
FUELS AND FIRE ANALYSIS

TRESTLE FOREST HEALTH PROJECT

Teresa Riesenhuber
Fire and Fuels Specialist
Placerville Ranger District
Eldorado National Forest
December 9, 2014

Reviewed By
Jason Withrow
District Fire Management Officer

CONTENTS

Introduction	4
Fire in Sierra Nevada Ecosystems	4
Fire History	5
Fire Hazard and Risk	6
Environmental Characteristics Affecting Fire Behavior and Containment Strategies	7
Fuels	7
Weather	7
Topography	8
Fire Modeling Methodology	9
Fire Behavior Characteristics	11
Flame Length and Fireline Intensity.....	11
Rate of Spread.....	12
Crown Fire Activity.....	12
Affected Environment	13
Fuels.....	13
Weather	14
Topography.....	14
Fire Behavior Synopsis	15
Wildland Urban Intermix	21
Strategically Placed Landscape Area Treatments.....	22
Management Activities and Uses	23
Environmental Consequences	24
Alternative 1.....	24
Direct & Indirect Effects.....	24
Cumulative Landscape Effects	25
Alternative 2.....	29
Direct & Indirect Effects.....	29
Cumulative Landscape Effects	35
Alternative 4.....	42
Direct & Indirect Effects.....	42
Cumulative Landscape Effects	45
Alternative 5.....	48

Direct & Indirect Effects.....	48
Cumulative Landscape Effects	49
Summary.....	53
References Cited.....	54

INTRODUCTION

This analysis reviews fire history, fire's role within the project area and describes the current fire hazard and risk of ignition within the Trestle Forest Health project area. The Affected Environment describes current conditions within the project area and surrounding landscape. Each alternative is analyzed within the Environmental Consequences section to describe the potential effects of fire behavior at the individual treatment level and within the landscape. Methodology of the analysis provides information on the type of fire modeling and specific measurements used to assess the effects of each alternative. A combination of professional fire management assessment and fire modeling is used to provide a meaningful analysis of potential effects of fire behavior related to the spread, intensity, fire type and strategies of fire managers to contain a wildland fire within the Trestle project area.

FIRE IN SIERRA NEVADA ECOSYSTEMS

Fire is an integral part of California ecosystems; for without fire, few of the state's native ecosystems, habitats, or even species, would persist as we know them today (Sugihara, et. al, 2006). Three basic components affect wildland fire and fire behavior – fuels, weather and Topography. Fire behavior and severity depend on the properties of the various fuel strata and the continuity of those fuel strata horizontally and vertically (Graham, McCaffrey, Jain, 2004). Elements of weather (abiotic factors) affecting the spread and severity of fire include – air temperature, atmospheric moisture, atmospheric stability, clouds and precipitation. More than 80 years of fire research shows that fuels (composition, amount, structure, moisture content of dead and live vegetation), physical setting (slope, aspect, elevation), weather (short-long-term wind, humidity, precipitation), and climate combine to determine wildfire intensity and severity (the effect the fire has on vegetation, soils, buildings, watersheds, and so forth: most often expressed in terms of the post wildfire condition of litter, soil, trees, and so forth) (Graham, McCaffrey, Jain, 2004).

Vegetation type varies in the Sierra Nevada due to topography and climate variations. These vegetation types can be grouped, or categorized into 6 ecological zones: (1) the foothill shrubland and woodland zone, (2) the lower-montane forest zone, (3) the upper-montane forest zone, (4) the subalpine forest zone, (5) the alpine meadow and shrubland zone and (6) the eastside forest and woodland zone (Sugihara et. al, 2006).

The lower-montane forest zone best represents the vegetation type within the Trestle project. Major vegetation types include California black oak (*Quercus kelloggii*), Ponderosa pine (*Pinus ponderosa*), White fir (*Abies concolor*) mixed conifer, Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*) mixed conifer, and mixed evergreen forests. Interspersed within the forests are chaparral stands, riparian forests, and meadows and seeps. Historically, fires within this zone had a frequent fire return interval. All sites in the lower-montane zone experienced fire frequently enough to reduce fuel accumulations and vegetation density, and as a result, these fires were primarily of low to moderate intensity and severity (Sugihara et. al, 2006).

In its natural role, fire is not a disturbance that impacts ecosystems; rather it is an ecological process that is as much part of the environment as precipitation, wind, flooding, soil development, erosion, predation, herbivory, carbon and nutrient cycling and energy flow. Fire resets vegetation trajectories,

sets up and maintains a dynamic mosaic of different vegetation structures and compositions, and reduces fuel accumulations. Humans have often disrupted these processes, and the result can be that fire behavior and effects are outside of their range of natural variation. At that point, fire is considered an exogenous disturbance factor (Sugihara et. al, 2006).

Previous activities within the Trestle project area have altered historic fire patterns. Multiple decades of fire exclusion, grazing by domestic livestock, previous stand replacing wildfire, mining and historic logging practices, including selective logging of large pines and lack of follow-up slash treatment, have contributed to altered fire regimes, heavy fuel loadings, and changed vegetation composition and structure. As a result, the number, size, and intensity of wildfires have been altered from their historical range (Boudin, 1999; Beesley, 1996; McKelvey & Johnston, 1992). In recent years, large fires have become less controllable and more severe, evidently reflecting in part increased fuel loadings (Weatherspoon & Skinner, 1996).

FIRE HISTORY

An analysis of the recorded wildland fire history for the Trestle project and its immediate surroundings indicate that fire continues to influence the landscape. The data from which the tables are derived is the recorded fire history for the Eldorado National Forest from 1960 to 2010 for A and B size class fires (less than 10 acres) and 1908 to 2013 for the C size class and greater fires (10 acres or greater). To gain an understanding of fires relationship with the landscape, the fire history encompasses fires occurring within 1 mile of the project area. It is understood that these data do not contain all of the fires that actually occurred due to numerous reasons: lack of reporting, differing management priorities over the decades, loss of records, and so forth. There is however, enough data to demonstrate the continuing influence of wildland fire in the project area. Record keeping for prescribed burning has only begun in 2004. Prescribed burning has been implemented during previous projects however, records of where and when the prescribed burning occurred is incomplete.

Fires: A and B class fires (<10 acres) 1960 – 2013	
Fire Cause	Number of Ignitions
Lightning	61
Human	100

TABLE 1: CLASS A AND B FIRES (< 10 ACRES) WITHIN 1 MILE OF TRESTLE PROJECT

**Fires: C class fires (≥ 10 acres)
1908 – 2013**

Year	Name	Cause	Size
1916	(unknown)	Human	1,397
1919	Grizzly Flat	Human	232
1919	(unknown)	Human	505
1919	(unknown)	Human	603
1919	Silver Hill	Human	363
1922	Leoni	Human	36
1924	Upper Desolation	Human	10,973
1925	(unknown)	Lightning	37
1926	(unknown)	Human	34
1926	(unknown)	Human	20
1926	(unknown)	Human	550
1926	(unknown)	Human	435
1928	McKinney Creek	Human	131
1928	(unknown)	Human	817
1930	Caldor	Human	233
1932	(unknown)	Human	328
1933	Steely	Human	15
1936	(unknown)	Human	777
1961	(unknown)	Human	175
1988	Bear	Human	1,010
1999	Big Mountain	Human	37
2008	Capps 2	Lightning	19
2013	Henry	Human	20

TABLE 2: CLASS C AND GREATER FIRES (> 10 ACRES) WITHIN 1 MILE OF TRESTLE PROJECT

FIRE HAZARD AND RISK

Fire risk is the probability or chance that a wildfire will start, either from natural or human causes, based on recent fire history. **Fire hazard** is the potential for damage or loss from a fire and is determined by the characteristics of fuels combined with the influences of topography and weather. The fuels characteristics apply to both dead and live fuels, and include loading (tonnage), size and shape, compactness, horizontal continuity, vertical arrangement, fuel moisture content, and chemical properties. Topographic and weather influences, combined with fuels characteristics, determine the rate of forward spread of a fire and the intensity at which a fire will burn. The Trestle proposed treatment units are currently classified as described in table 3 as determined by analysis of the Eldorado National Forest fire risk by watershed document and the Eldorado National Forest Fire Hazard Map. These documents describe the predicted fire hazard and probable fire risk by 7th field watersheds.

Fire Hazard and Risk		
Watershed Name	Hazard	Risk
Big Canyon Creek	Moderate	High
Clear Creek-Steely Fork Cosumnes River	Moderate	High
Dogtown Creek	Very High	Moderate
Lower Steely Fork Cosumnes River	Very High	High
McKinney Creek	Extreme	Moderate
Middle Dry Creek	Moderate	Moderate
Middle Fork Cosumnes River-Five Corners	Very High	Moderate
Middle Fork Cosumnes River-Pi Pi Creek	Very High	Moderate
North Fork Cosumnes river-Bear Meadow Creek	Very High	High
North Fork Cosumnes River-Van Horn Creek	Extreme	High
Upper Steely Fork Cosumnes River	High	High

TABLE 3: FIRE HAZARD AND RISK BY 7TH FIELD WATERSHED

ENVIRONMENTAL CHARACTERISTICS AFFECTING FIRE BEHAVIOR AND CONTAINMENT STRATEGIES

Fire activity that presents potential hazard to fireline personnel is defined as problem fire behavior. Extreme fire behavior is the highest level of problem fire behavior and it can be described with specific elements – rapid rate of spread, intense burning, spotting and crowning (NWCG, 1994). Fireline personnel observe current fire behavior characteristics (i.e. flame length, rate of spread, crown fire activity, spotting) and numerous environmental conditions on a constant basis to anticipate and predict potential fire behavior determine strategies and implement tactics to safely contain a wildland fire.

Fire managers specifically focus on three areas, fuels, weather and topography, when determining potential fire behavior and appropriate tactics to contain a wildland fire.

FUELS – Size, type, vertical arrangement, horizontal continuity and packing ratio all contribute to a fuels availability to ignite and consume as well as its contribution to fire spread and intensity. Key visual indicators of potential extreme fire behavior may include any or all of the following: continuous fine fuels, heavy loading of dead and down fuels, ladder fuels, tight crown spacing and special fuel conditions such as blow down, freeze damage or frost killed vegetation, insect damage or other widespread disease causing mortality.

When assessing fuel conditions, the concern is how a fire may burn given the current vegetation type, structure and arrangement of fuels. Fuels can be classified into three fuel profile layers: ground, surface, and canopy. Ground fuels include those fuels within the duff layer. Examples include roots and decomposing material. Surface fuels consist of fuels lying immediately on the ground to approximately six feet above the ground. Needle cast, oak litter, shrubs, brush and small trees are examples of surface fuels. Canopy fuels consist of the multi-layer canopy which extends from the surface fuels into the overstory canopy. It is the interaction between these fuel profiles that determines the availability of fuels to ignite, spread, initiate and propagate into surface and crown fire behavior.

WEATHER – A dynamic component of wildland fire environment, weather factors determine the ignition, fire behavior, and severity of a wildland fire. Temperature, precipitation, and humidity determine the

availability of fuel to ignite and sustain combustion. A direct relationship between fuel moisture (amount of moisture within dead fuel) and relative humidity exists; as relative humidity decreases, fuel moisture decreases. Wind patterns are normally slope driven with diurnal wind patterns (upslope/up-canyon during daytime hours and down slope/down-canyon during nighttime hours). Other wind patterns which occur with the passage of frontal systems are “North Wind” events. A “North Wind” event is a type of Foehn wind that typically occurs during the late summer and fall and brings high winds consisting of dry air from the north and east (USDA-FS, 1970). When unaccompanied by precipitation, this type of Foehn Winds generally decrease relative humidity and fuel moisture conditions resulting in potential for large fire events to occur. On the Eldorado National Forest a “North Wind” event typically brings strong winds from the east/northeast. The 2004 Freds fire and Power fire (both occurring on the Eldorado National Forest) experienced rapid fire growth and were the result of a Foehn Wind event and exhibited extreme fire behavior, influencing spread rate, flame length, fireline intensity and sustained crown fire.

Fire management specialists observe and obtain weather forecasts to implement safe firefighting tactics and determine strategies to contain a wildland fire. Environmental conditions contributing to extreme fire behavior potential include 1000 hour fuel moistures less than 9%, temperatures greater than 84° F and surface wind speeds greater than 5 mph (NWCG, Incident Response Pocket Guide, January 2014).

Indicators of extreme weather conditions may include some or all of the following: strong surface winds, cumulonimbus cloud development (thunderstorms), lenticular cloud development (high winds aloft which could potentially reach the surface), approaching cold fronts, high air temperatures, and extremely low relative humidity.

TOPOGRAPHY – Relatively static component within the wildland fire environment, topography by itself affects fire behavior. Steep slopes, box canyons, chutes, saddles and narrow canyons promote the potential for extreme fire behavior due to their ability to funnel wind and preheat fuels ahead of a fire allowing the ignition of surface and aerial fuels more rapidly than on flat terrain. Diurnal slope driven wind patterns in combination with the drainage and canyon position contribute to alignment of wind and slope causing extreme fire behavior.

Aspect influences fire behavior in several areas. Time of day is an important consideration when fuels are most readily available to burn and contributes significantly to fuel temperature and fuel shading. For example, a wildfire occurring at 9:00 am on a west aspect would react differently than that of an east aspect. At that time of day an east aspect would have lower fuel moistures than a west aspect due to solar heating on the east and shading on the west. The sun rising in the east would increase the fuel temperature and conversely decrease fuel moisture when compared to west aspects. A fire at 9:00 am on an east aspect would burn with more significant fire behavior than a west aspect where there is fuel shading from the sun. As the sun continues to rise and heat the fuels the south and west aspects begin to be affected by solar heating from the sun. Air and fuel temperatures begin to rise causing a decrease in fuel moisture and relative humidity. Typically, the “hottest” weather conditions (high temperature, low relative humidity, low fuel moisture), occur between 2:00 pm and 4:00 pm. During this period solar radiation is affecting fuel temperature making fuels more available for the ignition and spread of a wildfire. During the “hottest” period south and west aspects are most susceptible to fire ignition and spread.

Elevation factors into the type of vegetation and forest structure present as well as length and duration of the fire season. Within the project area typical fire season occurs during the months of May through October. In the fall, wildfire occurrence and growth are decreased due to precipitation, cooler temperatures and higher relative humidity.

Fuels, weather and topography work in combination to determine fire behavior. Visual indicators of extreme fire behavior include: wildfire spread rates uncontrollable and outpaced by suppression forces; well-developed smoke column that exhibits similarities of thunderstorms producing erratic wind conditions and down drafts; group tree torching; numerous spot fires occurring ahead of the main fire; and the presence of fire whirls. The observation of one indicator at a critical level does not always mean you will experience problem fire behavior. However, as additional indicators are observed, current strategies for fireline containment are reassessed to determine the safest suppression action.

Of the three environmental variables, fuels remain the one area which can be manipulated to minimize the potential for extreme fire behavior as well as assist fire managers with localized areas which can strategically be utilized to contain a large, rapidly advancing wildfire.

FIRE MODELING METHODOLOGY

Obtaining and assessing fire behavior characteristics allows fire managers to utilize modeling programs to display potential fire behavior in numerical form. This form allows for the comparison of each alternative considered, including the “no action” and current condition. The ability to compare alternatives under the same environmental conditions is a necessary aspect in order to ensure an objective analysis of alternatives. Geospatial data can be applied to represent a “numerical” landscape which combined with environmental components of wind and fuel moistures, produces fire behavior outputs. It is important to understand that fire behavior modeling is a caricature of reality not reality.

Fireline intensity, rate of spread, flame length and crown fire potential are modeled outputs to provide a comparison of each alternative. At a minimum, fuel treatments should treat fuels to the 90th percentile weather conditions. Utilizing Steely Fork and Grizzly Flat Remote Automated Weather Stations (RAWS) (located within the Trestle project area) and the National Fire Danger Rating System, historical weather was retrieved to determine 90th percentile weather conditions (Table 4). The winds used to model an east wind event were from the east-northeast at 30 miles per hour. It is important to remember that not all types of fire behavior or mechanisms that contribute to fire spread or extreme fire behavior can be accounted for within any geospatial fire behavior modeling programs such as the contribution of falling snags, rolling debris, fire whirls, horizontal roll vortices or plume-dominated events.

**90th Percentile Weather – Steely Fork and Grizzly RAWS
1992-2012 Weather Data**

1 – hour Dead Fuel Moisture	2%
10 – hour Dead Fuel Moisture	3%
100 – hour Dead Fuel Moisture	6%
1000 – hour Dead Fuel Moisture	7%
Live Woody Fuel Moisture	70%
Herbaceous Fuel Moisture	30%
Temperature	93°F
Wind (expressed as 20 foot wind)	12 mph

TABLE 4: 90TH PERCENTILE WEATHER - STEELY AND GRIZZLY RAWS

The following programs are utilized in the analysis of the Trestle Forest Health Project. Assumptions and limitation for each program are available online at www.firemodels.org :

- Behave Plus Fire Behavior Modeling Program
 - Surface fire behavior of vegetation to relate flame length and fireline intensity to crown fire initiation.
 - Crown fire initiation characteristics were modeled utilizing Behave Plus.
 - Probability of Mortality
- FlamMap
 - Combines both geospatial fuel and topographic data and historical weather conditions, fire spread, flame length, fireline intensity and crown fire type are modeled and compared to each alternative considered.
 - Each 30 x 30 meter grid make up a landscape file used to analyze potential fire behavior to compare to the alternatives.
 - Each cell (grid) composes numerical values of topography, surface fuel, and crown fuels which generate fire behavior values for each individual cell.
 - Adjacent cells do not have an effect on each other.
 - Does account for the effect of falling snags, rolling debris, fire whirls, and extreme fire behavior such as plume-dominated fires and horizontal roll vortices.
 - 4 ignition points were selected to analyze potential cumulative effects all action and no-action alternative (Figure 1).

Assumptions used for fire behavior modeling in the Trestle project area include:

- For alternatives 2, 4, and 5 fire behavior was modeled as if all treatments were completed within the same three year time period.
- Fire behavior was modeled after completion of all mechanical treatments, hand treatments and the first priority burn units.
- Since it is unclear which burn units would be completed within the first 3 year time period, no modeling occurred for the prescribed burn areas outside of the first priority burn units.
- Ignitions points were selected based on prior fire history or locations that are of concern for a fire ignition.

- Caldor Ignition: this is the location of a lightning fire and an area of high human recreational use. This ignition point was selected to represent a fire starting from either natural or human causes.
- Dogtown Ignition: an area of low to moderate human recreational use. This point was selected to represent what a fire would do if one should start in the steep, untreated areas of the Cosumnes/Dogtown River drainages. This area is remote and steep with only one road in and out.
- Long Bear Ignition: an area of high human use with abundant ignition source potential.
- Steely Ignitions: a fire starting in the Steely Fork is a concern for the Grizzly Flat community (Grizzly Flat CWPP, 2012). There is a history of high human use and lightning fires in the entire Steely Fork drainage.

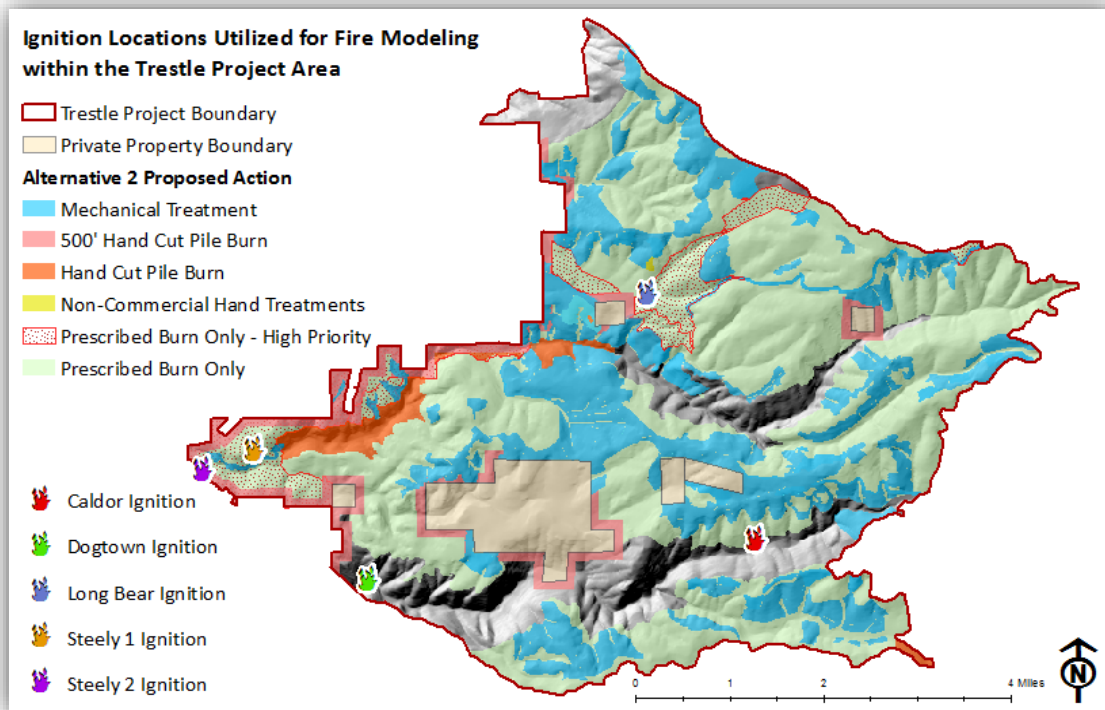


FIGURE 1: IGNITION POINTS UTILIZED FOR COMPARISON OF CUMULATIVE EFFECTS BETWEEN ALL ALTERNATIVES

FIRE BEHAVIOR CHARACTERISTICS

Fire behavior characteristics utilized to compare and analyze the current conditions and post treatment fuel conditions are flame length (FL), fireline intensity (FI), rate of spread (ROS) and crown fire (CF) type.

FLAME LENGTH AND FIRELINE INTENSITY - Table 5 displays the relationship of flame length and fireline intensity related to fire suppression capabilities and potential fire behavior. These two variables can be visually identified and felt by fire resources on scene of a fire. As flame length and/or fireline intensity increases, suppression capability, resource types and tactics differ. Fireline Intensities are measured in British thermal units per foot per second (btu/ft/sec). A four inch, wooden kitchen match consumed completely generates 1 BTU.

Flame Length (Feet)	Fireline Intensity (BTU/Ft/Sec)	Interpretations
0 - 4	0 - 100	Persons using handtools can generally attack fires at the head or flanks. Handline should hold the fire.
4 - 8	100 - 500	Fires are too intense for direct attack at the head of the fire by persons using handtools. Handline cannot be relied on to hold fire. Equipment such as dozers, engines, and retardant aircraft can be effective.
8 - 11	500 - 1000	Fires may present serious control problems such as torching, crowning, and spotting. Control efforts at the head of the fire will probably be ineffective.
11+	1000+	Crowning, spotting and major runs are common. Control efforts at the head of the fire are ineffective.

TABLE 5: RELATIONSHIP OF SURFACE FIRE FLAME LENGTH AND FIRELINE INTENSITY TO SUPPRESSION INTERPRETATIONS.

RATE OF SPREAD - Rate of spread is how fast the front or head of the fire is moving and is measured as chains per hour. Wind, topography, and fuel type play pivotal roles in spread rates. Fine fuels typically have faster spread rates than heavy fuels. The Placerville Ranger District fire resources are comprised of four Type 3 engines, one 10-person handcrew, and one hotshot crew. One helicopter with crew may be available within a 20 minute response time to the Trestle project area. Usually one dozer is available within one hour of the Trestle project area. Dependent on fuel type and fire location, initial production rates for a type 3 engine are approximately 20 chains per hour. A 10-person handcrew ranges from 3 to 15 chains per hour dependent on fuel type and terrain. Hotshot crews typically spend most of the summer away from the home forest performing fire suppression duties on larger wildland fire incidents. If available for initial attack a hotshot crew production rate is approximately 5 to 20 chains per hour dependent of fuel type and terrain.

One engine is stationed in Grizzly Flat and could respond to a fire occurring in the Trestle project area within 10-30 minutes if not committed to other wildland fires. The 10-person handcrew is also stationed at Grizzly Flat. However, they typically travel to other parts of the forest for project work or could also be committed to another wildland fire. If they are at Grizzly Flat at the time of a fire start, they could also have a 10-30 minute response time. The next closest resources to the project area would be approximately 30-60 minutes away with additional resources greater than 1.5 hours.

CROWN FIRE ACTIVITY - Fire behavior can be described in four ways; surface fire, passive crown fire, active crown fire and running crown fire:

1. Surface fire burns only the fuels at or near the surface without torching the trees above.
2. Passive crown fire which torches out individual trees as the surface fuels burning under them provide the convective heat to ignite the aerial fuels.
3. Active crown fire is fire spreading from tree to tree in conjunction with the convective heat of the surface fuels burning under them.
4. Running crown fire is a very rare occurrence in which the fire is spread from tree to tree independent of the burning surface fuels. This type of crown fire requires extreme weather conditions and contiguous heavy tree canopy and is not modeled for. The Power Fire burned in the Mokelumne River Drainage on the Eldorado National Forest in 2004 and is located

approximately 11 air miles to the south of the Trestle project. The Power Fire exhibited a running crown fire.

AFFECTED ENVIRONMENT

FUELS

Within the Trestle project area vegetation type varies creating a mosaic pattern amongst the landscape. With the absence of fire, due to fire suppression, other management activities, and previous land management activities, an accumulation of dead fuels, shrub and small tree understory connect the surface to the overstory fuels. Table 6 displays the amount and type of fuels within the project area; figure 2 visually displays their position on the landscape.

Vegetation Within The Trestle Project Area			
Vegetation Category	Acres		Primary Carrier of Fire
Non-Burnable	17	<1 %	Barren Land, Rock, and Water
Grass	5	<1 %	Grass
Grass/Shrub	364	1.8 %	Grass with small shrub influence
Shrub – Low/Moderate Load	479	2.3 %	Shrubs less than 4 foot tall
Shrub – High/Very High Load	930	4.5 %	Shrubs greater than 4 foot tall
Timber Shrub Understory – Low Load	814	4.0 %	Bear Clover, small shrubs less than 2 feet
Timber Shrub Understory – High Load	7,979	39.0 %	Bear Clover with ladder fuels such as small trees and shrubs
Conifer/Hardwood – Low/Moderate Load	2,409	11.8 %	Needle Cast and small dead and downed fuels typically 10 hour fuels
Conifer/Hardwood – High/Very High Load	6,758	33.0 %	Needle Cast with heavy component of dead and down fuels
Activity Slash/Blowdown	697	3.4 %	Areas with natural blowdown and heavy fuel loadings; mastication

TABLE 6: VEGETATION CLASSES WITHIN TRESTLE PROJECT AREA, CURRENT CONDITIONS

Ground fuels consisting of the duff layer are of concern for large tree mortality due to basal accumulation of fuel and potential for long residence times with excessive heating. Within the proposed units, isolated locations of basal accumulations around larger dominant trees exist. While ground fuels typically are not a contributor to fire behavior, they do contribute to fire effects related to soil and tree mortality.

Surface fuels consist of needle cast, dead downed woody fuel accumulations, ranging from ¼ inch to large woody debris, bear clover, ceanothus, Manzanita and deer brush. Mixed conifer small diameter trees extend into the crown of aerial fuels. Surface fuels contribute to fire spread and intensity. It is these fuels which are the predominate driver of fire behavior related to fuels and the ability of a surface fire to transition into the overstory crown fuels.

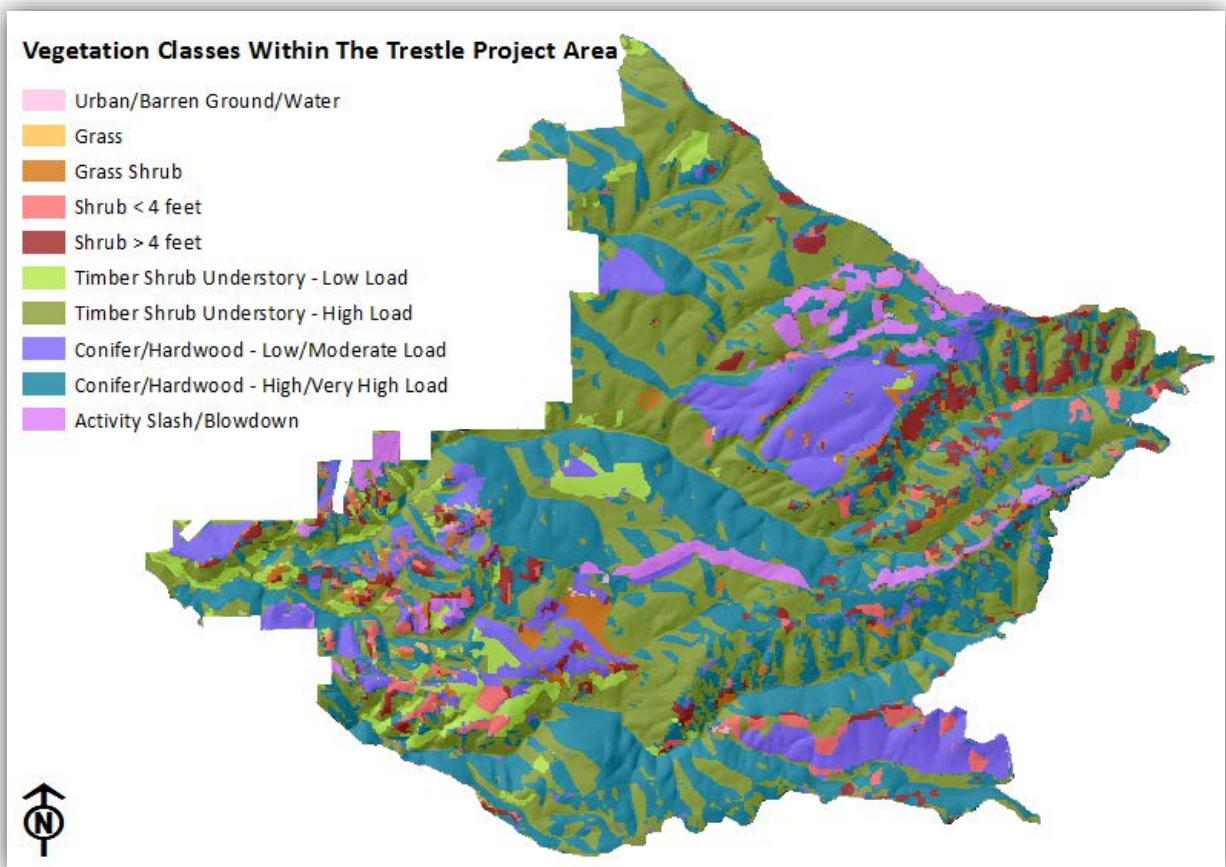


FIGURE 2: VEGETATION CLASSES USED FOR FIRE BEHAVIOR MODELING IN TRESTLE PROJECT AREA

Within the canopy fuel layer, the structure consists of multilayer arrangement of conifer and deciduous trees including black oak, ponderosa pine, sugar pine, incense cedar, and Douglas-fir. Canopy base heights range from interconnecting with surface fuels to heights thirty feet above the ground.

WEATHER

The Eldorado National Forest traditional fire season occurs May through October; at which time weather conditions typically equal or exceed the potential for extreme fire behavior (Table 4). Additionally, combined with topographical conditions, wind and slope alignment increases the potential for large fire growth in the Trestle project area.

Several steep drainages, generally flowing from east to west occur throughout the project area. Diurnal wind patterns within the area consist of the typical summertime pattern of upslope, terrain dominated winds. Ridge top winds are typically south to southwest during the daytime hours and reverse direction during nighttime hours, north to northeast in direction.

TOPOGRAPHY

The Trestle Project Area has characteristics that promote problem fire behavior and has the potential to exhibit extreme fire behavior. Steep slopes and deep drainages are the main feature within and adjacent to the Trestle project area, many of which are in a west to east alignment, others are more

southwest to northeast alignment. The major drainages within and adjacent to the project area are: North Fork Cosumnes River, Big Canyon, Long Bear Canyon, Steely Fork Cosumnes River, Clear Creek, Dogtown Creek and the Middle Fork Cosumnes River.

All three elements of fire behavior (fuels, weather, and topography) are present in the Trestle project area. Alone or in combination they have the ability to promote problem fire behavior. The potential exists that a fire can be slope driven, wind driven and/or fuel driven dependent on location of a fire and the weather conditions.

FIRE BEHAVIOR SYNOPSIS

The area presents difficult and remote access to fire starts due to topographic features and travel time for initial attack fire resources. Current strategies on initial fire starts is to utilize aircraft such as air tankers and helicopters to keep fires small and allow ground forces the time to get to the location.

Containing large fires is difficult due to several steep drainages in the project area. The current management strategy in these areas is to utilize ridge lines and road systems to contain a large fire. The difficult task is finding a ridge line which can be utilized to construct fireline down into these steep drainages to contain the flank of a fire. Terrain is a major influence due to the ability to safely access a flank and construct line down a usable slope.

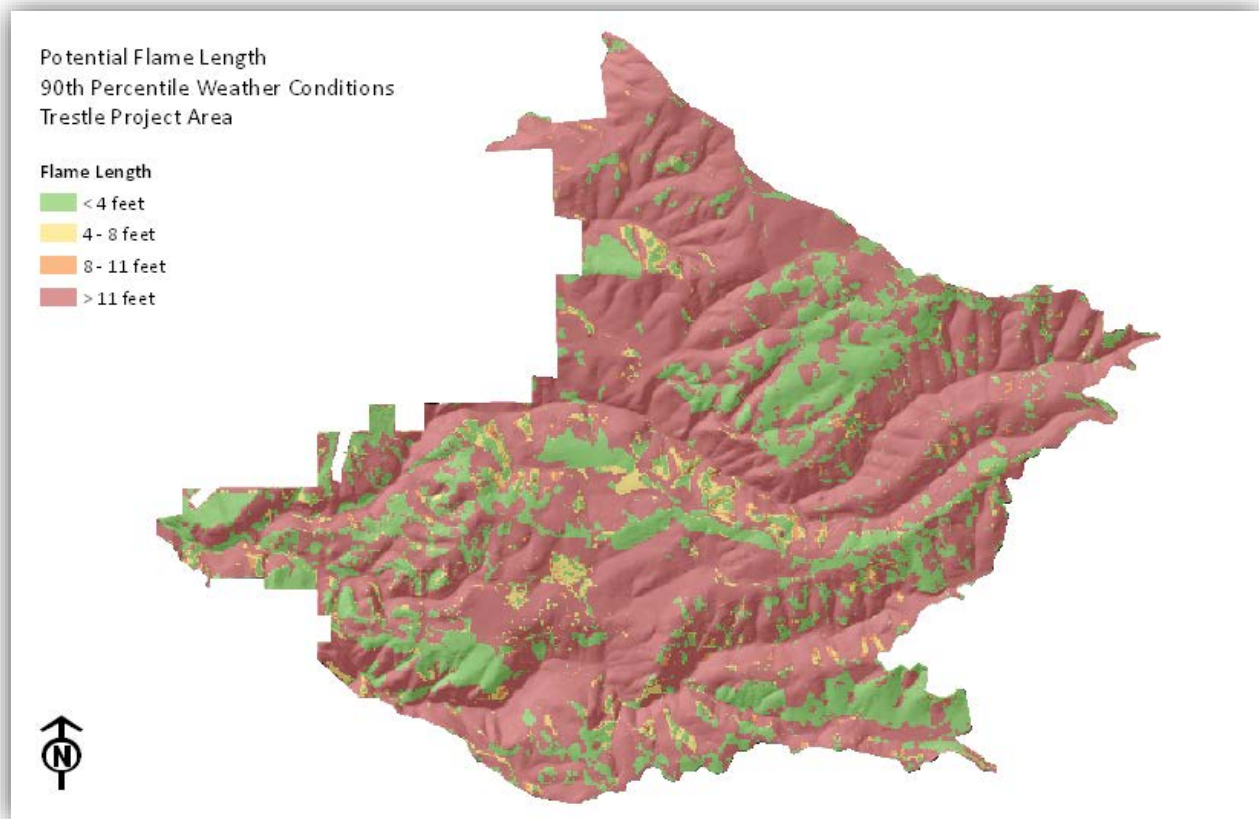


FIGURE 3: POTENTIAL FLAME LENGTHS WITHIN TRESTLE PROJECT AREA, CURRENT CONDITIONS

Flame Lengths

Flame Length (feet)	Project Area (acres)	Percent of Project Area
< 4	4,429	21.7%
4 - 8	1,099	5.4%
8 - 11	357	1.7%
> 11	14,564	71.2%

TABLE 7: POTENTIAL FLAME LENGTHS IN TRESTLE PROJECT AREA

Greater than 78% of the project area has fuel conditions exhibiting high fuel loadings which are capable of producing surface flame lengths greater than 4 feet; 71% of the project area potentially could have flame lengths in excess of 11 feet (Table 7); figure 3 displays potential flame lengths across the project area. There are enough ladder fuels in the mid-story canopy connecting to the overstory dominant and co-dominant trees to initiate crown fire activity. With the current fuel conditions in culmination with topographic features, the potential to exhibit high severity fire on 70% of the project area exists under 90th percentile weather conditions.

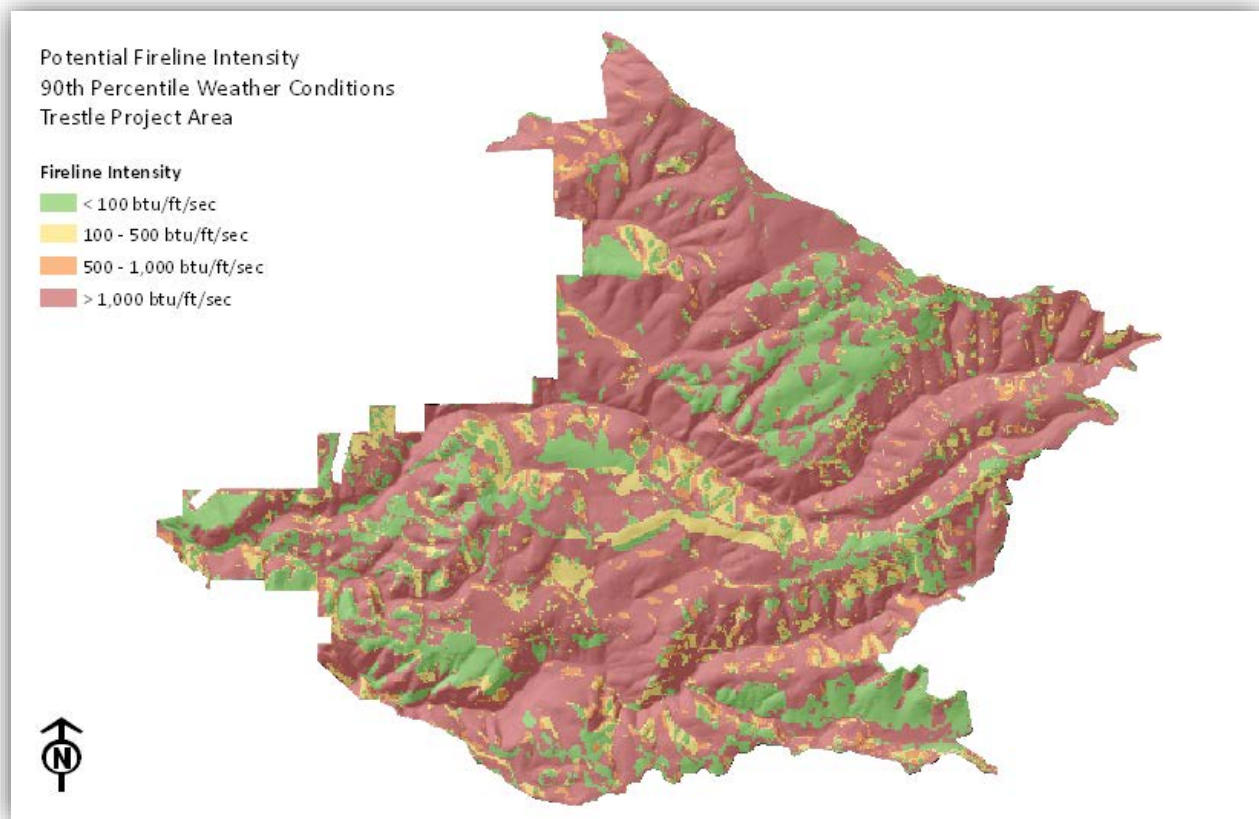


FIGURE 4: POTENTIAL FIRELINE INTENSITY ACROSS THE TRESTLE PROJECT AREA, CURRENT CONDITIONS

Fireline Intensity

Fireline Intensity (btu/ft/sec)	Project Area (acres)	Percent of Project Area
< 100	4,197	20.5%
100 - 500	1,728	8.5%
500 - 1000	1,110	5.4%
> 1000	13,390	65.6%

TABLE 8: POTENTIAL FIRELINE INTENSITY IN TRESTLE PROJECT AREA

The amount, type, size and arrangement of fuels also result in fire intensity being extremely high on the majority of the landscape. Figure 4 displays fireline intensity across the project area. Referring to Table 8, intensities greater than 500 btu/ft/sec represent potential areas where crown fire and spot fires become a concern in the control of a wildland fire. Greater than 70% of the project area exhibits this potential (Table 8).

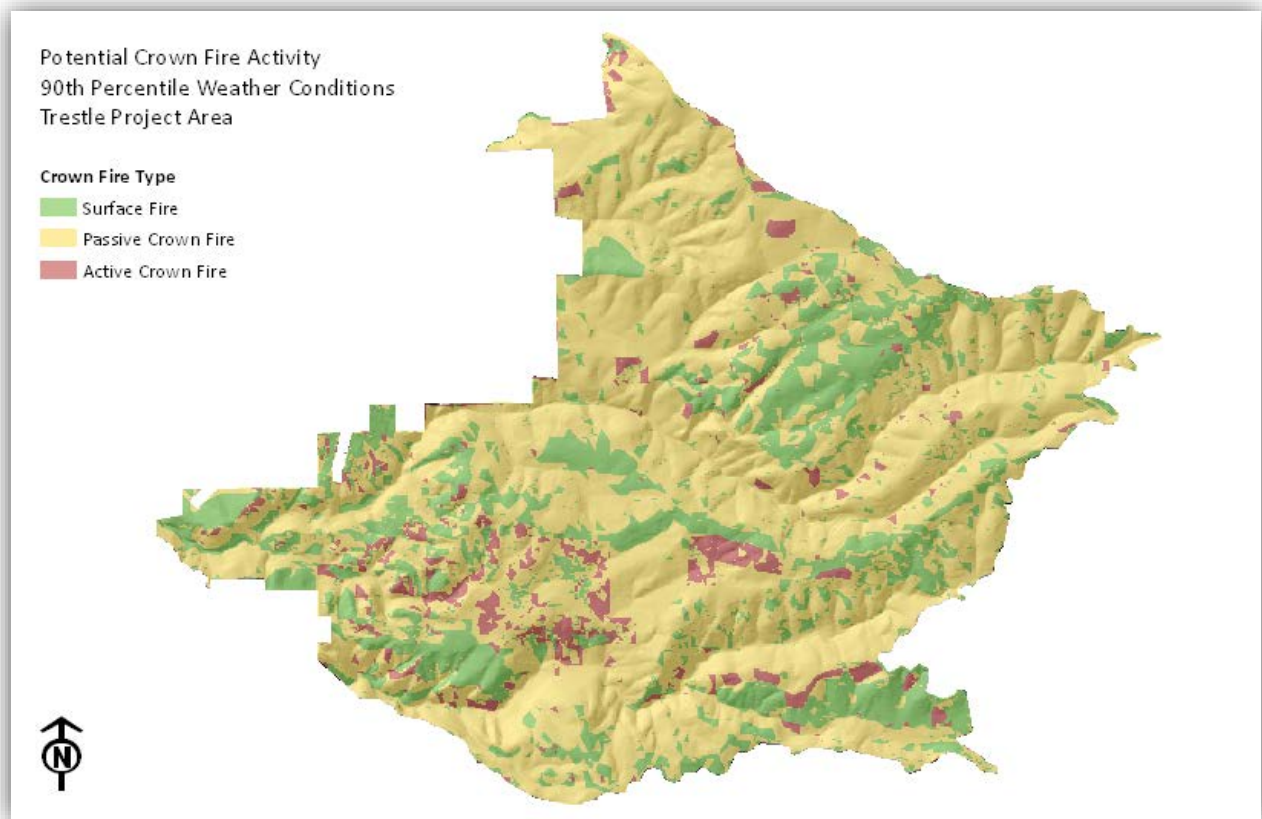


FIGURE 5: POTENTIAL CROWN FIRE ACTIVITY AND TYPE WITHIN TRESTLE PROJECT AREA, CURRENT CONDITIONS

Crown Fire Activity

Crown Fire Type	Project Area (acres)	Percent of Project Area
Surface	4,863	23.9%
Passive	14,464	70.7%
Active	1,109	5.4%

TABLE 9: POTENTIAL CROWN FIRE ACTIVITY IN TRESTLE PROJECT AREA

Across the landscape, 76% of the project area has the potential to exhibit crown and passive crown fire activity (Table 9). If a large fire were to develop in the project area it could be expected that these areas have the potential to exhibit more active fire behavior (Figure 5). FlamMap analyzes potential fire behavior based on each individual 30 square meter grid. Each grid composes information of topography, fuel and canopy fuel characteristics. In FlamMap adjacent grids have no influence on potential fire behavior. Therefore, the convective energy of a large fire along with increased winds and preheating of fuels creates an environment influencing active crown fire behavior.

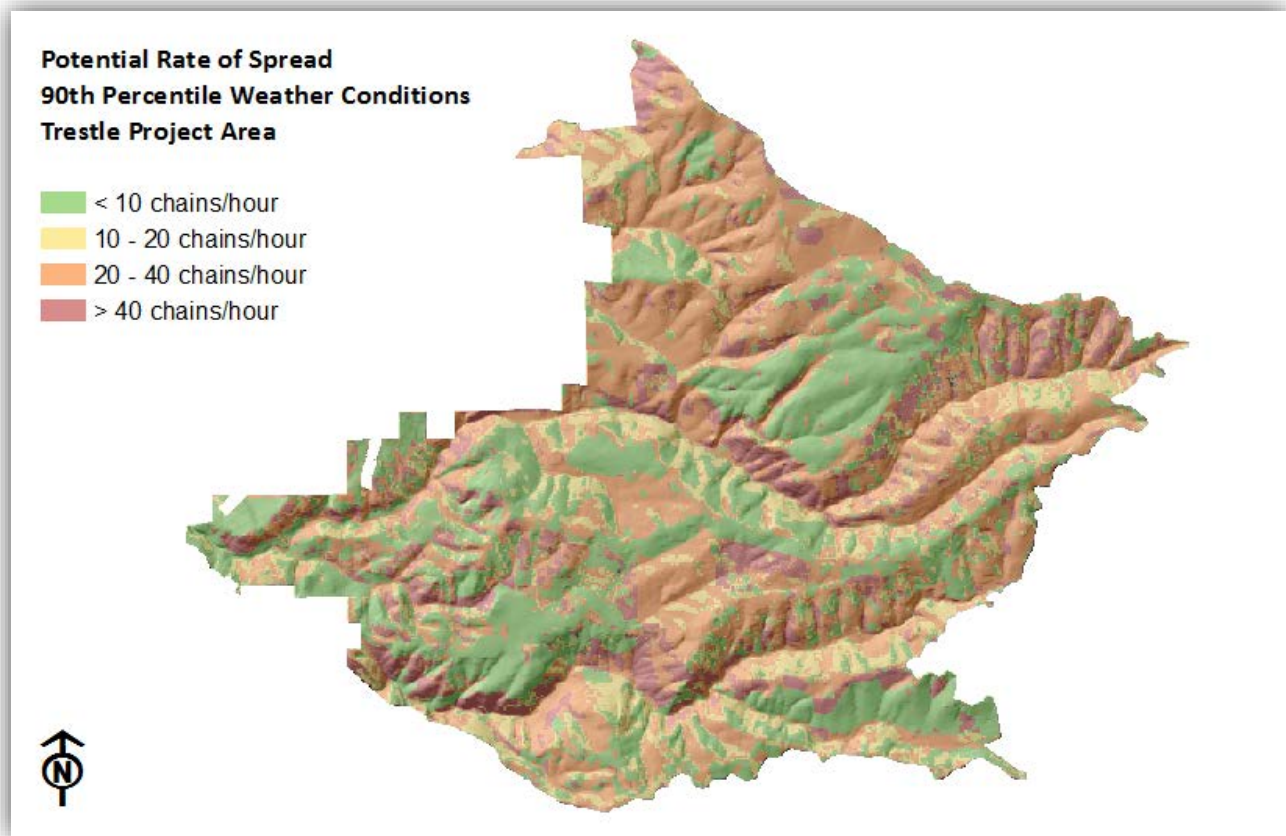


FIGURE 6: POTENTIAL FIRE RATE OF SPREAD WITHIN TRESTLE PROJECT AREA

Rate of Spread

Rate of Spread (chains/hour)	Project Area (acres)	Percent of Project Area
< 10	6,770	33.1%
10 – 20	2,653	13.0%
20 – 40	8,424	41.2%
> 40	2,605	12.7%

TABLE 10: POTENTIAL RATE OF FIRE SPREAD IN TRESTLE PROJECT AREA

In a majority of the Trestle project area, rates of fire spread less than 10 chains per hour would be ideal for fire fighters to use direct attack suppression tactics. In current conditions 33% of the Trestle project area would experience rates of fire spread less than 10 chains per hour (Table 10, Figure 6). Greater than 55% of the project area could have rates of fire spread that would require fire fighters to back off to ridge tops and implement indirect suppression tactics. This would require a significant use of heavy equipment and aircraft with large fire growth and high severity fire effects.

Flame Length and Fireline Intensity are factors in determining crown fire initiation into the canopy and crown fire type given fuel and weather conditions. Critical flame lengths and fireline intensities were obtained to determine surface fire behavior needed to generate crown fire activity (Table 11). This represents the minimum flame length and fireline intensities needed to initiate crown fire. Table 12 displays surface fire behavior potential by vegetation type; important to note is Table 12 only address surface fire behavior and does not take into account fire behavior in the overstory fuel profile. At 90th percentile conditions, all fuels with a canopy overstory would present some type of crown fire activity dependent on canopy base heights. Low canopy base heights require lower direct flame lengths and heating to torch and reach canopies due to their connectivity to the surface fuels below. Figure 5 displays crown fire activity by type in the project area. Under current conditions, 76 % of the area would currently exhibit active crown and passive crown fire activity (Table 9) with 53% with rate of spread greater than 20 chains per hour.

Critical Fire Behavior Values Needed to Initiate Torching Of Overstory Fuels Based On Canopy Base Height

	Canopy Base Height (ft)										
	1	2	3	4	5	6	7	8	10	15	20
Flame Length (ft)	1.1	1.8	2.4	2.9	3.4	3.8	4.3	4.7	5.4	7.2	8.8
Fireline Intensity (btu/ft/sec)	7	20	37	57	80	105	132	161	225	414	637

TABLE 11: POTENTIAL CROWN FIRE INITIATION BASED ON CANOPY BASE HEIGHT AND FLAME LENGTH OR FIRELINE INTENSITY

Surface Fire Behavior Characteristics

Vegetation Category	Flame Length (ft)	Fireline Intensity (btu/ft/sec)
Grass	11	1620
Grass/Shrub	5	188
Shrub – Low/Moderate Load	4	127
Shrub – High/Very High Load	15	2048
Timber Shrub Understory – Low Load	2	26
Timber Shrub Understory – High Load	8	547
Conifer/Hardwood – Low/Moderate Load	1	7
Conifer/Hardwood – High/Very High Load	3	90
Activity Slash/Blowdown	9	786

TABLE 12: POTENTIAL FIRE BEHAVIOR WITH 90TH PERCENTILE FUEL AND WEATHER CONDITIONS

Flame Lengths and Fireline Intensity values are modeled at the surface on flat ground using BehavePlus to provide a relationship to crown fire initiation based on surface fire characteristics.

Passive and particularly active crown fire could have consequences to different components of the forest ecosystem, such as botanical, hydrological, soils and wildlife as well as archeological sites given their intensities and resulting loss of vegetation. This would be both from the effects of the fire and

suppression efforts which would include hand tool use, mechanized equipment such as dozers and excavators and fire retardant application.

WILDLAND URBAN INTERMIX

The terms Wildland Urban *Intermix* and Wildland Urban *Interface* are similar terms to describe human habitation within or next to forested or other natural areas (Hermansen-Baez, 2009). *Intermix* and *interface* are terms commonly used interchangeably throughout fire management.

The Sierra Nevada Forest Plan Amendment (SNFPA) defines Wildland Urban Intermix (WUI) as an area where human habitation is mixed with areas of flammable wildland vegetation (fuels). It extends out from the edge of developed private land into Federal, private and State jurisdictions. The WUI is comprised of two zones: defense and threat. (SNFPA, ROD 2004)

The WUI defense zone is the buffer in closest proximity to communities, areas with higher densities of residences, commercial buildings, and/or administrative sites with facilities. Defense zones generally extend roughly ¼ mile out from these areas. WUI threat zones typically buffer the defense zone and generally extends approximately 1 ¼ miles out from the defense zone boundary. (SNFPA, ROD 2004)

Defense zones should be of sufficient extent that fuel treatments within them will reduce wildland fire spread and intensity sufficiently for suppression forces to succeed in protecting human life and property. Desired conditions in the WUI defense zones are described as having fairly open stands dominated primarily by larger, fire tolerant trees; surface and ladder fuel conditions are such that crown fire ignition is highly unlikely; the openness and discontinuity of crown fuels, both horizontally and vertically, result in very low probability of sustained crown fire. (SNFPA, ROD 2004)

SNFPA (2004) describes the goals of fuel treatments in the threat zones to be designed to reduce wildfire spread and intensity. Under high fire weather conditions, wildland fire behavior in treated areas within the WUI threat zone is characterized as the following desired conditions: 1) flame lengths at the head of the fire are less than 4 feet; 2) the rate of spread at the head of the fire is reduced to at least 50 percent of pre-treatment levels; 3) hazards to firefighters are reduced by managing snag levels in locations likely to be used for control of prescribed fire and fire suppression consistent with safe practices guidelines; 4) production rates for fire line construction are doubled from pre-treatment levels; and 5) tree density has been reduced to a level consistent with the site's ability to sustain forest health during drought conditions (SNFPA, ROD 2004).

Shortly after the Healthy Forest Initiative of 2000 and Healthy Forest Restoration Act (HFRA) of 2003 were in place, the community of Grizzly Flat was one of the first communities listed in the Federal Register as a community at risk of wildfire (USDA, USDI, 2001). The HFRA provides communities with a tremendous opportunity to influence where and how federal agencies implement fuel reduction projects on federal lands. A Community Wildfire Protection Plan (CWPP) is the most effective way to take advantage of this opportunity. Additionally, communities with CWPPs in place will be given priority for funding of hazardous fuels reduction projects carried out under the auspices of the HFRA (USDA, USDI, 2010). The Grizzly Flat Fire Safe Council (FSC) is one of the most active satellite FSCs in El Dorado County. Their active participation as a community to reduce fuels in and around the community has

been an example to the rest of the nation’s communities at risk. The Grizzly Flat FSC began working on a CWPP in 2004. In 2006 the first version of the CWPP was set in motion. As projects are completed, the CWPP is updated with new projects and revisions. As of this report, the boundary for the Grizzly Flat CWPP extends into the Eldorado National Forest to include Leoni Meadows and Henry’s Diggins properties and approximately one third of the Trestle project area. The Grizzly Flat FSC is in process of updating their CWPP once again to add projects and possibly extend the CWPP boundary to include Gilbert’s, a private inholding to the east of Grizzly Flat and within the Trestle project area.

Within the Trestle project area 19,672 acres have been identified as WUI; of that, 18,347 acres is on U.S. Forest Service properties (Figure 7). 7,085 acres of the Grizzly Flat CWPP fall within the Trestle Project Area (Table 13).

STRATEGICALLY PLACED LANDSCAPE AREA TREATMENTS

Strategically placed landscape area treatments (SPLAT) are blocks of land, ranging anywhere from 50 to over 1,000 acres, where one type of vegetation management strategy is to reduce fuel loading. The treatment areas are placed so that a spreading fire does not have a clear path of untreated fuels from the bottom of the slope to the ridge top. Managers consider historic fire regimes and the potential for severe wildfires (based on fuel loading, prevailing wind direction, and terrain features) in deciding where to place area treatments. Strategically placed area treatments are designed to burn at lower intensities and slower rates of spread during wildfires than comparable untreated areas. Hence, wildfires are expected to have lighter impacts and be less damaging in treated areas. The SPLAT strategy treats a relatively large proportion of the landscape, and this strategy facilitates fire reintroduction (Biological Assessment for SNFPA SEIS Final, July 30, 2003).

Within the Trestle project area 6,989 acres have been identified as SPLATs (Table 13). Of that, 2,725 acres of SPLATs occur within the boundary of the Grizzly Flat CWPP (Figure 7).

**Wildland Urban Interface (WUI)
Strategically Placed Landscape Area Treatment (SPLAT)
Community Wildfire Protection Plan (CWPP)**

	Acres	% Project Area
WUI Defense	3,716	18.2%
WUI Threat	15,956	78.0%
SPLAT	6,989	35.5%
Grizzly Flat CWPP	7,085	34.6%

TABLE 13: AREA OF WILDLAND URBAN INTERMIX DEFINED AS DEFENSE AND THREAT; AREA OF STRATEGICALLY PLACED LANDSCAPE AREA TREATMENTS; AND AREA OF GRIZZLY FLAT CWPP ALL OF WHICH FALL WITHIN TRESTLE PROJECT AREA

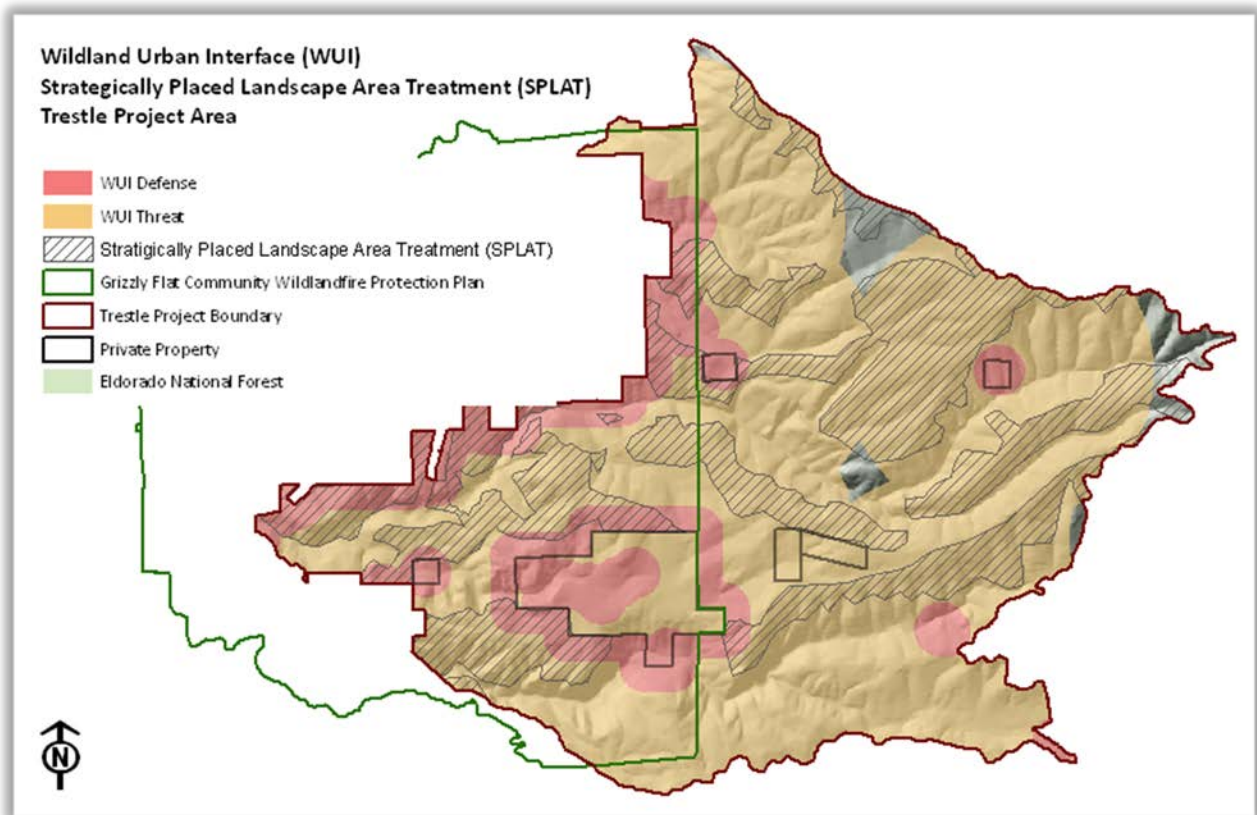


FIGURE 7: WILDLAND URBAN INTERMIX (DEFENSE AND THREAT ZONES) AND STRATEGICALLY PLACED LANDSCAPE AREA TREATMENTS WITHIN THE TRESTLE PROJECT AREA

MANAGEMENT ACTIVITIES AND USES

The domestic water supply for the community of Grizzly Flat originates on National Forest System Lands, inside the Trestle project area. This water system includes a main supply line, distribution lines and holding infrastructure on both Forest Service lands and private property.

Non-National Forest and forest system lands are intermixed within the project boundary. The majority of the project area is primarily utilized for recreational purposes such as hunting, hiking, camping, off highway vehicle (OHV) use and mining. Majority of the inholdings and adjacent private land is inhabited year-round.

The Trestle project area is intermixed with several private land inholdings immediately adjacent to and within the project area. The majority of activities occurring on adjacent private land is residential and recreation. Some landowners are active in forest management activities and some are not.

Leoni Meadows is a large private inholding and is primarily run as a youth summer camp. Any given weekend during the summer months could have as many as 400-800 non-local campers and staff. There are many buildings on site used for housing, administration, storage and maintenance. Several camping areas are established throughout the property. Leoni Meadows utilizes nearby Forest Service roads and trails under a special use permit. The management staff at Leoni Meadows is actively involved in the Grizzly Flat Fire Safe Council and is included in the Grizzly Flat Community Wildfire Protection Plan.

ENVIRONMENTAL CONSEQUENCES

ALTERNATIVE 1

No fuel reduction activities are planned for this alternative. Current management plans would continue to guide management of the project area. No commercial thinning, prescribed burning, or other fuel reduction activities would be implemented under the Trestle project decision.

DIRECT & INDIRECT EFFECTS

No fuel reduction activities are analyzed under this alternative, therefore no direct or indirect effects related to project activities would occur; however, fuels would continue to remain at their current levels with an expected increase as surface fuels continue to accumulate from dead trees and limb fall. Small diameter trees and shrubs would continue to grow in the understory and increasing both the horizontal and vertical arrangement of fuels. These ladder fuels would extend into the overstory dominant and co-dominant trees. Natural decomposition of fuels would continue to occur but not at a rate to outpace new accumulations of dead fuels.

Potential would continue to exist for high severity wildfire to occur over much of the project area. Since current fuel loadings are high, increased residence time of heat in the soil would be expected along with increased heat transfer from surrounding fuels burning at the surface and ground level.

In addition, ground fuels contribute to large tree mortality from excessive heating of the cambium and roots from current fuel loading and fuel structure. The dense understory surface combined with ladder fuels are such that crown fire propagation is probable. Injury to tree crowns also affects potential mortality and susceptibility to disease due to the trees and weakened state from the intense heat of the burning dense understory vegetation. Utilizing BehavePlus fire modeling program, tree mortality can be predicted by species under 90th percentile weather conditions (for Ponderosa Pine tree species see Table 14). As tree size and d.b.h decrease, mortality increases for all surface fuel conditions. Under current conditions more than two thirds of the project area consists of high to very high fuel load timber shrub and mixed conifer vegetation types (Table 6). Higher mortality rates would be expected with Sugar Pine (approximately 25% higher) and White Fir (approximately 10% higher).

Probability of Mortality of Ponderosa Pine 90th Percentile Weather Conditions Average Tree Height 100 feet, 30 inch d.b.h

Vegetation Type	Tree Crown Fraction (proportion of crown to tree height) (ft)			
	0.3	0.5	0.8	1
Timber Shrub Understory – High/Very High Load	32%	62%	74%	76%
Mixed Conifer – High/Very High Load	0%	0%	3%	10%
Timber Shrub Understory – Low/Moderate Load	0%	0%	0%	6%
Mixed Conifer – Low/Moderate Load	0%	0%	0%	6%

TABLE 14: PROBABILITY OF MORTALITY IN PONDEROSA PINE BASED ON SURFACE FUEL CONDITIONS AND PROPORTION OF TREE CROWN

Plantations within the Trestle project area are an additional concern for fuels. These areas consist of pine trees spaced closely together with interconnected crowns. Manzanita brush, needle drape, and grass are the predominate surface fuels. A fire in these stands would be difficult to control and expect mortality of plantation stands high due to the relative small tree size and interconnectivity to the surface fuels. Plantations could burn similar to a brush field exhibiting high rates of spread and high mortality.

CUMULATIVE LANDSCAPE EFFECTS

No cumulative effects from treatments would occur in the Trestle project under Alternative 1. Current potential fire behavior within the project area would continue to exist. To provide a comparison to action alternatives fire modeling software was utilized to simulate fire growth on the landscape.

Some private landowners are active in forest management activities. These activities include timber harvesting, pre-commercial thinning, mastication, burning of activity slash and tree planting. While some areas such as clear-cuts are a benefit to fire spread and intensity, other areas exacerbate fire behavior; such as plantations where pre-commercial thinning leaves cut trees within the plantation units, increasing fuel loading and heights.

Within the project area a full suppression response would be implemented in this area due to the proximity and intermixed National Forest System Lands and private land. Under the no action Alternative 1, should a large fire occur in the project area, only a few opportunities exist to reduce fire size, intensity, and severity; specifically along Plummer Ridge and Big Mountain Ridge where previous fuel reduction treatments have occurred. Fire managers would naturally gravitate to the prominent ridges to contain a fire. Equipment such as dozers, fire engines, handcrews and retardant dropping aircraft would be utilized to construct firelines and pretreat fuels for burnout operations ahead of a conflagration. Included in the line construction would be construction of safety zones to provide a safe area for firefighters to withdrawal to should fire activity dictate such a response. Safety zones are constructed based on worst probable fire behavior predicted. Under current conditions safety zone size could range from 3 acres to greater than 60 acres dependent on location. Additionally, steep areas would require more safety zones be built due to slower travel times of firefighters on steep slopes. Within the project area, not only would a fire have high severity effects on the majority of the landscape, also fire suppression damage could potentially increase effects to forest resources. This has been observed recently on numerous large fires throughout California, most recently the King Fire which occurred during September and October 2014 on the Eldorado National Forest.

Simulated fire in Long Canyon and Big Canyon would reach Bear Meadow and the North Fork Cosumnes River within the first burn period during 90th percentile weather and fuel conditions and no suppression actions. North Fork Cosumnes River is a steep and mostly inaccessible drainage at the northern boundary of the Trestle project area.

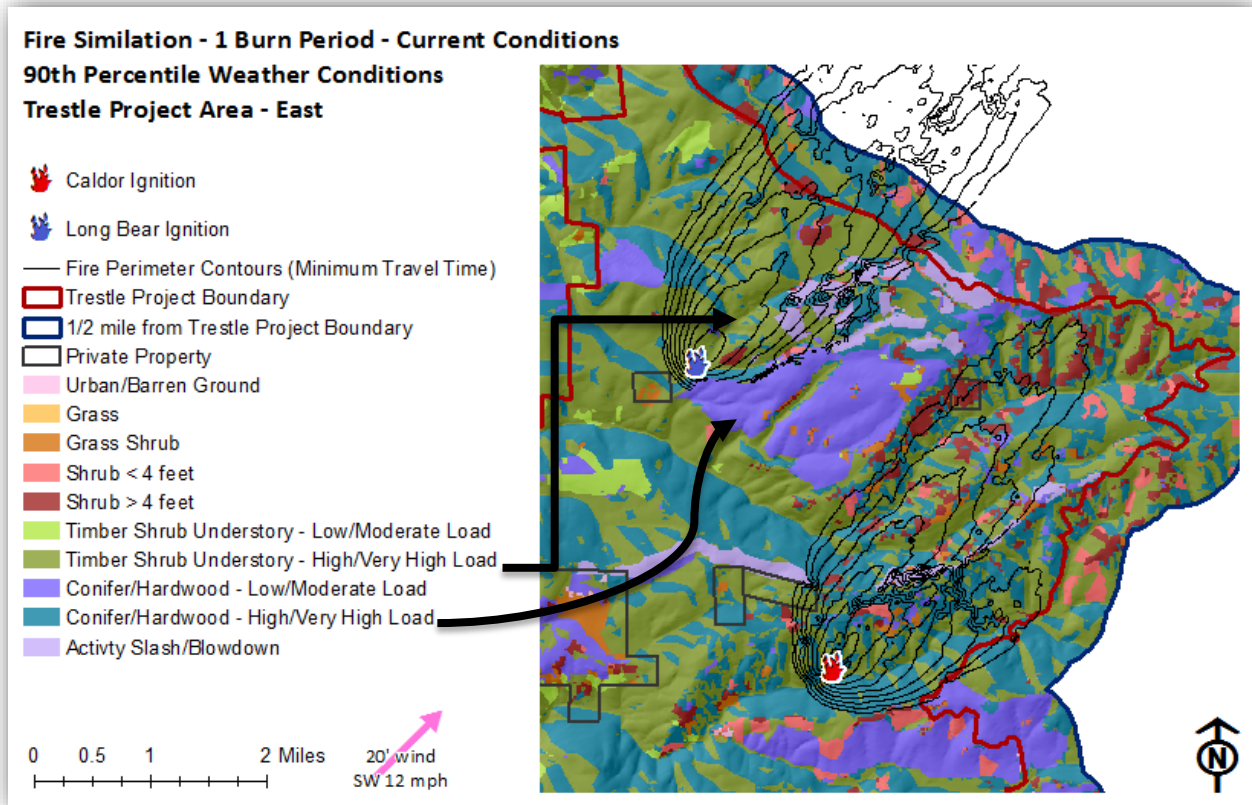


FIGURE 8: CALDOR AND LONG BEAR IGNITIONS, EAST TRESTLE PROJECT AREA, CURRENT CONDITIONS

Bear Meadow is located on top of a prominent ridgeline running in a southeast to northwest direction, eventually ending in the steep canyon of the North Fork Cosumnes River. A fast spreading fire under current conditions would easily spread to this ridge top and continue spreading beyond. This ridge top would be an ideal location for fire managers to contain a large fire. Under current conditions it would be difficult to contain a fire such as this one modeled since there would be insufficient time to prep road systems and ridgelines for burn out operations. Fire managers witnessed this exact problem when attempting to contain the King Fire of 2014 (Eldorado National Forest).

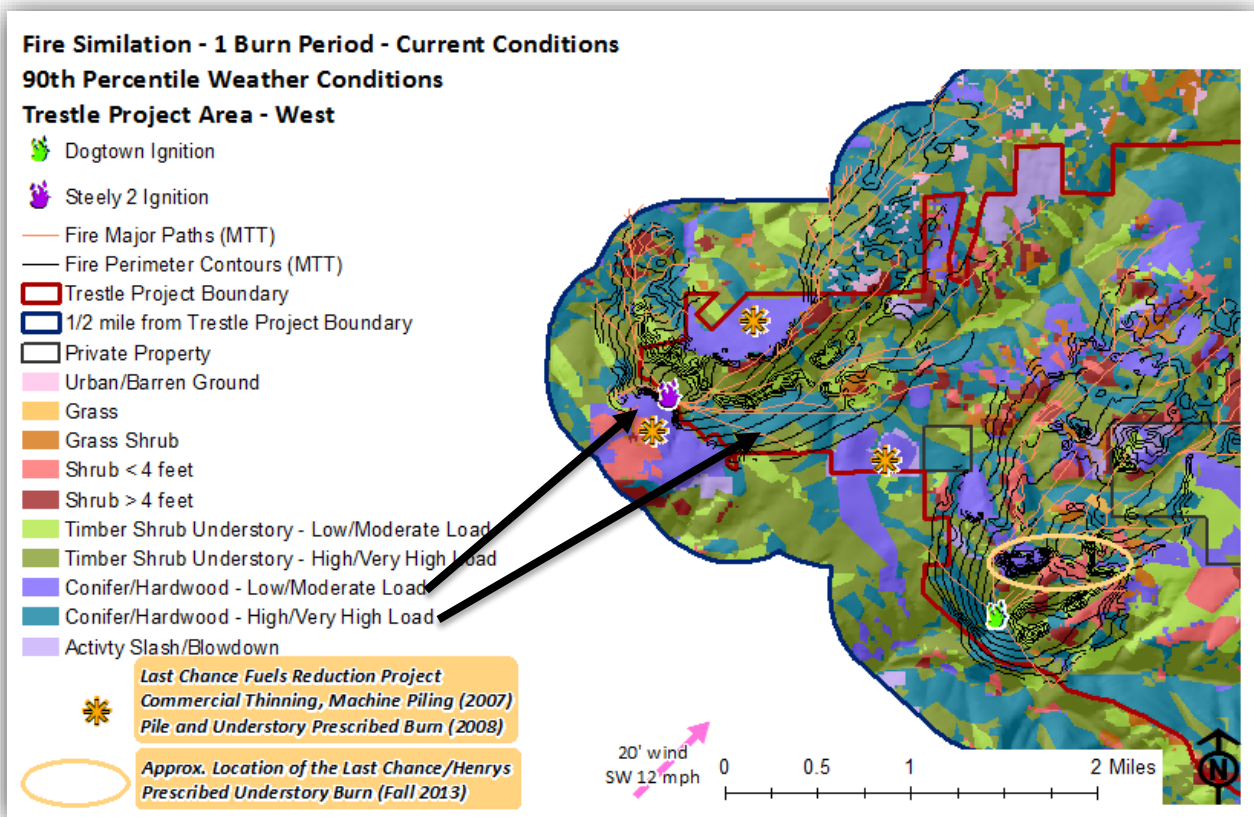


FIGURE 9: FIRE SIMULATION, WEST TRESTLE PROJECT AREA, CURRENT CONDITIONS

Notice how both fires slow down or stall out in the low load fuel models (Timber Shrub low load; and Conifer/Hardwood low/mod load) while a faster moving fire with several major paths are formed in the high load fuel models (Conifer/Hardwood high/very high; and Timber Shrub Understory high load).

As in Figure 8, high load fuel models reveal high rates of fire spread where the fire perimeter contour lines are widely spaced.

The Last Chance Fuels Reduction Project altered surface fuel loading, increased canopy base heights of remaining trees and reduced ladder fuels in the treatment units. This results in reduction of fire spread as shown by fire growth of the fire perimeter contours lines.

Fire perimeter contours close together represent slow rates of fire spread and conversely for rapid rates of fire spread. Fire rate of spread through treated units of the Last Chance project are so slow the contour lines appear as a thick bold line.

The Last Chance Fuels Reduction Project shows the potential benefits of fuels reduction treatments. Similar activities are proposed for treatment in the Trestle Forest Health Project.

A fire start from down slope quickly spreads in all directions; at the ridgeline in this portion of the Trestle project area (see Last Chance/Henrys prescribed burn, Figure 9), fire spread is reduced. Notice that

once fire enters the Last Chance treatments (mechanical and prescribed burn units), fire perimeter growth is reduced as shown by the Fire Perimeter contour lines (MTT; black) and flanks around the treatment unit. This particular area could give fire managers time to focus on other areas of concern and contain this portion of a fire with minimum suppression resources.

North and east wind events cause concern to fire managers and communities in El Dorado County because of the extreme fire danger associated with these dry, fast moving Foehn winds which occur several times a year during the dry late summer and fall. The running crown fire experienced in the Power Fire (ENF, 2004) was an example of this type of a wind event. Figure 10 displays what could happen in these types of events. Less than ten years post treatment of the Last Chance Fuels Reduction project and the treatments are still able to slow the rate of spread of a simulated wildfire.

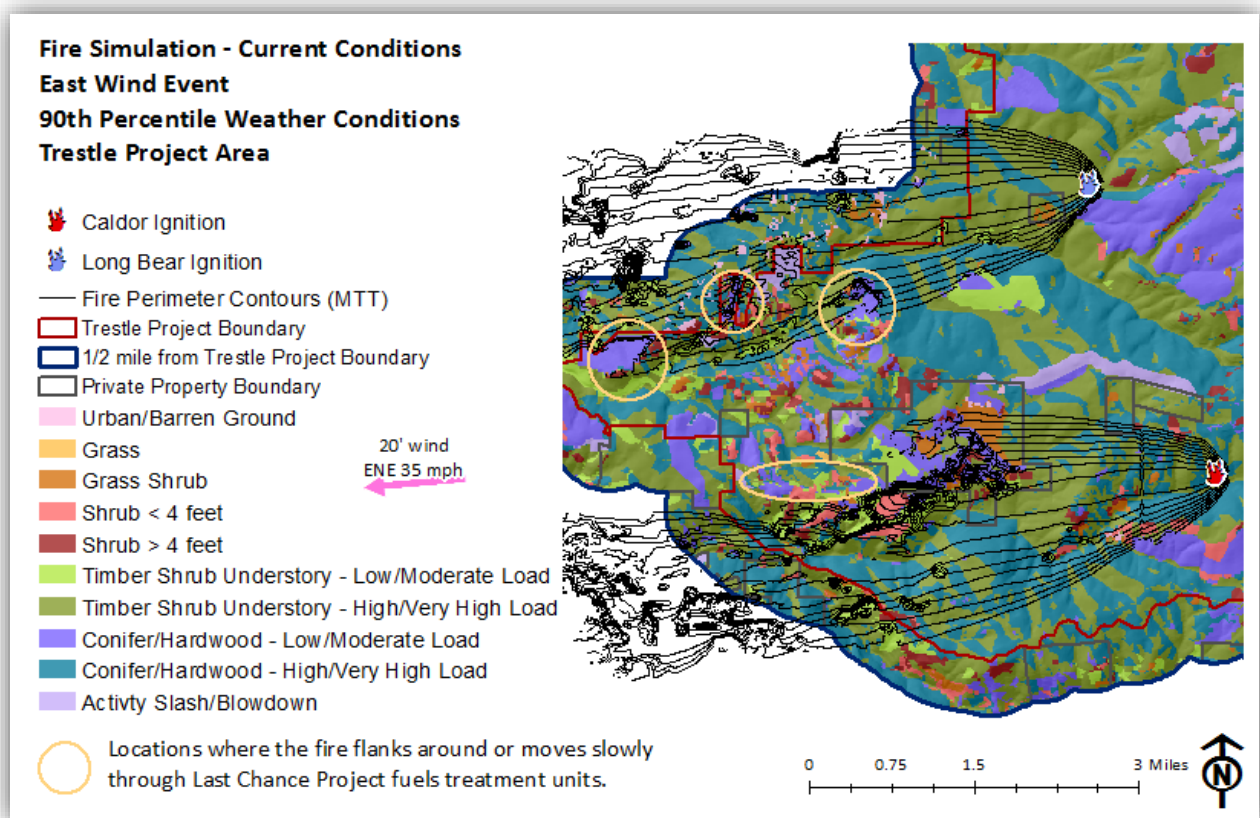


FIGURE 10: FIRE SIMULATION, EAST WIND EVENT, TRESTLE PROJECT AREA, CURRENT CONDITIONS

ALTERNATIVE 2

The following activities are proposed for treatment under Alternative 2 and pertain to achieving fuel reduction and fire behavior modification goals to meet the purpose and need for the Trestle Forest Health Project.

- ♦ Mechanical thinning on approximately 4,834 acres (4,391 acres within natural stands and 443 acres within plantations). Thinning would include the cutting and removal of select commercial (trees 10" to 29.9" d.b.h) and non-commercial (trees 4" to 9.9" d.b.h) sized trees, using a combination of variable density thinning and thinning from below to maintain or increase within stand heterogeneity while reducing ladder fuels in strategic locations.
- ♦ Cutting of small trees (1" to 3.9" d.b.h) and brush would occur on approximately 1,522 acres.
- ♦ Conduct non-commercial mechanical thinning (trees less than 12 inches d.b.h) up to 100 feet on one or both sides of the Capps Crossing Road (9N30) and Grizzly-Caldor Road / Leoni Road (09N73) in 5 segments totaling approximately 3 miles (approximately 57 acres). Material would be moved to landings and treated as described for biomass from thinning units.
- ♦ Conduct brush cutting up to 100 feet of Capps Crossing Road (9N30) and Grizzly-Caldor Road / Leoni Road (09N73) in 3 segments totaling approximately 5 miles (approximately 88 acres).
- ♦ Biomass (non-commercial) material accumulated on landings would be disposed of or removed in a number of ways, including on-site burning, commercial and personal use firewood, or as co-generation fuel where feasible.
- ♦ Existing and operations generated slash and brush would be tractor piled or grapple piled after mechanical thinning operations on approximately 1,597 acres in natural stands and 310 acres in plantations to reduce ground fuels and ladder fuels.
- ♦ Hand cut and pile understory vegetation (trees less than 9 inches d.b.h and brush) on approximately 1,490 acres. Approximately 1,044 acres of the treatments by hand occur in units that are located within 500 feet of private property boundaries in the Wildland Urban Interface (WUI) defense and threat zones.
- ♦ Understory burning is proposed as the initial or primary treatment for this project on approximately 9,583 acres. Of the approximately 9,583 acres of understory burning as an initial treatment, 984 acres is considered priority for prescribed fire only treatments and anticipated to be completed within the next 5 to 10 years.
- ♦ Most mechanical treatment units are proposed for follow-up prescribed burning. Multiple burn entries would occur in burn only stands with heavy fuel build up conditions to reach desired conditions described in the purpose and need for the project.
- ♦ Pile burning is proposed as a follow-up treatment on 3,412 acres. Within thinning and piling units, understory burning may be implemented concurrent with pile burning or separately.

DIRECT & INDIRECT EFFECTS

MECHANICAL THINNING

Proposed thinning with follow up pile burning and prescribed fire activities would reduce surface fuels, remove small diameter trees there by reducing ladder fuels, increase canopy base heights, and reduce crown bulk density of overstory dominant and co-dominant trees within units proposed for commercial thinning.

Effects to surface fuels post treatment include a decrease in fuel loadings and a change in size, type, and arrangement of the fuels. The decrease in surface fuel loading changes the primary carrier of fire within units proposed for thinning with follow-up prescribed burning. Table 15 provides the vegetation that would be the primary carrier of fire effecting flame length, rate of spread, fireline intensity and crown fire initiation under the proposed action.

The horizontal continuity and vertical arrangement of fuels is altered to reduce ladder fuels to the overstory with the removal of small diameter trees within the intermediate and suppressed tree class; canopy base heights across the stand increase in height. Larger dominant and co-dominant tree species harvested from units assists in reducing the canopy bulk density thereby reducing the interconnectivity of overstory trees.

The resulting change in surface and overstory fuels correlates to a reduction in fire behavior within the treatment units. A change in surface fuels affects flame length, rate of spread, fireline intensity and crown fire activity. A change in surface fuels in-conjunction with removal of the ladder fuels and some overstory trees reduce crown fire activity and type. Utilizing Tables 17 and 18, a shift in surface fuels reduces flame lengths and fireline intensities thereby reducing crown fire potential (Table 16) even in areas with low canopy base heights such as areas left for wildlife habitat for stand structure and cover.

Vegetation Type Post Treatment - Alternative 2

Vegetation Category	Alternative 2		Current Condition		% Change
	Acres	% Project Area	Acres	% Project Area	
Urban/Barren Ground	17	< 1 %	17	< 1 %	0.0 %
Grass	5	< 1 %	5	< 1 %	0.0 %
Grass Shrub	364	1.8 %	364	1.8 %	0.0 %
Shrub – Low/Moderate Load	717	3.5 %	479	2.3 %	1.2 %
Shrub – High/Very High Load	668	3.3 %	930	4.5 %	-1.3 %
Timber Shrub Understory – Low Load	3,716	18.2 %	814	4.0 %	14.2 %
Timber Shrub Understory – High Load	4,981	24.4 %	7,979	39.0 %	-14.7 %
Conifer/Hardwood – Low/Moderate Load	4,896	23.9 %	2,409	11.8 %	9.4 %
Conifer/Hardwood – High/Very High Load	5,315	26.0 %	6,758	33.0 %	-7.1 %
Activity Slash/Blowdown	341	1.7 %	697	3.4 %	-1.7 %

TABLE 15: COMPARISON OF ALTERNATIVE 2 TO CURRENT CONDITIONS

% CHANGE INDICATES THE CHANGE IN FUEL CONDITIONS POST TREATMENT UNDER THE PROPOSED ACTION.

PRESCRIBED BURN ONLY AND HAND THINNING

Direct effects of prescribed burning are the consumption and subsequent reduction in ground and surface fuels. Typically 70% of dead surface fuel is consumed within the 1 and 10 hour dead fuel category (0 to 1 inch diameter fuels). Dependent on seasonality, 100 and 1000 hour fuels (1 to 3 inch diameter fuels) can be partially and/or fully consumed. Ground fuels are reduced as portions of the duff layer are consumed.

Prescribed fire would naturally prune the lower branches of trees by burning the live and dead needles effectively increasing the canopy base heights. Overall canopy bulk density would be expected to compare to current conditions since mid-story and overstory canopies would remain intact. Isolated

torching of single trees is expected where enough surface fuels exist to perpetuate activity even at cooler weather conditions when prescribed burning is planned.

Units proposed for prescribed burn only may take up to three entries to achieve desired fuel treatment objectives. Units where prescribed burning would be the initial treatment would reduce surface fuel loads initially; however, overtime dead fuels would expect to increase as dead material from the initial burn entry fall to the ground and accumulate. A second entry utilizing hand treatments (such as hand cut pile burn) or another prescribed understory burn would then reduce those fuels and the process would once again occur. A third entry may be required depending on the remaining fuels after the second entry. Overall, it is expected that the area would have increased canopy base heights enough that additional dead overstory fuels resulting from prescribed fire activities would be minimal. None the less, after each prescribed burn surface fuel loadings and resulting fire behavior from a wildfire during 90th percentile weather fuel conditions would decrease compared to the current condition. Many areas previously thinned and/or burned during previous projects are ripe for re-entry burning. Depending on the date of the last treatment and conditions surrounding the recent prescribed burn, these units may take one or two prescribed burn entries to reach the desired fuel conditions.

Hand thinning within prescribed fire only units and selected units for hand thinning would be utilized to reduce ladder fuels and reduce fire effects surrounding large trees or other areas of concern to selected resources such as heritage sites. Proposed hand thinning with follow up pile burning and/or prescribed understory burning would reduce surface fuels; removing small diameter trees there by reducing ladder fuels and increase canopy base heights.

The opportunity for prescribed burning within masticated units from previous projects such as Last Chance Fuels Reduction project could be implemented with caution taken to limit mortality due to increased surface fuel loadings. The “Red Mountain Mastication Study” (Vaillant, et al. 2010), on the Sequoia National Forest provides information on the effects of mastication alone, and mastication with follow up prescribed burning. While mastication alone lessened the likelihood of crown fire, mastication followed by prescribed burning not only reduced crown fire potential, it also reduced flame lengths and rates of spread. These results are due to the reduction of surface fuel loadings; however, caution should be applied when burning within mastication as the potential for unacceptable mortality of trees may occur due to residence time of heat during post fire combustion. Prescribed burning in masticated units is preferred to occur prior to full vigor green up of pine trees. At least seven years of decomposing should occur prior to burning in masticated units. Last Chance Fuels Reduction project was the last entry within the Trestle project area. All masticated units from previous forest activities are greater than seven years.

SUMMARY OF EFFECTS TO ALL PROPOSED ACTIVITIES

Mechanical treatments are important because there is a high probability these treatments will be accomplished with minimal restrictions to implementation. Prescribed fire can be difficult to implement for numerous reasons. Examples include: weather conditions, fuel conditions, air quality issues and resource availability. California has some of the most restrictive air quality regulations in the country, a relatively high density of rural homes surrounded by flammable vegetation, extremely dry conditions during periods when prescribed fire could be used, and rugged topography that challenges containment efforts (North et al. 2012). The units proposed for thinning have the ability to be implemented and meet

the proposed action in a timely manner without the many restrictions of prescribed burning; mechanical thinning can take place during summer during extended dry conditions and when air quality restricts the use of prescribed fire. Within the proposed action, prescribed burn units are intermixed between mechanical treatments to expand the effectiveness of the mechanical thinning units. Additionally there are stand-alone prescribed burn units located throughout the Trestle project area. These prescribed burn areas would take advantage of the previous fuel reduction activities on ridge tops to use as holding lines when applying prescribed fire to steeper, untreated slopes.

The benefit in the end is mechanical treatments meet the fuels objective of reducing problem and extreme fire behavior with the added benefit of expanding some windows for implementing prescribed burning; Within mechanical thinning units, the change in forest structure decreases surface fuel loadings and increases canopy base heights which reduces fireline intensities, flame lengths, rates of spread and crown fire activity. With this reduction, the range of weather conditions may increase; with the change in fuel conditions the resources required to implement and hold the prescribed burn would be less as well due to the decreased risk associated with burning in open stands with decreased fuel loadings. Air quality issues would lessen with the amount of fuel available to burn decreased which leads to less smoke emissions. Finer fuels produce less smoke emission with shorter duration compared to larger fuels which would be expected to produce emissions for a longer duration as these fuels continue to consume.

The longevity of fuel treatments varies by vegetation type. However, field observations from previous projects on the Eldorado National Forest indicate that mechanical fuels treatments in-conjunction with prescribed fire last at a minimum 10 years or greater. Incorporating the use of prescribed fire as a maintenance tool can increase their longevity an additional 10 years. Stephens and others (2012) highlight the effectiveness of fuels treatments and potential longevity. They found in their study that prescribed fire only treatments begin to diminish in effectiveness at 10 years. Follow-up burning can increase their effectiveness to 15 to 20 years. Mechanical followed up with prescribed fire have a longer effectiveness of approximately 15 to 20 years due to the consumption of surface fuels from fire.

FIRE BEHAVIOR

Tables 16 – 19 provide a comparison of fire behavior characteristics between the proposed action and current conditions. Thinning, piling and prescribed fire treatments reduce flame length, fireline intensity, rate of spread and crown fire activity. From a fire suppression standpoint, fire behavior is affected by a reduction in the spread, intensity and type of fire anticipated under the treatments. The proposed action would reduce rate of spread to less than 10 chains per hour on 11,671 acres (57%) of the project immediately post treatment. Currently 6,770 acres (33%) would have rates of spread less than 10 chains per hour. That would be 24% increase in rates of spread less than 10 chains per hour.

A reduction in fireline intensities and flame length creates a reduction in crown fire potential as both surface fuels and canopy fuels are changed. In the advent of a large fire, it would be expected as fire enters the treated area the fire front would slow, reducing the spread and intensity as it moves through the treated stands. Research has determined that the reduction of surface fuels is the most important component of reducing forest fire hazards since this leads to lower fireline intensity and increased ability to manage fire when needed (Stephens et al. 2012; Stephens et al. 2009). Breaking the continuity of the overstory trees in conjunction with the ladder fuels would reduce crown fire activity. The second most

important fuel stratum in terms of fire hazard reduction is commonly ladder fuels which can provide vertical continuity to move fire from the surface to the forest overstory (Stephens et al. 2012; Stephens et al. 2009).

Referring to Tables 14 and 15, mortality of large diameter trees would be expected to be reduced to 6% or less probability on approximately 22% of the project area. The remaining trees post treatment would have a higher survival rate should a wildfire enter the stand as fuel conditions would be a low load timber shrub component or low/moderate load mixed conifer fuels consisting of small dead wood and needle cast. Retaining and growing larger trees is also an important aspect of fire hazards reduction treatments since these trees have a higher survival probability because of their thicker bark and elevated crowns (Stephens et al. 2012; Nurteau and North 2009; Fule et al., 2007; Agee and Skinner 2005). The potential for passive crown fires is reduced most efficiently by the reduction of surface fuels followed by a reduction of ladder fuels (Stephens et al. 2012). The potential for active crown fires is reduced most effectively by a combination of mechanical and prescribed-fire treatments, because these treatments target ladder and surface fuels and intermediated-size trees. However, prescribed fire alone can greatly increase the wind speed needed to initiate a passive crown fire which effectively reduces stand vulnerability to torching and transition to active crown fire (Stephens et al. 2012; Stephens et al. 2009). This result is supported by both modeling and empirical studies of wildfires burned through treated stands (Stephens et al. 2012, Ritchie et al. 2007)

Stephens and others (2009) discuss treatment effectiveness of mechanical only, prescribed fire, and a combination mechanical and prescribed fire. These results highlight the effectiveness of reducing surface fuels, thinning from below, and retaining the larger dominant and co-dominant trees in residual stands for reducing fire severity and increasing forest resilience (Agee & Skinner, 2005). The essence of the Alternative 2, the Proposed Action, meets the purpose and need of the Trestle Forest Health Project. In particular, fire behavior is altered, trees are more resilient, increases the potential survival of remaining trees on site to perpetuate old forest ecosystem habitat components.

Several examples highlight the effectiveness of fuel treatments similar to the proposed action. Examples include the Bell Fire on the Plumas National Forest. Moghaddas and Craggs (2007) describe how a fuel treatment influenced fire behavior and enhanced suppression efficiency in a mixed conifer forest. Murphy and others (2007) describe fuel treatment effectiveness on the Angora Fire (Lake Tahoe Basin Management Unit) and how treatments reduced fireline intensity, slowed fire spread and changed fire type from passive/active crown fire to surface fire activity within the treatment units. The paper also discusses the fact "Fuel treatments need to be more intensive (more surface fuels removed and wider crown spacing) on slopes to achieve the same effect as flat ground." Fire behavior effects were studied on the Antelope Complex – Wheeler Fire (Plumas National Forest). Fites and others (2007) found "treated areas had significantly reduced fire behavior and tree soil impacts compared to untreated areas." Additionally, Fites and others highlight the use of suppression resources utilization of fuel treatments and direct attack suppression methods on the fire with handcrews, dozers and engines and utilize indirect methods such as burn outs. During the Bagley Fire (2012) located on the Shasta-Trinity National Forest, fuel treatment made an excellent place to utilize burnout operations to contain a section of fireline. When burnout operations occurred, it was more like a prescribed burn than a wildfire as fire remained on the ground and consumed the surface fuels; canopy base heights were greater than 20 feet in the treated area and this allowed suppression resource to minimize line

construction and suppression damage to the landscape due to surface fuel conditions (Personal Observation; Ebert, Riesenhuber, Withrow). These examples highlight the benefit of fuel treatments. These are the same type of treatments planned under the proposed action.

Crown Fire Activity

Crown Fire Type	Alternative 2		Current Condition		% Change
	Acres	% Project Area	Acres	% Project Area	
Surface	11,057	54.1 %	5,688	27.8 %	26.3 %
Passive	8,706	42.6 %	13,791	67.4 %	-24.8 %
Active	688	3.4 %	976	4.8 %	-1.4 %

TABLE 16: POTENTIAL CROWN FIRE ACTIVITY, ALTERNATIVE 2 COMPARED TO CURRENT CONDITIONS

Flame Length

Flame Length (feet)	Alternative 2		Current Conditions		% Change
	Acres	% Project Area	Acres	% Project Area	
< 4	10,826	52.9 %	5,753	28.1 %	24.8 %
4 - 8	615	3.0 %	559	2.7 %	0.3 %
8 - 11	272	1.3 %	380	1.9 %	-0.6 %
> 11	8,737	42.7 %	13,760	67.3 %	-24.6 %

TABLE 17: POTENTIAL FLAME LENGTHS, ALTERNATIVE 2 COMPARED TO CURRENT CONDITIONS

Fireline Intensity

Fireline Intensity (btu/ft/sec)	Alternative 2		Current Conditions		% Change
	Acres	% Project Area	Acres	% Project Area	
< 100	8,734	42.7 %	3,080	15.1 %	27.6 %
100 - 500	2,037	10.0 %	2,631	12.9 %	-2.9 %
500 - 1000	533	2.6 %	483	2.4 %	0.2 %
> 1000	9,148	44.7 %	14,258	69.7 %	-25.0 %

TABLE 18: POTENTIAL FIRELINE INTENSITY, ALTERNATIVE 2 COMPARED TO CURRENT CONDITIONS

Rate of Spread

Rate of Spread (chains/hour)	Alternative 2		Current Condition		% Change
	Acres	% Project Area	Acres	% Project Area	
< 10	11,671	57.1 %	6,770	33.1 %	24.0 %
10-20	1,842	9.0 %	2,653	13.0 %	-4.0 %
20 - 40	5,047	24.7 %	8,424	41.2 %	-16.5 %
> 40	1,892	9.2 %	2,605	12.7 %	-3.5 %

TABLE 19: POTENTIAL RATE OF SPREAD, ALTERNATIVE 2 COMPARED TO CURRENT CONDITIONS

Surface fires with flame lengths less than 4 feet allow fire managers to utilize direct suppression tactics during a wildland fire situation. Areas where flame lengths are still greater than 8 feet and exhibit active crown fire activity would predominately be in the no treatment areas of Trestle project area. It is anticipated that maintenance burning in previously treated areas would maintain lower fuel loading and higher canopy base heights. However, areas that were previously excluded from fuels reduction activities and are within the prescribed burn only units may not reduce the overall fuels due to the mosaic pattern of burning therefor could also exhibit passive crown fire activity and flame lengths greater than 8 feet during a wildland fire situation.

The importance of reduced rates of spread and fireline intensities are such that it gives fire managers opportunities to plan a containment strategy and potentially utilize less resource and have less suppression impact on the landscape. Lower fireline intensities during a wildfire event provide less adverse effects to other resources such as soils, hydrology, wildlife and aquatics.

CUMULATIVE LANDSCAPE EFFECTS

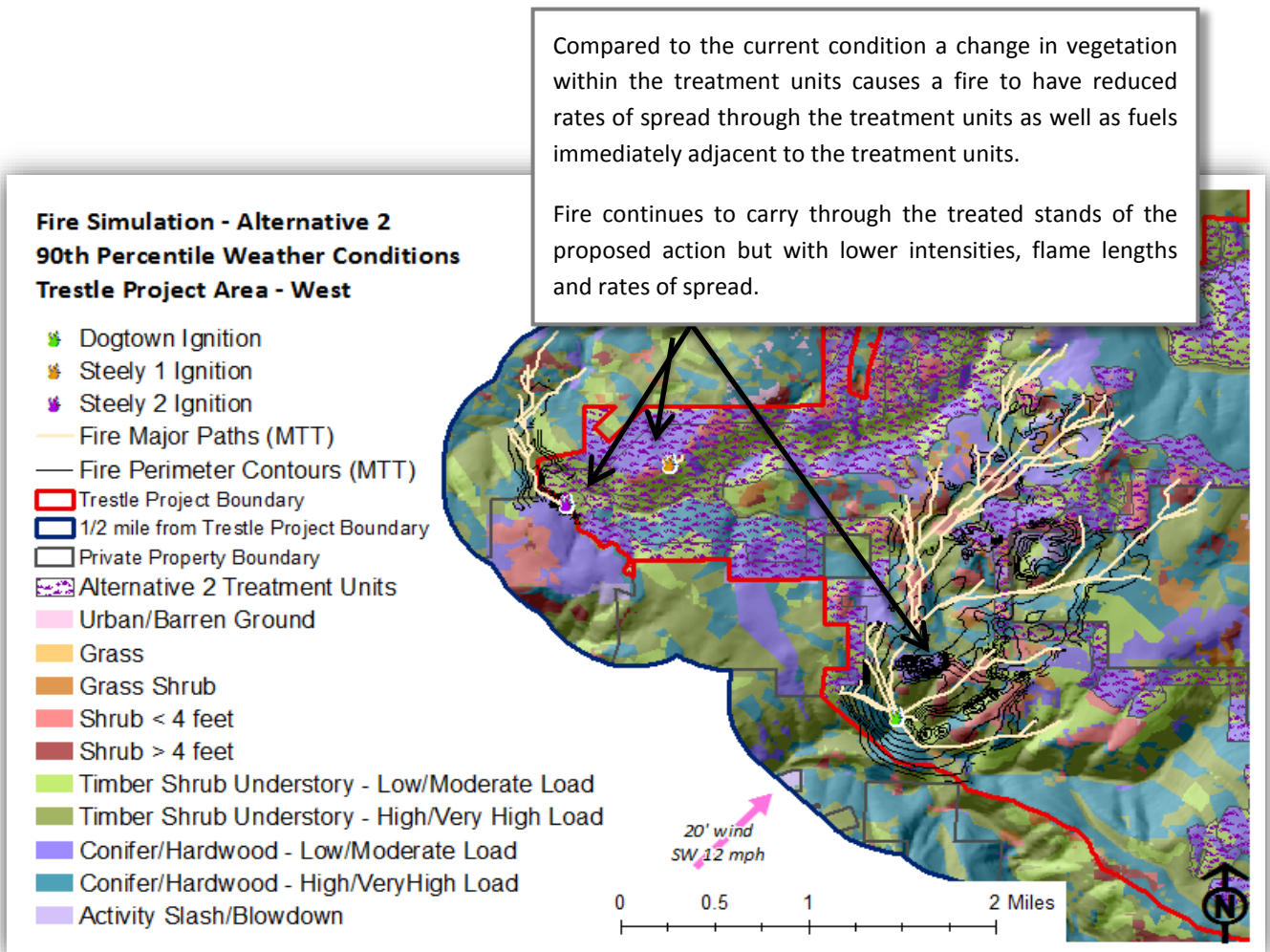
Alternative 2 has an overall effect to the landscape in the advent of a large fire. From a fire suppression standpoint, the majority of thinning treatments are located on strategic ridge lines that would be used to contain a large fire in the project area. Having these treatment areas in place allow fire managers to concentrate forces on other sections of a fire where line construction is needed. Fire resources can make a stand in these units either by containing the fire direct in the treatment units or utilizing the treatment units as a place to burnout from. The overall effect regarding suppression strategy is that suppression damage would typically be less than the current condition since post treatment fuel conditions would be such that either handline construction or a single blade dozer line could be utilized. To illustrate, during the Star Fire (ENF, Georgetown Ranger District, 2001) the containment strategy was to utilize prominent ridgelines. To achieve successful containment required the use of dozers to construct fireline. Where dozers were utilized, a four blade dozer line was used to construct control lines (Sandoval, 2013). During the Ralston fire (ENF, Georgetown Ranger District, 2006) a minimum six blade dozer line was utilized to control the fire (Sandoval, 2013). During the Mill Fire (Mendocino National Forest, 2012) many miles of six to eight blade dozer lines on several ridge tops were utilized to contain the fire while a secondary dozerline of four to eight blades wide were being built in case the primary line didn't hold (Withrow, 2012). A D-8 Dozer blade is approximately 10 feet wide. Suppression damage to these areas includes approximately 40 to 80 feet of line that is constructed to mineral soil; trees shrubs and other vegetation are removed and pushed into large berms. Follow up suppression repair post fire would include water barring fire lines and utilizing handcrews and excavators to pull the vegetation back onto the fire line.

Figures 11 – 12 provide a one day fire simulation of a free burning fire within the Trestle project area. The overall cumulative effect to the fire spread occurs when the proposed treated area burns, fire spread is reduced and conversely, the size and intensity of the fire is changed adjacent to the treatment units as fire slowly moves through the treated units and flanks around them.

Treating fuels within and adjacent to Protected Activity Centers (PAC) for the California Spotted Owl, Northern Goshawk and Great Gray Owl would assist in reducing negative fire effects inside PACS where mechanical treatments may not occur. The more fuels that can be treated adjacent to and within the PAC areas, the greater the reduction of extreme fire behavior. Large tree survival within treatment units

would be expected as a flanking fire around the treated units would lessen fire effects on those areas immediately adjacent to such units.

Important to note, while Alternative 2 decreases fire behavior potential inside and immediately adjacent to proposed treatment units, the Trestle project area would still contain areas post treatment that exhibit high severity fire potential. The current potential active and passive crown fire activity in the Trestle project area (Tables 9 and 16) is 76%. The proposed action reduces that potential by at least 26%. This results in approximately 50% of the project area which could still experience crown fire activity and overall, approximately 46% could experience high severity fire effects.



Compared to the current condition a change in vegetation within the treatment units causes a fire to have reduced rates of spread through the treatment units as well as fuels immediately adjacent to the treatment units.

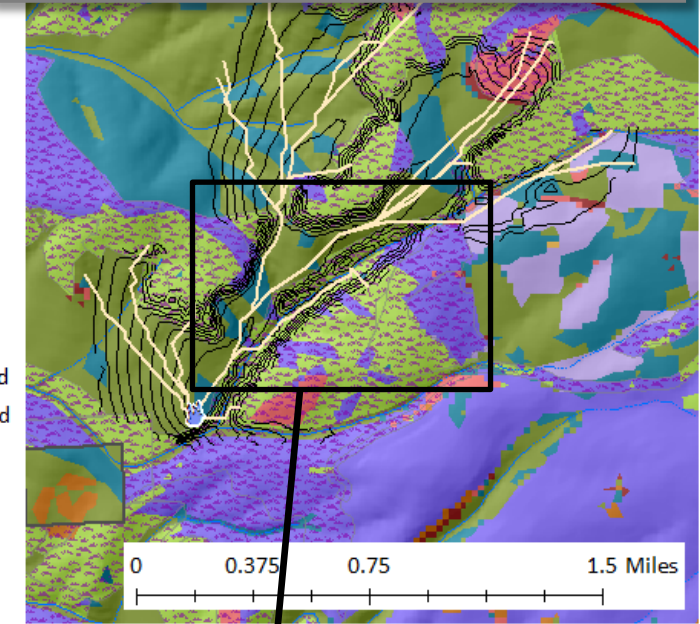
Fire continues to carry through the treated stands of the proposed action but with lower intensities, flame lengths and rates of spread.

FIGURE 11 FIRE SIMULATION, DOGTOWN AND STEELY IGNITIONS, ALTERNATIVE 2

**Fire Simulation - Alternative 2
90th Percentile Weather Conditions
Trestle Project - Long Bear Ignition**

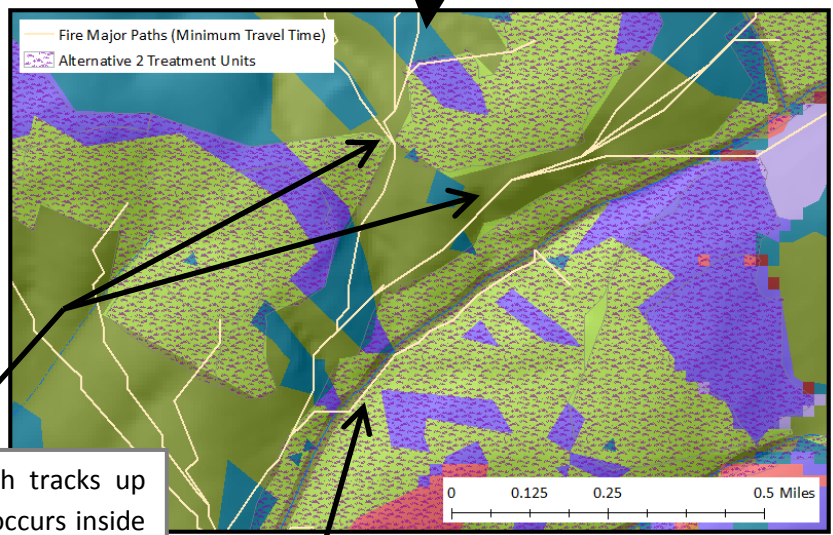
-  Long Bear Ignition
-  Fire Major Paths (Minimum Travel Time)
-  Fire Contours (Minimum Travel Time)
-  Alternative 2 Treatment Units
-  Urban/Barren Ground
-  Grass
-  Grass Shrub
-  Shrub < 4 feet
-  Shrub > 4 feet
-  Timber Shrub Understory - Low/Moderate Load
-  Timber Shrub Understory - High/Very High Load
-  Conifer/Hardwood - Low/Moderate Load
-  Conifer/Hardwood - High/VeryHigh Load
-  Activity Slash/Blowdown

20' wind
SW 12 mph



Compared to the current condition a change in vegetation within the treatment units causes a fire to have reduced rates of spread through the treatment units as well as fuels immediately adjacent to the treatment units.

Fire continues to carry through the treated stands of the proposed action but with lower intensities, flame lengths and rates of spread.



Notice the modeled fire path tracks up the untreated drainage that occurs inside a treatment unit and the untreated areas outside of the units

FIGURE 12: FIRE SIMULATION, LONG BEAR IGNITION, ALTERNATIVE 2

Figure 12 displays the result of untreated drainages adjacent to and within treatment units. These untreated drainages would act as a wick, channeling fire quickly up the drainage, especially when wind is in alignment with the drainages. However, the fire would drop to the ground and move slower in the treatment units due to the lack of receptive fuel bed. The trees and vegetation within the treatment units and adjacent to the untreated drainages would sustain increased fire behavior effects from the more intense fire burning below and adjacent to the treatment unit. This type of “edge effect” was observed in the Hey Joe project area after the King Fire moved through the area (ENF Georgetown Ranger District, 2014). Much of the increased mortality and high severity fire effects within the treatment units were immediately adjacent to the untreated drainages. Dense fuel loading and surface to crown ladder fuels caused these drainages to burn with high severity fire effects and in many locations experienced greater than 90% mortality of all vegetation classes.

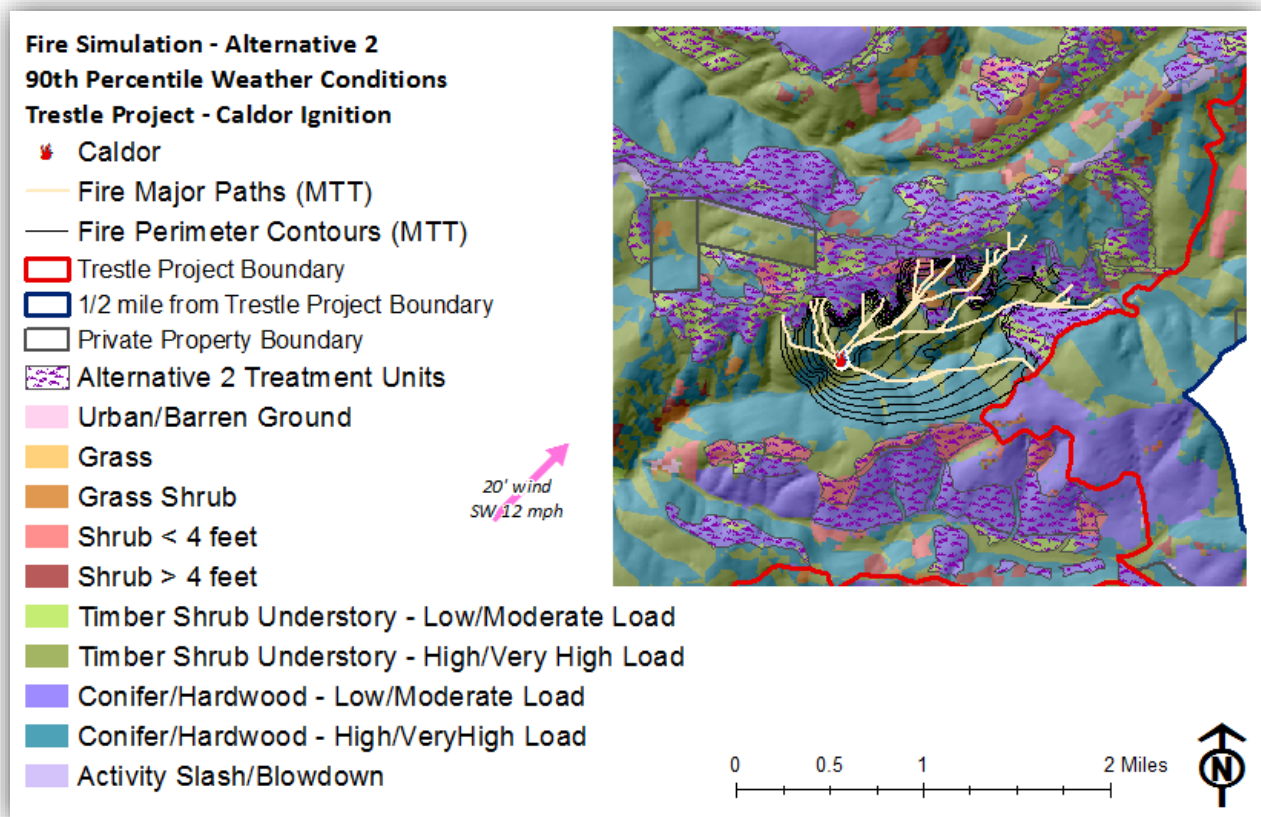


FIGURE 13: CALDOR IGNITION, ALTERNATIVE 2

Post treatment of Alternative 2 would keep wildfires small and could be contained quickly using direct attack suppression techniques, most likely utilizing handtools and hoselays. This type of suppression equipment causes the least amount of resource damage on the landscape.

Alternative 2 of the Trestle project compliments the Last Chance Fuels Reduction Project. The Last Chance project treated fuels within SPLATs and along ridgelines just south of Grizzly Flat. The Last Chance project which under the current condition continues to be effective at reducing fire spread. During fire behavior modeling many of the Last Chance units still exhibit lower rates of fire spread and intensities.

Opportunities for prescribed fire aim to increase the fuel treatment effectiveness by increasing the spatial scale of mechanical treatments on steeper inaccessible slopes.

Should Grizzly Flat and String Canyon Roads be cut off to the west of Grizzly Flat, the Grizzly Flat Awareness Manual and CWPP identify Capps Crossing Road (FS road 9N30) and Grizzly Caldor Road (also known as Leoni Road; FS road 9N73) as alternate routes “out of the community” (Almer et al., 2013).

Treatments along these roads align with the Grizzly Flat CWPP and also give fire fighters an option to establish an anchor point during fire suppression activities. The Grizzly Flatt CWPP identifies several fuels reduction project areas, some of which are within the Trestle project area (see GF-4, 6, 7 in Figure 14). The projects that occur on participating private property (GF-4, 6, 7, 8, and 12) have been completed and all connect to or occur in the Trestle project area (Grizzly Flat CWPP, 2012). Project GF-13 is being implemented as of the writing of this report and has been recently amended to extend down into the Trestle project area into sections 16 and 21 in Figure 14 (Grizzly Flat Fire Safe Council Meeting, 2014 November 1).

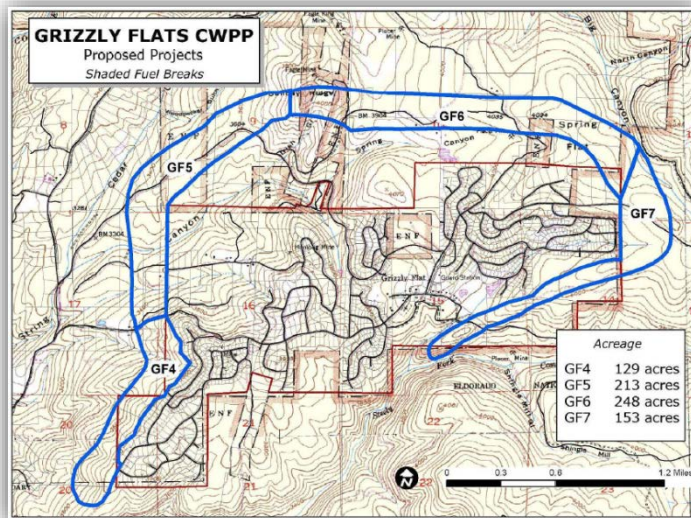


FIGURE 14 GRIZZLY FLATT CWPP 2006 PROJECTS

Alternative 2 treats 3,564 acres of SPLATs and 7, 858 acres of the WUI within the Trestle project area (Table 20). Fire modeling supports the value of fuel reduction treatments (Figures 9 – 13).

**Wildland Urban Intermix (WUI)
Strategically Placed Landscape Area Treatment (SPLAT)
Community Wildfire Protection Plan (CWPP)**

	Alternative 2		Current Conditions		Remaining Post Treatment	
	Acres	% Project Area	Acres	% Project Area	Acres	%
WUI	7,858	38.4 %	19,672	96.2 %	11,814	57.8 %
SPLAT	3,564	17.4 %	6,989	35.5%	3,425	18.1 %
Grizzly Flat CWPP	3,682	18.0 %	7,085	34.6%	3,403	16.6 %

TABLE 20: WUI, SPLAT, CWPP WITHIN UNITS OF ALTERNATIVE 2 COMPARED TO CURRENT CONDITIONS AND REMAINING UNTREATED AREA POST TREATMENT

Figures 1 displays the proposed treatment units under Alternative 2, the Proposed Action. If a wildland fire occurs post implementation of the mechanical treatments and prior to prescribed understory burning, fire mangers would be able to utilize both the road system and connect into the proposed treatment units. Limited prep work would be needed in the mechanical treatment units therefore fire fighters could concentrate building containment lines in untreated portions of the landscape. Utilizing both the road system and treated units would potentially reduce suppression damage. Altering the surface and crown fuel profile reduces fire behavior characteristics of problem and extreme fire

behavior. The treatment units provide options for fire managers to strategize a safe and efficient way to confine and contain a fire. Opportunities for prescribed burning aim to increase the effectiveness by increasing the spatial scale of mechanical treatments on steeper inaccessible slopes.

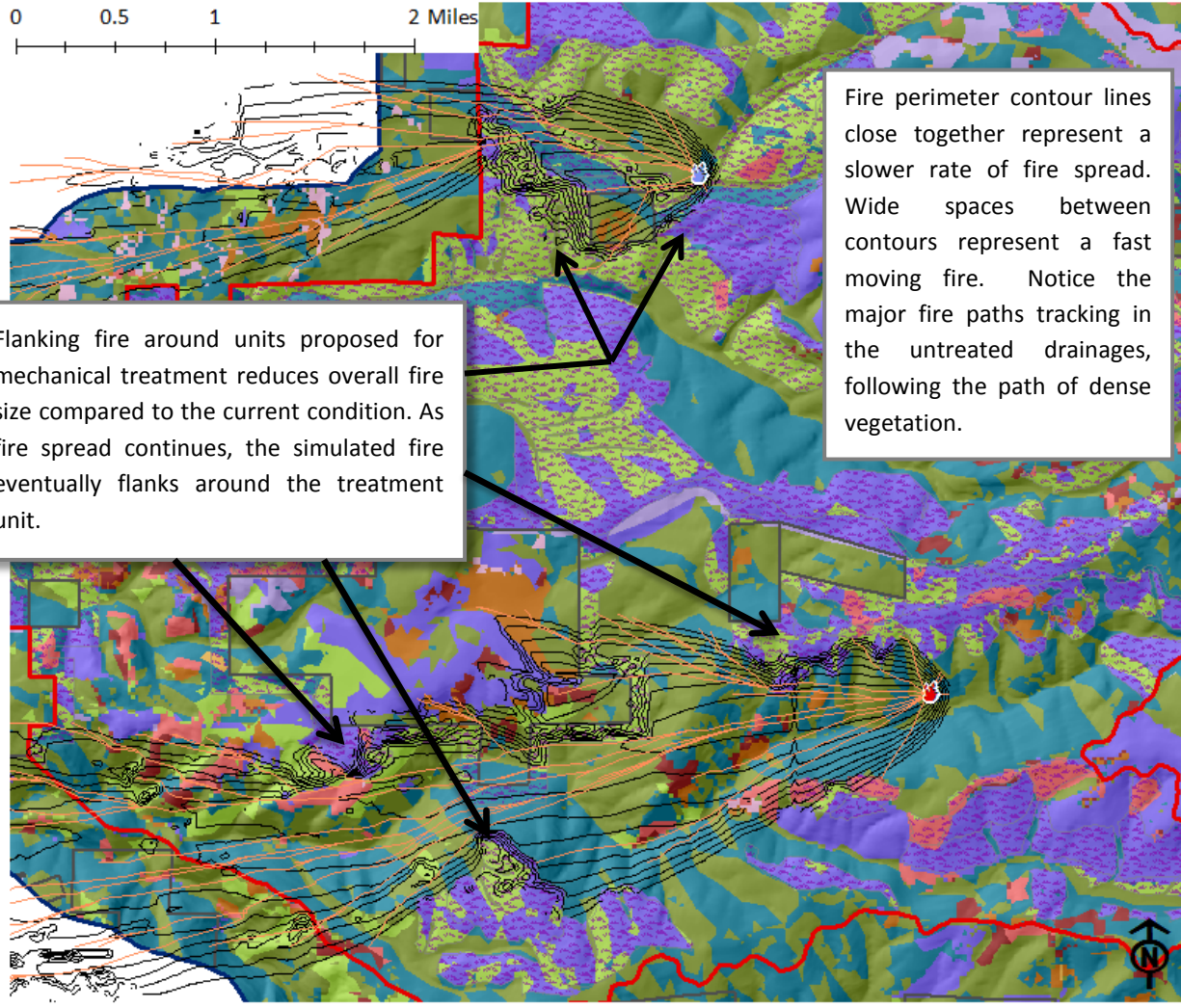
Fire behavior modeling at 90th percentile conditions during an east wind event continues to prove that fuel treatments are effective even in situations of significantly increased wind speeds (Figure 15). Fire behavior in treatment units in both the typical diurnal winds and during the east wind event is expected to be low enough for fire fighters to utilize direct or parallel suppression tactics. During an east wind event under Alternative 2 it is expected there would be fire rates of spread less than 10 chains per hour on approximately 9,348 acres or 46% of the project area. Higher wind speeds provide more oxygen to the fire therefore increasing fire rates of spread, fireline intensities, flame lengths and crown fire activity. With the increased wind speeds there would be an increase in fire behavior conditions in untreated areas. For example, on average, the flame lengths inside untreated areas during an east wind event could potentially be 160 feet with a maximum over 300 feet; as compared to 45 feet average and 80 feet maximum height during a typical diurnal southwest wind. Likewise, increases in fire rates of spread would occur: East wind event – median 143 chains per hour and a maximum of 350 chains/hour; typical diurnal winds – median 27 chains per hour and maximum 125 chains per hour. The substantial increase in fire behavior from a typical wind type day to the east wind event would cause fire fighters to implement indirect suppression tactics several ridges away utilizing heavy equipment in order to have the time necessary to prepare the ridgeline for a backfire operation. Fuel reduction treatments on ridges that are connected to each other are the most efficient and safe locations for fire fighters to make a stance against a wildfire making a run out of steep and deep canyons such as any of the forks of the Cosumnes River or Dogtown Creek. Fuel treatments mid-slope and lower slope positions help to reduce the rate of fire spread and flame lengths before the fire reaches the ridge tops allowing fire fighters more time to plan and implement suppression strategies.

Fire Simulation - Alternative 2
90th Percentile Weather Conditions -- East Wind Event
Trestle Project Area - East

- | | |
|--|---|
| Caldor Ignition | Urban/Barren Ground |
| Long Bear | Grass |
| Fire Major Paths (MTT) | Grass Shrub |
| Fire Perimeter Contours (MTT) | Shrub < 4 feet |
| Trestle Project Boundary | Shrub > 4 feet |
| 1/2 mile from Trestle Project Boundary | Timber Shrub Understory - Low/Moderate Load |
| Private Property Boundary | Timber Shrub Understory - High/Very High Load |
| Alternative 2 Treatment Units | Conifer/Hardwood - Low/Moderate Load |
| | Conifer/Hardwood - High/Very High Load |
| | Activity Slash/Blowdown |

20' wind
ENE 30 mph

0 0.5 1 2 Miles



Flanking fire around units proposed for mechanical treatment reduces overall fire size compared to the current condition. As fire spread continues, the simulated fire eventually flanks around the treatment unit.

Fire perimeter contour lines close together represent a slower rate of fire spread. Wide spaces between contours represent a fast moving fire. Notice the major fire paths tracking in the untreated drainages, following the path of dense vegetation.

FIGURE 15: FIRE SIMULATION, EAST WIND EVENT, ALTERNATIVE 2

ALTERNATIVE 4

The following activities are proposed for treatment under Alternative 4 and pertain to achieving fuel reduction and fire behavior modification goals to meet the purpose and need for the Trestle Ecological Restoration Project.

- ♦ 2,735 acres of mechanical thinning of commercial and non-commercial sized trees (2,304 acres within natural stands and 431 acres of plantations) using ground based equipment, with follow up surface fuels treatments as proposed in Alternative 2;
- ♦ Conduct approximately 53 acres of non-commercial mechanical thinning (trees less than 10 inches d.b.h) within natural stands and 25 acres within plantations;
- ♦ Within the mechanical thinning units, cutting of small trees (1" to 3.9" d.b.h) and brush would occur on approximately 1,007 acres;
- ♦ Conduct non-commercial mechanical thinning (trees less than 12 inches d.b.h) within 100 feet on one or both sides of Capps Crossing Road (9N30) and Grizzly-Caldor Road / Leoni Road (09N73) (approximately 59 acres);
- ♦ Conduct mechanical brush cutting up to 100 feet of Capps Crossing Road (9N30) and Grizzly-Caldor Road / Leoni Road (09N73) (approximately 167 acres);
- ♦ Hand thin and pile on approximately 1,123 acres, including 483 acres located within 500 feet of private property boundaries;
- ♦ Conduct approximately 6 acres of hand thinning within conifer plantations;
- ♦ Perform tractor piling on approximately 1,049 acres within natural stands and 312 acres within plantations, and grapple piling approximately 15 acres within natural stands;
- ♦ Conduct prescribed understory burning as the initial or primary treatment on approximately 11,032 acres, of which 1,563 acres is first priority burning;
- ♦ Pile burning is proposed as a follow-up treatment on 2,508 acres;
- ♦ Conduct prescribed understory burning as a follow-up treatment on up to 15,113 acres

DIRECT & INDIRECT EFFECTS

Within the units proposed for treatment under Alternative 4 similar effects to fuel conditions would compare as discussed above in Alternative 2 (pages 29-40) however, the treatments are on approximately 3005 fewer acres than Alternative 2. The treatment units proposed in Alternative 4 where similar activities are planned would result in breaking the continuity and vertical arrangement of fuels to decrease the threat of crown fire activity within the treated areas. Fewer acres would be mechanically treated for fuels reduction purposes with a reliance on prescribed understory burning to obtain fuels reduction objectives. Table 21 displays the fuel models and where the changes occur after implementation of Alternative 4 treatments and the change from Alternative 2.

As compared with Alternative 2, changes in surface fuel loadings and increase in canopy base heights in mechanical treatment units result in similar fire behavior modifications of flame length, fireline intensity, rate of spread and crown fire activity. Tables 22-25 display the change in fire behavior characteristics between Alternative 4 compared to Alternative 2.

Areas that still exhibit extreme fire behavior potential are predominately located within landscape not being considered for treatment at all. Localized negative effects potentially may occur in those areas proposed for prescribed understory burning and then later eliminated from understory burning or not completed due to funding or environmental constraints. These areas of no treatment would retain their current fuel loading and structure. In this situation fuels would continue to promote problem and extreme fire behavior conditions for fire suppression resources. Areas left untreated would allow a large fire to travel easily through the untreated areas when compared to a unit that has been treated reducing the fuel loading and minimizing the effects of problem and extreme fire behavior.

It is anticipated that a prescribed burn would not burn uniformly and therefore there would still be pockets of unburned fuels with heavy fuel loading and ladder fuels. Units which were previously treated within the most recent fifteen years or so would expect to meet resource and fuels reduction objectives within one understory prescribed burn. In order to meet fuels reduction objectives in previously untreated units scheduled for prescribed burning only under Alternative 4 would take approximately two to three entries utilizing a combination of prescribed burning and hand treatments. Prescribed burn only units and areas left for wildlife hiding cover would still be susceptible to crown fire activity and high severity fire effects during a wildland fire event.

Vegetation Type Post Treatment - Alternative 4

Vegetation Category	Alternative 4		Alternative 2		% Change
	Acres	% Project Area	Acres	% Project Area	
Urban/Barren Ground	17	< 1 %	17	< 1 %	0.0 %
Grass	5	< 1 %	5	< 1 %	0.0 %
Grass Shrub	364	1.8 %	364	1.8 %	0.0 %
Shrub – Low/Moderate Load	641	3.1 %	717	3.5 %	0.8 %
Shrub – High/Very High Load	744	3.6 %	668	3.3 %	-0.9 %
Timber Shrub Understory – Low Load	2,995	14.6 %	3,716	18.2 %	10.7 %
Timber Shrub Understory – High Load	5,736	28.0 %	4,981	24.4 %	-11.0 %
Conifer/Hardwood – Low/Moderate Load	3,588	17.5 %	4,896	23.9 %	5.8 %
Conifer/Hardwood – High/Very High Load	5,886	28.8 %	5,315	26.0 %	-4.3 %
Activity Slash/Blowdown	476	2.3 %	341	1.7 %	-1.1 %

TABLE 21: VEGETATION TYPE POST TREATMENT, ALTERNATIVE 4 COMPARED TO ALTERNATIVE 2

Crown Fire Activity

Crown Fire Type	Alternative 4		Alternative 2		Change	
	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area
Surface	9,660	47.2 %	11,057	54.1 %	-1,397	-6.9
Passive	10,060	49.2 %	8,706	42.6 %	1,354	6.6
Active	732	3.6 %	688	3.4 %	44	0.2

TABLE 22: POTENTIAL CROWN FIRE ACTIVITY, ALTERNATIVE 4 COMPARED TO ALTERNATIVE 2

Flame Length

Flame Length (feet)	Alternative 4		Alternative 2		Change	
	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area
< 4	9,494	46.4 %	10,826	52.9 %	-1,332	-6.5 %
4 - 8	572	2.8 %	615	3.0 %	-43	-0.2 %
8 - 11	291	1.4 %	272	1.3 %	19	0.1 %
> 11	10,094	49.4 %	8,737	42.7 %	1357	6.7 %

TABLE 23: POTENTIAL FLAME LENGTHS, ALTERNATIVE 4 COMPARED TO ALTERNATIVE 2

Fireline Intensity

Fireline Intensity (btu/ft/sec)	Alternative 4		Alternative 2		Change	
	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area
< 100	7,119	20.4 %	8,734	42.7 %	-1,615	-22.3 %
100 - 500	2,312	13.0 %	2,037	10.0 %	275	3.0 %
500 - 1000	504	3.0 %	533	2.6 %	-29	0.4 %
> 1000	10,516	63.6 %	9,148	44.7 %	1,368	18.9 %

TABLE 24: POTENTIAL FIRELINE INTENSITY, ALTERNATIVE 4 COMPARED TO ALTERNATIVE 2

Rate of Spread

Rate of Spread (chains/hour)	Alternative 4		Alternative 2		Change	
	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area
< 10	10,316	50.7 %	11,671	57.1 %	-1,355	-6.4 %
10 - 20	1,996	9.8 %	1,842	9.0 %	154	0.8 %
20 - 40	5,939	29.2 %	5,047	24.7 %	892	4.5 %
> 40	2,113	10.4 %	1,892	9.2 %	221	1.2 %

TABLE 25: POTENTIAL RATE OF SPREAD, ALTERNATIVE 4 COMPARED TO ALTERNATIVE 2

CUMULATIVE LANDSCAPE EFFECTS

At the landscape level, Alternative 4 is less effective at modifying fire growth within the Trestle project area. Due to the elimination of strategically placed mechanical thinning units, fire is more prone to move through and into the canopy more easily when compared to Alternatives 2 and 5.

Similar fire growth is expected in Caldor and both of the Steely ignition points (Figures 11 and 13) as units proposed for treatment are similar to Alternatives 2 and 5. Long Bear ignition point saw the most significant change in fire growth as treatment units were eliminated along the ridge separating Bear Meadow and Long Canyon (Figure 16).

An area of concern for high fire hazard is located in the northern portion of the Trestle project area (see Figure 16, Alternative 4 “High Hazard Area”). Under Alternative 4 this general location has little fuels reduction activities planned compared to Alternative 2. Treatment areas are disconnected providing little to no options for firefighting resources to make a stance against a wildfire burning at 90th percentile conditions. Fire behavior modeling shows extreme and problem fire behavior subsequently causing high severity fire effects. Figure 17 displays Fireline Intensity comparisons for Alternatives 2 and 4 in the northern portion of the Trestle project. Note the area of High Hazard and the disconnected fuel treatments along several ridges. Under Alternative 4 a wildfire burning at 90th percentile in this area would have little to no opportunities to implement direct fire suppression tactics.

Under Alternative 4 there would be an increase of approximately 3,012 acres of prescribed burning as the initial treatment. Due to the backlog of understory burning across the entire Eldorado National Forest; it would be difficult to rely on prescribed burning alone to meet fuels reduction objectives. Considering the many constraints associated with prescribed burning (weather, fuels, air quality, funding, resource availability, limited operating periods, government shutdowns, etc.) it is highly unlikely that the entire project area would meet fuels reduction objective within the same five year time period.

As displayed in Table 26 below, in the WUI, there is a reduction of approximately 1,600 acres (8%) in Alternative 4 treatments compared to Alternative 2 treatments. Under Alternative 4 the reduction of fuel treatments compared to Alternative 2 occurring in the Grizzly Flat CWPP is reduced by nearly 700 acres. Treatments in SPLATs are reduced by about 178 acres.

**Wildland Urban Intermix (WUI)
Strategically Placed Landscape Area Treatment (SPLAT)
Community Wildfire Protection Plan (CWPP)**

	Alternative 4		Alternative 2		Change	
	Acres	% Project Area	Acres	% Project Area	Acres	%
WUI	6,229	30.5 %	7,858	38.4 %	-1,629	-7.9 %
SPLAT	2,873	14.0 %	3,564	17.4 %	-691	-3.4 %
Grizzly Flat CWPP	3,504	17.1 %	3,682	18.0 %	-178	-0.9 %

TABLE 26: WUI, SPLAT, AND CWPP, COMPARISON OF ALTERNATIVE 4 TO ALTERNATIVE 2

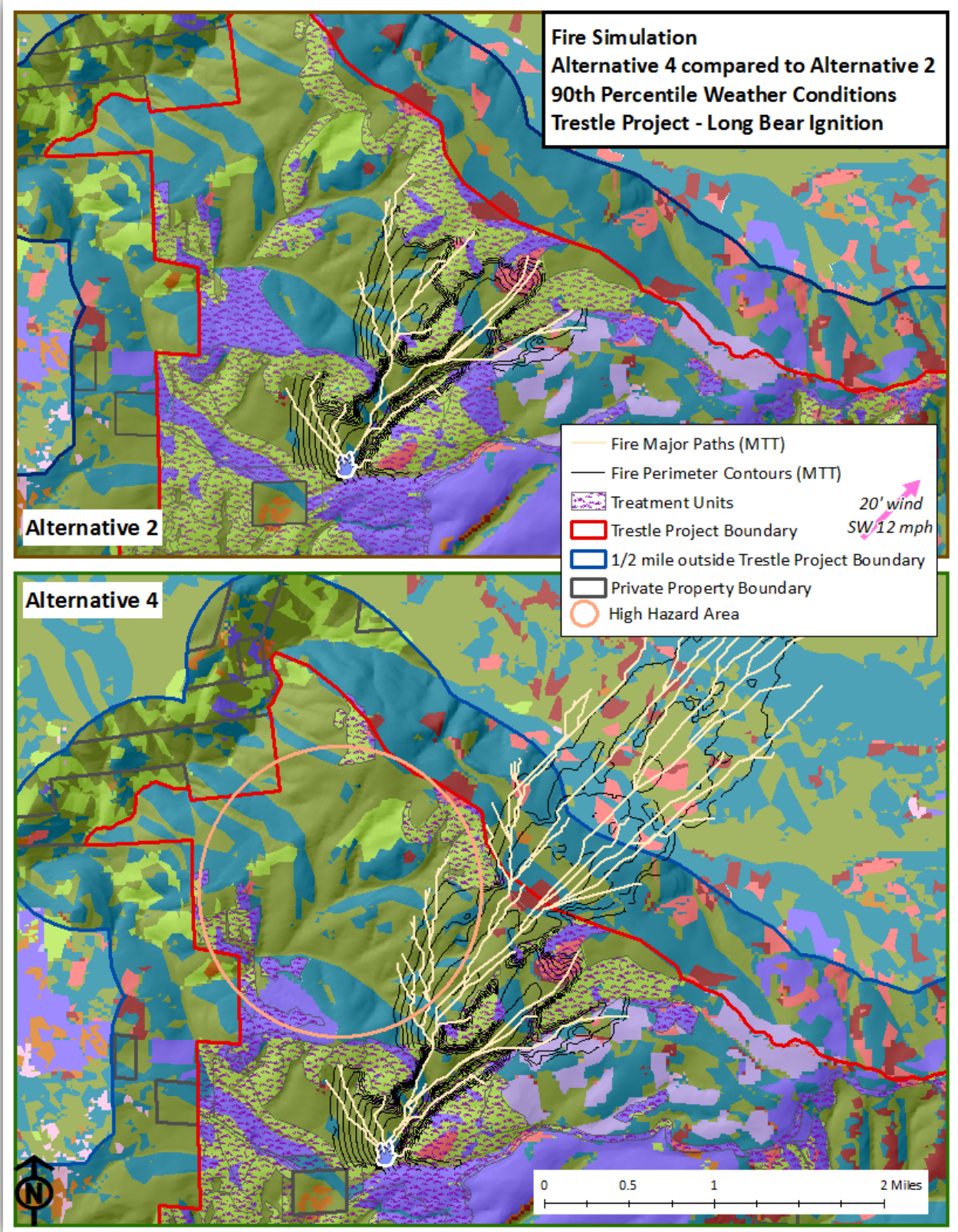


FIGURE 16: ALTERNATIVE 4 COMPARED TO ALTERNATIVE 2, LONG BEAR IGNITION POINT

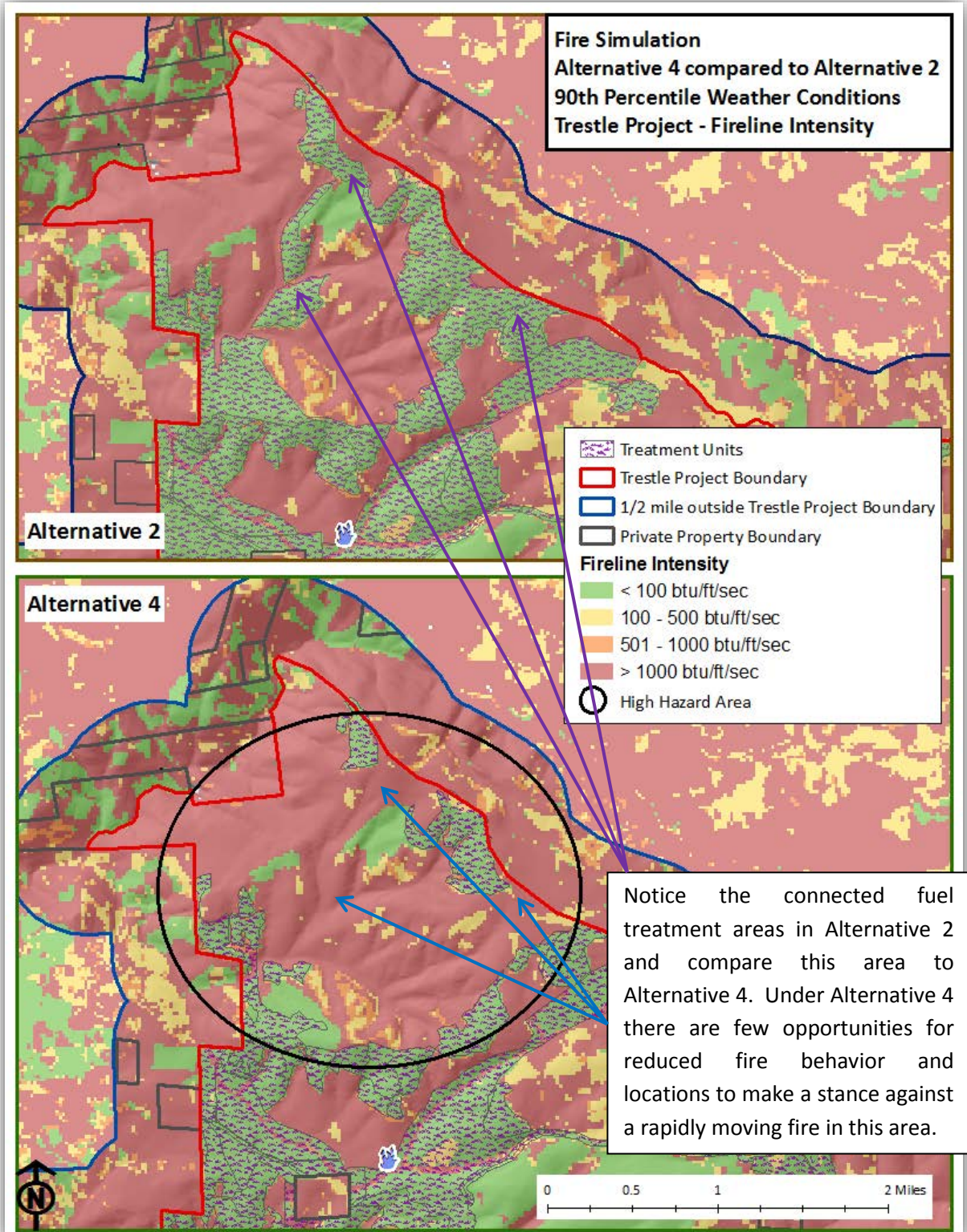


FIGURE 17: ALTERNATIVE 4 COMPARED TO ALTERNATIVE 2, FIRELINE INTENSITY

ALTERNATIVE 5

The following activities are proposed for treatment under Alternative 5 and pertain to achieving fuel reduction and fire behavior modification goals to meet the purpose and need for the Trestle Forest Health Project.

- ♦ 3,726 acres of mechanical thinning of commercial and non-commercial sized trees (3,295 acres within natural stands and 431 acres of plantations) using ground based equipment, with follow up surface fuels treatments as proposed in Alternative 2;
- ♦ Conduct approximately 25 acres of non-commercial mechanical thinning (trees less than 10 inches d.b.h) within conifer plantations;
- ♦ Within the mechanical thinning units, cutting of small trees (1" to 3.9" d.b.h) and brush would occur on approximately 1,190 acres;
- ♦ Conduct non-commercial mechanical thinning (trees less than 12 inches d.b.h) within 100 feet on one or both sides of Capps Crossing Road (9N30) and Grizzly-Caldor Road / Leoni Road (09N73) (approximately 59 acres);
- ♦ Conduct mechanical brush cutting within 100 feet of one or both sides of Capps Crossing Road (9N30) and Grizzly-Caldor Road / Leoni Road (09N73) (approximately 167 acres);
- ♦ Perform tractor piling on approximately 1,231 acres within natural stands and 312 acres within plantations, and grapple piling approximately 15 acres within natural stands.
- ♦ Hand thin and pile on approximately 1,112 acres, including 470 acres located within 500 feet of private property boundaries;
- ♦ Conduct approximately 6 acres of hand thinning within conifer plantations;
- ♦ Conduct prescribed understory burning as the initial or primary treatment on approximately 10,132 acres, of which 970 acres is priority burning for initial prescribed fire treatment;
- ♦ Pile burning is proposed as a follow-up treatment on 2,671 acres
- ♦ Prescribed understory burning is proposed as a follow-up treatment on approximately 15,111 acres

DIRECT & INDIRECT EFFECTS

Within the units proposed for treatment, similar effects to fuel conditions would compare as discussed above in Alternative 2 (Pages 29-40) however, approximately 1,328 fewer acres would receive mechanical treatments as compared to Alternative 2 (Table 27). Similar activities are planned that would result in breaking the continuity and vertical arrangement of fuels to decrease the threat of crown fire activity within the treated areas. The activity generated slash from removal of such trees in combination with reducing surface fuels with use of piling slash to burn would produce similar effects as Alternative 2 in terms of reducing fireline intensities, flame length, rates of spread and crown fire potential during a wildfire situation. Treating the surface fuels and increasing the canopy base heights reduces crown fire initiation (potential for ignition) (Table 11).

Vegetation Type Post Treatment - Alternative 5

Vegetation Category	Alternative 5		Alternative 2		% Change
	Acres	% Project Area	Acres	% Project Area	
Urban/Barren Ground	17	< 1 %	17	< 1 %	0.0 %
Grass	5	< 1 %	5	< 1 %	0.0 %
Grass Shrub	364	1.8 %	364	1.8 %	0.0 %
Shrub – Low/Moderate Load	672	3.3 %	717	3.5 %	0.9 %
Shrub – High/Very High Load	713	3.5 %	668	3.3 %	-1.1 %
Timber Shrub Understory – Low Load	3,227	15.8 %	3,716	18.2 %	11.8 %
Timber Shrub Understory – High Load	5,503	26.9 %	4,981	24.4 %	-12.1 %
Conifer/Hardwood – Low/Moderate Load	3,809	18.6 %	4,896	23.9 %	6.8 %
Conifer/Hardwood – High/Very High Load	5,671	27.7 %	5,315	26.0 %	-5.3 %
Activity Slash/Blowdown	471	2.3 %	341	1.7 %	-1.1 %

TABLE 27: VEGETATION TYPE POST TREATMENT, ALTERNATIVE 5 COMPARED TO ALTERNATIVE 2

CUMULATIVE LANDSCAPE EFFECTS

At the landscape level, Alternative 5 is comparable to Alternatives 2. While approximately 1,328 fewer acres of mechanical and hand treatments are proposed to occur, the location of reduced acreage is in proximity to large areas where mechanical understory treatments and prescribed fire activities are still planned. Therefore, at the landscape level, Alternative 5 would be an efficient project to reduce the spread and intensity of a wildfire within the project area. Figure 18 displays the Long Bear ignition as an example of effective fuel treatments under Alternative 5 compared to Alternative 2. Under both Alternatives, fuel treatments have the same effect in slowing or stopping a wildfire under 90th percentile conditions. As described in Alternative 4, there is still an area of concern for problematic wildfire in the northern portion of the Trestle project area, just north of the Long Bear fire paths and contours. Alternative 5 is more effective than Alternative 4 at reducing the fire effects of a wildland fire on the landscape and reducing chances of problematic fire behavior. Under Alternative 4, few mechanical treatments are scheduled for this area. The treatments in Alternative 5 are islands of treatments which would still slow an advancing fire as it flanked around the treatment units setting up a scenario similar to that of the SPLAT strategy. Figure 19 displays the flame lengths expected for Alternatives 2 and 5.

As displayed in Table 28 below, in the WUI, there is a reduction of approximately 1,400 acres (7%) in Alternative 5 treatments compared to Alternative 2 treatments. Under Alternative 5 the reduction of fuel treatments compared to Alternative 2 occurring in the Grizzly Flat CWPP is reduced by nearly 600 acres. Treatments in SPLATs are reduced by nearly 400 acres.

Wildland Urban Intermix (WUI) Strategically Placed Landscape Area Treatment (SPLAT) Community Wildfire Protection Plan (CWPP)

	Alternative 5		Alternative 2		Change	
	Acres	% Project Area	Acres	% Project Area	Acres	%
WUI	6,397	31.3 %	7,858	38.4 %	-1,461	-7.1 %
SPLAT	2,967	14.5 %	3,564	17.4 %	-597	-2.9 %
Grizzly Flat CWPP	3,295	16.1 %	3,682	18.0 %	-387	-1.9 %

TABLE 28: WUI, SPLAT AND CWPP, COMPARISON OF ALTERNATIVE 5 TO ALTERNATIVE 2

Crown Fire Activity

Crown Fire Type	Alternative 5		Alternative 2		Change	
	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area
Surface	9,950	48.7 %	11,057	54.1 %	-1,107	-5.4
Passive	9,779	47.8 %	8,706	42.6 %	1,073	5.2
Active	723	3.5 %	688	3.4 %	35	0.1

TABLE 29: POTENTIAL CROWN FIRE ACTIVITY, ALTERNATIVE 5 COMPARED TO ALTERNATIVE 2

Flame Length

Flame Length (feet)	Alternative 5		Alternative 2		Change	
	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area
< 4	9,771	47.8 %	10,826	52.9 %	-1,055	-5.1 %
4 - 8	603	2.9 %	615	3.0 %	-12	-0.1 %
8 - 11	294	1.4 %	272	1.3 %	22	0.1 %
> 11	9,784	47.8 %	8,737	42.7 %	1,047	5.1 %

TABLE 30: POTENTIAL FLAME LENGTHS, ALTERNATIVE 5 COMPARED TO ALTERNATIVE 2

Fireline Intensity

Fireline Intensity (btu/ft/sec)	Alternative 5		Alternative 2		Change	
	Acres	% Project Area	Acres	% Project Area	Acres	%
< 100	7,489	21.4 %	8,734	42.7 %	-1,245	-21.3 %
100 - 500	2,223	12.7 %	2,037	10.0 %	186	2.7 %
500 - 1000	530	3.2 %	533	2.6 %	-3	0.6 %
> 1000	10,209	62.7 %	9,148	44.7 %	1,061	18.0 %

TABLE 31: POTENTIAL FIRELINE INTENSITY, ALTERNATIVE 5 COMPARED TO ALTERNATIVE 2

Rate of Spread

Rate of Spread (chains/hour)	Alternative 5		Alternative 2		Change	
	Acres	% Project Area	Acres	% Project Area	Acres	%
< 10	10,659	52.1 %	11,671	57.1 %	-1,012	-5.0 %
10 - 20	2,031	9.9 %	1,842	9.0 %	189	0.9 %
20 - 40	5,674	27.7 %	5,047	24.7 %	627	3.0 %
> 40	2,087	10.2 %	1,892	9.2 %	195	1.0 %

TABLE 32: POTENTIAL RATE OF SPREAD, ALTERNATIVE 5 COMPARED TO ALTERNATIVE 2

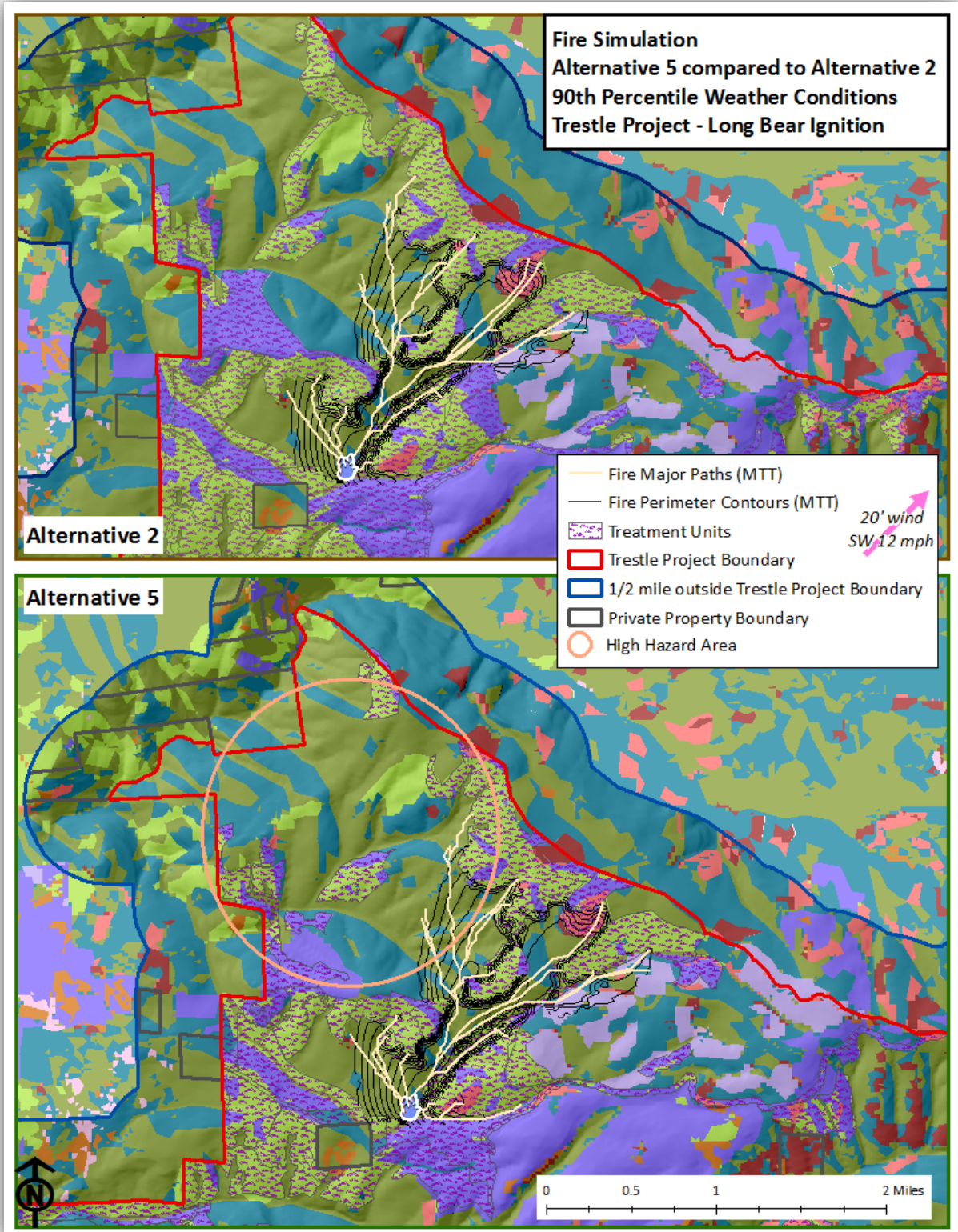


FIGURE 18: POTENTIAL FIRE PERIMETER, ALTERNATIVE 5 COMPARED TO ALTERNATIVE 2

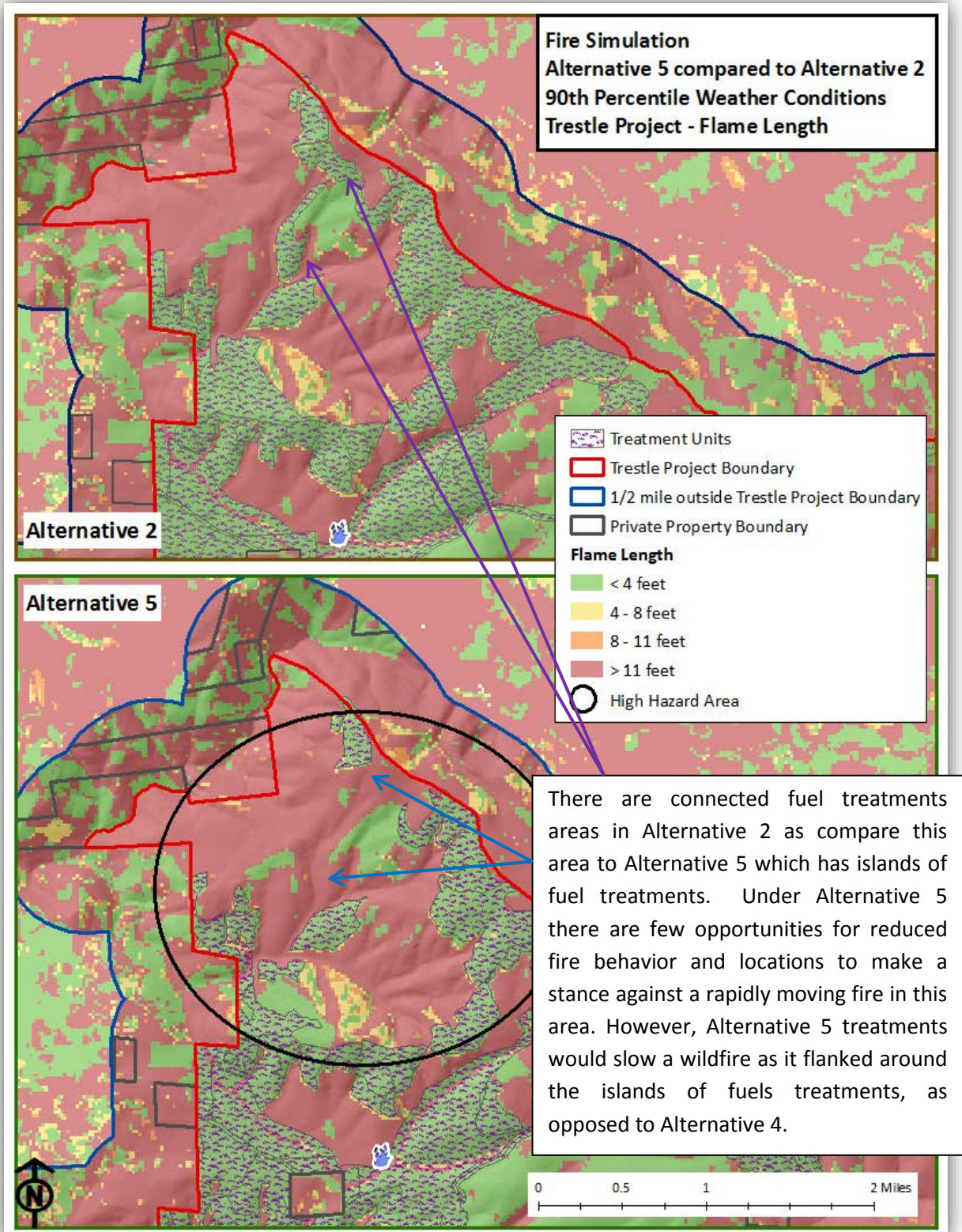


FIGURE 19: POTENTIAL FLAME LENGTHS, ALTERNATIVE 5 COMPARED TO ALTERNATIVE 2

SUMMARY

Alternative 2 would be the most effective at reducing fuel loading on the greatest area of the Trestle project therefore reducing the likelihood of high severity fire across the landscape and adjacent to the community of Grizzly Flat. Fuel reduction treatments would be connected to each other and to treatments from previous projects. Connected mechanical fuel treatments on ridge-tops provide excellent locations from which to fight a wildland fire and for implementation of prescribed burns. Fuel treatments mid-slope and lower slope positions help to reduce the rate of fire spread and flame lengths before the fire reaches the ridge tops allowing fire fighters more time to plan and implement suppression strategies.

Alternative 5 is also effective at changing the threat and severity of a wildland fire on the landscape. However under Alternative 5, fewer acres would be treated therefore the effectiveness is less than that of Alternative 2. Some mechanical fuel treatments are not connected to past treatments while others are located mid-slope. More time would be required to prepare ridge-tops and roads to contain or hold a fire during either a wildland fire scenario or prescribed burning. As with Alternative 2 mechanical fuel treatments mid-slope and lower slope positions help to reduce the rate of fire spread and flame lengths before the fire reaches the ridge tops allowing fire fighters more time to plan and implement suppression strategies.

Alternative 4 is the least effective at changing the threat and severity of a wildland fire on the landscape as compared to Alternatives 2 and 5. Alternative 4 places greater reliance on prescribed burning and hand treatments on more than 3,000 acres. Areas of dense fuel loading would require more than one prescribed burn entry and/or hand treatments to bring the landscape to the desired condition. Due to the many constraints for prescribed burning and the time to prepare units for an understory burn it is highly unlikely that the entire project area would meet fuels reduction objective within the same five year time period under Alternative 4.

REFERENCES CITED

Almer, Mark, et al. 2012, 2006; Grizzly Flat Community Wildfire Protection Plan.

Almer, Mark, et al. 2013; Grizzly Flat Community Awareness Manual. Arctic Lane Publishing.

Agee, J. k., and C.N. Skinner. 2005. Basic principles of fuel reduction treatments. *Forest Ecology and Management* 211: 83-96.

Beesley, David. 1996. *Reconstructing the Landscape: An Environmental History, 1820-1960*. Sierra Nevada Ecosystem Project: Final report to Congress, vol. II Assessments and scientific basis for management options. Davis: University of California, Centers for Water and Wildland Resources.

Busse, M. D.; Hubbert, K. R.; Fiddler, G. O.; Shestak, C. J.; Powers, R. F. 2005. Lethal soil temperatures during burning of masticated forest residues. *International Journal of Wildland Fire*. 14: 267-276.

Bouldin, Jim. 1999. *Twentieth Century Changes in Forests of the Sierra Nevada Mountains*. Dissertation. University of California, Davis. pp. 223.

Ebert, Brian. Personal Communication 6 December 2013.

Fites, J.A. et al. 2007. Fire Behavior and Effects Relating to Suppression, Fuel Treatments, and Protected Areas on the Antelope Complex Wheeler Fire.

http://www.fs.fed.us/r5/hfqlg/monitoring/resource_reports/fire_and_smoke/antelopecomplex_Final_20071204.pdf

Frandsen, W. H.; Ryan, K. C. 1986. Soil moisture reduces belowground heat flux and soil temperatures under a burning fuel pile. *Canadian Journal of Forest Research*. 16: 244-248.

Graham, Russell T; McCaffrey, Sarah; Jain, Theresa B. Science basis for Changing forest structure to modify wildfire behavior and severity, Gen. Tech. Rep. RMRS-GTR-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, 2004.

Hermansen-Baez, L. Annie; Seitz, Jennifer; Monroe, Martha. Wildland-Urban Interface: Varied Definitions. University of Florida, Institute of Food and Agricultural Sciences' EDIS publication FR287/FOR225 <http://www.srs.fs.usda.gov/factsheet/pdf/wui-varieddef.pdf>

Hood, S. 2010. Mitigating Old Tree Mortality in Long-Unburned, Fire-Dependent Forests: A Synthesis. General Technical Report RMRS-GTR-238 http://www.fs.fed.us/rm/pubs/rmrs_gtr238.pdf

McKelvey, K.S., and J.D. Johnston. 1992. Historical Perspectives on Forests of the Sierra Nevada and the Transverse Ranges of Southern California: Forest Conditions at the Turn of the Century. USDA Forest Service Gen. Tech Rep. PSW-GTR-133. pp 225-246.

Moghaddas JJ, Craggs L 2007. A fuel treatment reduces fire severity and increases suppression efficiency in a mixed conifer forest. *International Journal of Wildland Fire* **16**, 673–678.

Murphy, K. Rich, T. Sexton, T. 2007. An Assessment of Fuel Treatment Effects on Fire Behavior, Suppression Effectiveness, and Structure Ignition on the Angora Fire. R5-TP-025.

<http://www.fs.fed.us/r5/angorafuelsassessment/>

National Wildfire Coordinating Group (NWCG); 1994. Intermediate Wildland Fire Behavior. National Interagency Fire Center, NFES# 2378.

National Wildfire Coordinating Group (NWCG); 2014. Eldorado National Forest Pocket Card.

North, Malcolm; Collins, Brandon M; Stephens, Scott; 2012. Using Fire to Increase the Scale, Benefits, and Future Maintenance of Fuels Treatments. *Journal of Forestry* 110(7): 392-401.

Quinn-Davidson, L.N.; Varner, J.M. 2011. Impediments to Prescribed Fire Across Agency, Landscape and Manger: An Example from Northern California. *International Journal of Wildland Fire* 21: 210-218.

Riesenhuber, Teresa. Personal Observations. Power Fire, Eldorado National Forest, 2004; Wallow Fire, Apache-Sitgreaves National Forest, 2011; Mill Fire, Mendocino National forest, 2012; Bagley Fire, Shasta Trinity National Forest, 2012; Rim Fire, Stanislaus National Forest, 2013; King Fire, Eldorado National Forest, 2014.

Ritchie, MW; Skinner, CN; Hamilton, TA. 2007. Probability of Tree Survival After Wildfire in an Interior Pine Forest of Northern California: Effects of Thinning and Prescribed Fire. *Forest Ecology and Management* 247: 200-2008.

Sandoval, Mike. Personal Communication 8 December 2013.

Stephens, Scott. et. al. 2012. The Effects of Forest Fuel-Reduction Treatments in the United States. *Bioscience* 62: 549-560.

Stephens, Scott. 1998. Evaluation of the effects of silvicultural and fuels treatments on potential fire behavior in Sierra Nevada mixed-conifer forests. *Forest Ecology and Management* 105, 21-35.

Stephens, Scott; Collins, Brandon M; Roller, Gary. 2012. Fuel Treatment Longevity in a Sierra Nevada Mixed Conifer Forest. *Forest Ecology and Management* 285: 204-212.

Stephens, Scott, Moghaddas, Jason; 2005. Silvicultural and Reserve Impacts on Potential Fire Behavior and Forest Conservation: Twenty-five Years of experience from Sierra Nevada Mixed Conifer Forests. *Biological Conservation* 125: 369-379.

Stephens, Scott; Ruth LW. 2005. Federal Forest Fire Policy in the United States. *Ecological Applications* 15: 532-542.

Sugihara, N. G., J. W. van Wagtendonk, K. E. Shaffer, J. Fites-Kaufman, and A. E. Thode (eds). 2006. Fire in California's Ecosystems. University of California Press.

Valette, J. C.; Gomendy, V.; Marechal, J.; Houssard, C.; Gillon, D. 1994. Heat transfer in the soil during very low-intensity experimental fires: The role of duff and soil moisture content. *International Journal of Wildland Fire*. 4: 225-237.

Valient N. et al. 2010. Red Mountain Mastication Study. JFSP Project Number 05-2-1-30.

http://www.fs.fed.us/adaptivemanagement/projects/mastication/Final_report_redmnt_072209sd2.pdf.

Weatherspoon, P. C., and Skinner, C. N. 1996. Reconstructing the Landscape: An Environmental History, 1820-1960. Sierra Nevada Ecosystem Project: Final report to Congress, vol. II Assessments and scientific basis for management options. Davis: University of California, Centers for Water and Wildland Resources.

United States Department of Agriculture, Forest Service. 2004. Sierra Nevada Forest Plan Amendment, Final Supplemental Environmental Impact Statement, Record of Decision. R5-MB-046. USDA Forest Service, Pacific Southwest Region. Pages 34-36, 40-41, 59-60.

United States Department of Agriculture and United States Department of Interior, Federal Register 2001. Federal Register / Vol. 66, No. 160 / Friday, August 17, 2001 / Notices. Page 43388

United States Department of Agriculture and United States Department of Interior, Wildland Fire Leadership Council. 2010. <http://www.forestsandangelands.gov/resources/policies.shtml> Accessed 2014 November-December.

Withrow, Jason. Personal Communication, December 7, 2013; September 15, 2014.