short term. In areas of higher mortality, fuels can be expected to accumulate due to breakage and fall-down of the standing dead timber. Although this area is outside of the cumulative effects area, the fact that it escaped initial suppression action and reached over 5500 acres in size is worth noting. A fire burning in the Salt project may or may not burn in the same manner as the Telephone fire. It would be based upon the conditions at the time of the fire.

Under alternative 1, the cumulative effects of past management actions and the continuation of fire suppression without management action will result in the area trending toward increasing fire hazard.

Under the action alternatives (2 and 3). Treatment would reduce the effects of aggressive suppression and past management effects by reducing the fuels available for burning.

Summary and Conclusion

Alternatives 1, 2, and 3

Alternatives 2 and 3 similarly reduce surface, ladder and crown fuels that change the fuel profile resulting in reduced fireline intensity and severe crown. However, because of the additional fuels removed in alternative 2, a greater number of acres would be moved into the desirable classes of flame length and fire type. A comparison of the alternatives is summarized in Tables 5 and 6.

Table 6: Flame Length Class-Acres and Percentage of Area by Alternative

Flame Length Class-Acres and Percentage of Area by Alternative				
	0-4 Feet	**4-8 Feet**	**8-11 feet**	**11+ feet**
Alternative 1	1030 (24%)	290 (6%)	1075 (25%)	1910 (44%)
Alternative 2	1930 (45%)	170 (3%)	700 (16%)	1505 (35%)
Alternative 3	1900 (44%)	190 (4%)	735 (17%)	1480 (34%)

* Approximately 1% of the project area is classified as unburnable (rock etc.) and therefore not quantified.

The reduction of flamelengths has a cascading effect on fire behavior. As a result of lower flamelengths, it is less likely that the crowns of trees become involved in the fire, reducing the amount of embers produced from individual and or groups of trees burn intensely. Burning embers can produce spots at distances over ¼ mile. The increased fire behavior associated with the burning of tree crowns further complicates suppression action and makes direct attack unlikely to be successful.

Table 7: Fire Type Acres and Percentage of Area by Alternative

Fire Type Acres and Percentage of Area by Alternative			
	Surface	Passive Crown	Active Crown
Alternative 1	525 (12%)	3710 (85%)	70 (2%)
Alternative 2	1640 (38%)	2600 (60%)	65 (1%)
Alternative 3	1590 (37%)	2650 (61%)	65 (1%)

* Approximately 1% of the project area is classified as unburnable (rock etc) and therefore not quantified.

Selection of one of the action alternatives would enhance the continuation of the ecosystem restoration, community protection, forest health, and natural fuels reduction strategy initiated by the South Fork Management Unit. The strategy involves a series of projects that would restore ecosystem health and reduce fire hazard in the watershed. Alternative 2 would result in more acres meeting the desired conditions for fire and fuels management. The action alternatives are also responsive to the Trinity County Community Wildfire Protection Plan, by reducing fuels and fire behavior in the vicinity of the community of Peanut, which is listed as a community at Risk and Post Mountain. Alternative 1 does not do this.

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Appendix A - Models and Assumptions

Field observations were made and timber stand exam data was collected within the analysis area in 2008. See the Silviculture Report for more detailed explanation on stand exam data collection. Photo series handbooks and ocular estimating were also applied. Stand exam and fuels data were processed through Forest Vegetation Simulator and Fire & Fuels Extension (FVS-FFE) by vegetative strata to derive data used for modeling in the fire behavior software package FlamMap. Fire behavior characteristics and hazard were derived for the proposed treatment areas by placing forest vegetation types into nationally accepted fire fuel model groups that describe the potential fire behavior within defined weather variables and the fuel model groups were used as a measure to estimate changes in fuel profile by alternative Fuel models were taken from the national Landfire database and compared to information gathered during walkthrough surveys by fuels specialists. The Landfire data was found to give a good representation of on the ground conditions and the fuel models were used as is for the existing conditions. For the proposed action, FVS was again used to determine the effects of treatment by strata on the vegetation. Adjustments to fuel models were made based upon the treatment types and were again adjusted by strata.

FlamMap is a fire behavior mapping and analysis program that computes potential fire behavior characteristics over an entire landscape for given weather and fuel moisture conditions. FlamMap uses GIS-based raster inputs for terrain and fuel characteristics (elevation, slope, aspect, fire behavior fuel models, and canopy characteristics), computes fire behavior outputs for a given landscape using standard fire behavior prediction models, and generates raster maps of potential fire behavior characteristics (spread rate, flame length, crown fire activity, etc.) over an entire landscape.

FlamMap employs the fire behavior model (Rothermel's 1972). The Rothermel fire behavior model makes several assumptions which include:

- The fire is free-burning;
- Fire behavior is predicted for the flaming front of a surface fire;
- Fine fuels are the primary carrier of the initial fire front
- Fuels are continuous and uniform.

FlamMap then utilizes VanWagner's 1977 crown fire initiation model, Rothermel's 1991 crown fire spread model, and Nelson's 2000 dead fuel moisture model to model both crown fire. FlamMap defines two types of crown fire:

- Passive - fire does not carry continuously through the crown fuels, but burns crown fuels intermittently, such as when individual trees or groups of trees torch.
- Active - fire carries continuously through the

Assumptions and variables used in the model include:

- Weather parameters used in the models represent the 90th percentile weather conditions for the area. These values were derived from a weather station site located near the project area. 90th percentile wind speed for the area is approximately eight miles per hour. However, since FlamMap does not incorporate spotting, an important means of fire spread, a moderate wind (25 miles/hour at 20 feet) was used to represent the greater spotting potential (Fites-Kaufman

et al. 2003). This also is more likely to represent the actual conditions when a fire is likely to escape initial suppression actions.

Fire behavior outputs generated from modeling exercises only reflect static conditions and do not take into account changing weather conditions. Any change in these factors could drastically affect fire behavior. Given the uncertainty of any modeling exercise, the results are best used to compare the relative effects of the alternatives, rather than as an indicator of absolute effects. Interpretation, professional judgment, and local knowledge of fire behavior were used to evaluate the outputs from the models and adjustments made as necessary to refine the predictions.