06-08- Doc # 25

Lake Project

Fuels Report

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Fire and Fuels

This section describes the current condition of the vegetation as it relates to the significant issue of Forest Vegetation and the effects of implementing alternatives.

Issue – Activity fuels generated by harvest activities could increase fire risk

Indicators

- *Spruce-fir and aspen stands treated (acres).*
- *Tons per acre of <3" material.*
- *Slash treatment (acres) – fine fuel reduction.*
- *Large fuel reduction (acres harvested).*
- *Crown Fire Potential*
    - *Fire Type (surface fire, passive crown fire, active crown fire)*
    - *Expect stand mortality (percent of stand)*

Issue – Activity fuels generated by harvest activities could temporarily increase fire risk.

Indicators used:

- *tons per acre of <3" material*
- *Slash treatment (acres) – fine fuel reduction*

Fire and Fuels

Fire History

The Lake Project is within the Ferron/ Price Ranger District of the Manti-La Sal National Forest and encompasses about 820 acres. Fire occurrence within a ten-mile radius of the project area on the Price/Ferron and Sanpete Ranger District averages about 4.2 fires per year. Two fires have occurred within the project area in the last 10 years. The number and size of fires have varied widely during the last 13 years; ranging from 1 reported fire to as many as 10 fires. The 2001 fire season had the largest increase in the number fires with 10 fires. In 2002, approximately 31 miles south of the project area, the North Horn fire burned 648 acres in mixed fuels including sub-alpine fir, Douglas fir, aspen at 9,000 feet (Manti-LaSal National Forest fire history records). In the last five years the North Zone of the Manti-La Sal has had two Wildland Fire Use (WFU) fires and one escaped prescribed fire burn significant acres in the spruce-fir zone; these are Sixmile WFU, White Knoll WFU, and Jungle prescribed fire.

Figure 1 – Summarizes the number of fires by decade within 10 miles of the project area. The figure for the current decade is only the first 7 years and includes Wild Fire Use fires.

Decade	Number Of Fires	Acres
1980's	28	647
1990's	30	30
2000's	37	3,430

Fires can occur on the north zone of the Manti-LaSal National Forest during years of normal precipitation and during extreme drought. Two points need to be established; one, large areas can burn in extreme weather years, and two, depending on rainfall patterns and time of year, fires can burn in any part of the zone during the normal fire season.

Fire occurrence records obtained from the Moab Interagency Fire Center for the years 1980 – 2007 indicate fires burning in the months of July to October in normal precipitation years as well as those characterized as drought. Other factors influencing fire occurrence include:

- First that Utah is an area of characteristically dry conditions, with regular lightning occurring throughout the season;
- Second, that large areas can be burned in years of extreme drought and under extreme weather conditions;
- And third, that depending on rainfall patterns and time of year, fires can burn in any part of the district during the normal fire season regardless of drought conditions.

The level of drought experienced since 2000 occurs approximately every 7 - 12 years on average in this part of the State (Palmer Drought Severity Index Chart for Utah Climate Division 7, 1991 – 2007 Project File).

Typically, due to direct suppression and/or wet conditions lightning fires have been 1/10 of acre in size. Within the project area over the last 13 years there have been 56 wildfires averaging 1/3 of an acre. Three Wildland Fire Use fires for approximately 3,426 acres were managed within 10 miles of the planning area; with one in Rolfson drainage in 2007, this fire was within ¾ of mile from the project area, which grew to approximately 10 acres in size. There has been no substantial wildfire within the project area in the last 75 to 100 years, but there were 53 fires within a 10-mile radius surrounding the project area. The causes of these fires are mostly lightning, the 22% that were man-caused is a source of concern in this area, especially given the proximity to large blocks of private lands to the northeast (approximately 9 sections, 5,700+ acres), and to the southeast (approximately 3 sections, 1,900+ acres). Figure 2 lists the number of fires within a 10-mile radius of the project area by the year they occurred.

Figure 2 – Lists the number of fires and acres each year within a 10 miles radius of the project area. The first three columns are suppressed wildfires; last three columns are managed Wildland Fire Use fires.

Year	Number Of Fires	Total Acres	Largest Fire	WFU Fires	WFU Acres	Largest Fire
1995	6	7.5	7.0			
1996	2	.4	.3			
1997	5	3.4	3.0			
1998	3	.3	.1			
1999	2	.2	.1			
2000	2	.4	.2			
2001	10	1.1	.2			
2002	5	.1	.7			
2003	5	.3	.25			
2004	3	.3	.1			
2005	3	.3	.1			
2006				1	127	127
2007	7	1.25	.5	2	3299	3287

Fire Susceptibility

Historically, high intensity fire activity in spruce-fir stands result in stand replacement events. Normal fire return intervals in this forest type are generally from 250 to 300 years (Jenkins et al 1998). During normal weather conditions fire does not carry well through existing fuels in spruce-fir stands. The higher fuel moistures result in a lower probability of fire starts. Under extreme burning conditions, fire potential exists during all stages of forest community development in the spruce-fir zone (Bessie and Johnson 1995). Widespread stand replacing fires did occur in the Rocky Mountain Region in the last half of the 19th Century, when spruce beetle-killed trees were common, and the lack of fires since that period suggest that spruce beetle disturbances are a pre-cursor of large fires.

However, the situation is complicated by the high frequency of human-caused fires during that time and it is difficult to determine whether spruce beetles did or did not increase the susceptibility of these forests to natural fires (Baker and Veblen 1990).

Large, high intensity stand replacement fires can occur in spruce-fir stands under the extreme conditions of drought, high winds, high temperatures and low humidity. An example of this occurred in 2002 on the Sanford fire, Dixie National Forest. This was a prescribed burn in a lower elevation vegetation type that escaped the planned burn area due to an unusual wind event (45 MPH winds), the fire eventually grew and gained elevation and burned into spruce-fir stands. The conditions in the spruce-fir stands were the following: fuel loadings were high due to spruce beetle mortality (some of the dead spruce had fallen); 1000-hour fuel moistures were below 10 percent; average humidity's were below 20 percent; and winds were greater than 40 MPH (Sanford Fire, Dixie National Forest, Crawley 2002).

Severe and extreme drought conditions occur 3 to 5 percent of the time in central Utah. Coupled with lower than normal fuel moistures, high fuel loadings, high winds, and steep terrain, an increase in stand replacement fires could be expected over time (Revalidation Case Study – Stand-replacing Fire in Spruce Mortality on the Wasatch Plateau, Crawley, 2007).

Crown fire potential is a key element for stand-replacement wildfires. Stands within the project area are dominated by mature spruce and sub-alpine fir and have significant amounts of fine fuels in the lateral twigs, which when dead, curl against the larger branches or trunk, frequently along the entire length of the tree. This along with any smaller live trees, especially sub-alpine fir creates a vertical continuity of fuels commonly called ladder fuels. These ladder fuels create a potential risk of a ground fire transitioning to a crown fire. Dead trees are often closely intermingled with live vegetation and easily spread fire to the overstory crowns during dry weather. The increased threat of crown fire remains until the dead needles and/or the fine branches fall from the tree (Fire Ecology of Forests and Woodlands in Utah, 1992).

The spruce in the Lake Fuels Project Area is over 90 percent dead and most of the needles have fallen. The fine branches are still evident on the standing dead spruce. These dead trees are intermingled with the remaining sub-alpine fir throughout the stands (Field observations - Stephen Cote Pre-Sale Technician Feb. 25, 2008).

Need for Treatment

While a catastrophic stand replacement fire event is possible, but unlikely, any proposed treatments of spruce beetle-killed Engelmann spruce stands on the Wasatch Plateau needs to consider the social and biological resource values at risk under both extreme and normal weather conditions. The Lake planning area includes the following resources; private land holdings, campgrounds and trails, streams and reservoirs, municipal watershed, wildlife and soils resources. A responsible course of action is to reduce potential fire severity by reducing total fuel loads over time through the use of mechanical means such as tractor, skyline or helicopter and surface fuels reduction such as prescribed fire, (Revalidation Case Study – Stand-replacing Fire in Spruce Beetle Mortality on the Wasatch Plateau). The Lake Fuels Project Area has been harvested in the past and lends itself to salvage logging techniques. The best available science was considered in the discussions and analyses of the fuels project; reports, observations and reviews are documented in the report and listed under Literature Cited.

Methods

The following indicators were used to evaluate the alternatives:

1. **Fuel Loading (tons/acre of < 3 inch material)** - Fuel accumulations as a result of acres treated and spruce beetle mortality in spruce-fir and aspen-mixed conifer stands in the Planning Area. The indicator used is predicted fuel loadings and the effects on fire behavior and potential crown fire.

2. **Fire Susceptibility / Fire Behavior:** Existing fuel loadings (Field Data, 2002) and subsequent additional loading from treatments affect fire susceptibility and fire behavior (Forest Vegetation Simulator – Fire/Fuels Extension). The indicator used for evaluation is flame length of 4 feet: Flame lengths of 4 feet can be directly attacked at the head or flanks by persons using hand tools, handline should hold the fire. Flame lengths greater than 4 feet are too intense for direct attack and handline cannot be relied on to hold the fire (Wildland Fire Suppression Tactics Reference Guide).

3. **Crown Fire Potential –** Crown fire is a key element for stand-replacement wildfires. Two indicators will be used to evaluate the alternatives: Type of fire, Surface fire, Passive crown fire, Active crown fire, Conditional surface fire; the second indicator is Potential tree mortality by percent. Crown fire potential will compare the alternatives under both moderate and severe fire conditions.

A literature search and analysis conducted for the South Manti FEIS (USDA Forest Service 2000) to determine the rate at which dead spruce trees would fall to the ground over time has been determined to be applicable for this analysis. The following summarizes the findings of that literature review:

James L. Mielke (December 1950) on the Dixie National Forest reported, "Although dead for about 25 years, in 1948, 84 percent of the beetle killed trees of all sizes were still standing on Boulder Mountain and only 16 percent were down." He goes on to state "All indications suggest that in stands not removed by salvage the dropout will continue to be gradual for a number of years in the future." Studies of dead spruce on the White River National Forest showed that within 20 years, 72 percent of the beetle-killed trees of all sizes were still standing and 28 percent were down (Mielke J. L. Journal of Forestry, 1950). The final date of 80 years from the outbreak was from a personal contact with the managers of the Dixie National Forest who visited the site since the final evaluation of the plots. Based on these figures a regression analysis was completed to determine the fall rate of the dead spruce.

The total tons per acre for the Lake Project were calculated using a fall rate of 1.3 percent per year (Schmid and Hinds 1974; and Revalidation Case Study Stand-replacement Fire in Spruce Beetle Mortality On The Wasatch Plateau, Michael O. Crawley April 2004). Ponderosa pine wood weights displayed in RMRS-GTR-105, Coarse Woody debris: Managing Benefits and Fire Hazard in the Recovering Forest (Brown, Reinhardt, and Kramer, July 2003) was used to create an estimate of wood weights for the dead Engelmann spruce over 10" dbh in the stand. Total number of dead spruce per acre is 40 trees with an average diameter of 20 inches, this was determined using the Lake Stand exam data. When compared to the table in GTR-105 an average of 53 tons per acre was obtained.

The Fire and Fuels Extension (FFE) to the Forest Vegetation simulator (FVS) was used to simulate fuels dynamics and potential fire behavior over time.

Existing fuel loading from CSE Browns Protocol Report (2003) in both the spruce-fir and the aspen-mixed conifer stands were averaged together and were used as the base fuel loadings for the FVS-FFE model. They were combined due to the extensive spruce mortality in both the stands. Figure 3 displays the data used as the existing condition in the FVS-FFE model.

Figure 3 –Summarizes the existing fuel the spruce-fir and aspen-mixed conifer vegetation types within the project area, spruce fir and aspen types have been combined for analysis.

Initial Fuel Values	Spruce/fir/aspen (Tons/Acre)
Fuels <1"	4.6
Fuels 1" to 3"	8.2
Fuels 3" to 6"	2.9
Fuels 6" to 12"	7.9
Fuels > 12"	4.6
Total Tons/Acre	28.2

Fuel Loading - The fuels that influence fire behavior are the < 3-inch material. This fuel size is composed of the following time lag categories: the 1-hour (0”-0.25”); the 10-hour (0.26”- 1.0”); and the 100-hour (1.1”- 3.0”) time lag fuel categories. FVS combines these time lag categories into < 1” fuels, 1-3” fuels, 3-6” fuels, 6-12” fuels and > 12” for fire behavior calculations. Based on the existing fuel loadings and the stand exam the representative Fuel Group was identified as a Fuel Model 10.

Parameters for Potential Fire Conditions: Two sets of parameters were developed for input into the vegetation/fire model; the parameters are the base data for weather and fuel conditions for the planning area. Bruin Point weather and fuel moistures where used due to the accuracy of the data. Joes Valley is closer to the location however two years of weather data (2004 and 2005) from the Joes Valley RAWS site is skewed, the max temperture has readings above 110 degrees. June 1st to September 30th weather and fuels data was used because this is the period used for national fire planning. 50th percentile weather and fuel moistures where used to calculate moderate weather conditions. 90th percentile weather and fuel moistures where used to calculate severe weather conditions because this is what is used when requesting severity funds. Winds are calculated on a 15 minute sustained average and temperatures where calculated using dry bulb readings taken at approximately 12:30 observations. Duff fuel moisture where calculated using First Order Fire Effects Module (FOFEM) for moderate and very dry moisture conditions. Live fuel moistures where calculated from observations taken on prescribed burns that fit into conditions that are described in the following tables.

Moderate Weather Conditions
Temperature: 68
Wind speed: 3

Moisture Level	***Duff***	***1-Hour***	***10-hour***	***100-hour***	***> 3”***	***Live***
Moderate	75	5	6	9	11	125

Severe Weather Conditions
Temperature: 79
Wind speed: 6

Moisture Level	***Duff***	***1-Hour***	***10-hour***	***100-hour***	***> 3”***	***Live***
Severe	20	2	2	4	6	<100

Description of Alternatives

Alternative 1 - no action alternatives

Alternative 1 describes the existing condition after beetle infestation in which most of the spruce is dead. There would be no fine (< 3-inch) or large (> 3-inch) fuel reductions. Wildland Fire Use is not planned for this area due to the existing improvements and public safety. Fine and large fuels, predicted fire behavior, and potential of escape from initial attack (IA) resources will remain high over time due to changes in the structure of the stands and fuel loadings that will result from the spruce mortality.

The following fires have occurred within the last 5 years on the North Zone of the Manti-LaSal NF.

Sixmile Wildfire Use – 2004 burned approximately 1000 acres in spruce beetle killed spruce fir type. The mortality occurred from 1995 thru 1998, the needles and small branches were no longer on the trees, and understory vegetation had already responded to the decreased canopy cover.
White Knoll Wildfire Use – 2005, ignition started in a spruce beetle killed spruce at 10,000 foot elevation on July 14, burned approximately 500 acres in the spruce fir type, the rest in aspen mixed conifer type. The mortality occurred from 1998 thru 1992.
Jungle burn escaped wildfire burned approximately 400 acres of spruce beetle killed spruce fir type. The mortality occurred from 1995 thru 1998, the needles and small branches were no longer on the trees, and understory vegetation had already responded to the decreased canopy cover

All 3 of the wildfires listed burned in spruce beetle killed forests that no longer had red needles on the trees. The needles had fallen a minimum of 4 years prior to the wildfires.

Alternative 2

Alternative 2 proposes to remove most of the dead Engelmann spruce 10 inches and larger and thinning of non merchantable conifers. The stands classified, as aspen-mixed conifer would have most of dead spruce and encroaching conifers treated; fuels treatments would consist of jackpot burning in 100 percent of the stand. Within the spruce-fir stands approximately 30 percent of the area maybe in openings greater than 10 acres; fuel treatments will consist of jackpot burning 25 percent, chipping 33 percent, hand piling 2 percent and lopping and scattering of slash 28 percent. Harvest and fuel reduction treatments are expected to reduce fuel loadings, ladder fuels and increase the height to canopy with the benefit of reducing flame lengths and crown fire potential.

With a goal to effect an immediate and long term changes in the potential wildfire behavior by removing standing dead fuels, treating slash and ladder fuels; to reduce the rate of spread and intensity of fire; to maintain vegetation conditions that allow fires to burn with lower intensities in ground fuels; to provide a good opportunity for fire crews to stop the fire spread quickly and safely (Wildland Fire Effects in Silviculturally Treated vs. Untreated Stands of New Mexico and Arizona).

Direct/Indirect Effects

Fuel Loading – Large Fuels Reduction

Alternatives 1 will not remove any spruce and fir and will not increase fuel loading from harvest activities. Alternative 1 is the existing condition.

Alternative 1 models the spruce beetle mortality in the stands. Fine and large fuel loadings in both the spruce-fir and aspen-mixed conifer are elevated and do not drop to manageable levels for the 50 years that were modeled. As fine fuel hazard is lowering over time, stand structure and large fuel loading is increasing. This alternative has the highest probability of an escaped fire and increased chance for a stand replacement fire. Over time, due to the numerous large snags, large down woody debris and heavy surface fuels, fires are difficult to control, and pose extreme safety hazards to firefighters.

Alternative 2 would remove most of the standing dead trees in the spruce stands; fuels treatment would consist of jackpot burning, chipping, handpiling and lop and scattering of slash. The stands classified, as aspen-mixed conifer would have most of the standing dead spruce and ladder fuels removed; merchantable sub-alpine trees in the tractor units would be harvested, the non-merchantable sub-alpine fir and slash would be treated by jackpot burning in 100 percent of the stand. Design Features in Appendix B require leaving 3 dead trees at least 18 inches or larger DBH per acre and protecting existing large down logs will address wildlife habitat. Surveys to verify the snag and down log requirements will be performed following sale layout to document the existing condition of the large log component. The 2002 field surveys did not meet the down log require of a minimum of 10 tons per acre of logs 12 inches at midpoint diameter and 8 feet long. Subsequent field visits have observed the presence of recent blowdown throughout the area. This will be documented in a field survey following sale layout as listed in Appendix D under the Vegetation Monitoring Plan. Figure 4 displays the acres of large fuel reductions by alternative.

Figure 4 – Acres of large fuel reductions by alternative.

Vegetation Types	Large Fuel Treatments	Alt. 1,	Alt. 2
Spruce-Sub-alpine fir	Treated	0	675
	Untreated	1,273	598
Total Acres		**1,273**	**1,273**
Aspen-Mixed Conifer	Treated	0	145
	Untreated	216	71
Total Acres		**216**	**216**

Fuel Loading – Fine Fuels Reduction

Alternative 1 does not propose to reduce fine and large fuel loadings within the project area. Alternative 2 propose to treat the fuels by chipping activity fuels, jackpot burning, hand-piling and lop and scatter. Figure 7 displays the amount of fine fuel treatments proposed by each alternative.

Jackpot Burn Acres
Jackpot or concentration burning is a modified form of broadcast slash burning in which only the greater accumulations are ignited and the scattered nature of these concentrations limits the spread of the fire. Stands proposed for jackpot burning will be lopped but not scattered following harvest. Approximately 50 to 60 percent of the acres treated by jackpot burning should have fine fuel loadings reduced to less than 5 tons per acre, which is within the ability of initial attack forces to suppress in 4 hours.

Chipping
Chipping of slash is a method of fuels reduction in which a mechanical cutting head is mounted on a tractor and used to masticate fuels into small sized wood chips. Chipping changes the structure, orientation and size fuels in the stand, the resulting material is left on the soil surface and is more effective fuels treatment than lopping. The Lake project would treat activity slash, ladder fuels and damaged live trees on slopes 15 percent and less by mastication. A tracked Bobcat with a mastication head would be used. Converting15 to 20 tons per acre of biomass into small pieces would produce a uniform layer less than 1 inch deep (Fire Behavior and Effects Relating to Suppression, Fuel Treatments, and Protected Areas).

Handpiling
Handpiling is the method of physically piling slash into uniform piles by hand to be burned later. The Lake project would hand pile the slash within the streamside management zones within 100 feet of live streams and 50 feet from intermittent streams.

Lop and Scatter
Lopping cuts off the residual material left from the harvest of a tree (branches and tops) into smaller pieces so they lie close to the ground. Scattering distributes the lopped material more or less evenly across the ground. The fine fuels will not be reduced and the average fuel loading may exceed 5 tons/acre. This material will naturally decay and may take approximately 5 to 9 years to return to a manageable fuel loading of less than 5 tons per acre (Personal communication with Russell T. Graham, Research Silviculturist, RMRS). Monitoring of completed projects show approximately 80 percent of the treatment units had less than 5 tons per acre in the less than 3 inch fuels within 5 years of harvest in the South Manti Project (Post Treatment Evaluation and Prescriptions, South Manti EA, 2005 and 2006).

Figure 5 – Acres of Fine (<3-inch) Fuel Treatments.

Vegetation Types	Fine Fuel Treatments	Alt. 1	Alt. 2
Spruce-Sub-alpine fir	Jackpot Burn	-	143
	Chipping	-	190
	Handpile	-	15
	Lop/ Scatter	-	232
Total Acres			**580**
Aspen-Mixed Conifer	Lop/scatter	-	0
	Jackpot burn	-	145

Total Acres	0	145

Short Term – 5 years after harvest

The fine fuel loadings could exceed the 12-tons/acre thresholds in the short term for fuel model 10[1] (Anderson, Hal E. 1982. Aids to determining fuel models for estimating fire behavior) in both the spruce-fir and aspen vegetation types in Alternative 2. This will not occur at one time in all the treatment units. The units would probably be logged over two or more operating seasons and slash treatment operations would begin in individual units in the year following harvest. Fuel levels will be declining as fuel reduction treatments are completed for the individual stands and remain a fuel model 8[2]. Alternative 1 exceeds slash levels for a fuel model 10 for ten years as the fine fuels increase due to the recent mortality and approach a fuel model 12[3]. Figure 6 displays the base line fine fuel level (Alternative 1) and the short-term increase in the average fine fuels prior to fuel treatments in Alternative 2.

Figure 6 – Short Term fine fuel loading for the No action Alternative 1; Alternative 2 after harvest prior to jack pot burning, handpiling, chipping and lop and scatter treatments

Fine Fuels	Alternative 1 Fuel Load, < 3 in. Tons/acre	Alternative 2 Fuel Load, < 3 in. Tons/acre
<5 Years	11.2	17.9
> 5 Years	14.6	5.1

Long Term – 50 years after treatment

After the fuels treatments are complete under Alternative 2 the fine fuels (<3 inches) will be below five tons per acre and be considered a fuel model 8. Fine fuels will increase

[1] The fires burn in the surface and ground fuels with greater fire intensity than the other timber litter models. Dead-down fuels include greater quantities of 3-inch (7.6-cm) or larger limbs resulting from over maturity or natural events that create a large load of dead material on the forest floor. Crowning out, spotting, and torching of individual trees are more frequent in this fuel situation, leading to potential fire control difficulties. Any forest type may be considered if heavy down material is present; examples are insect- or disease-ridden stands, windthrown stands, overmature situations with deadfall, and aged light thinning or partial-cut slash.

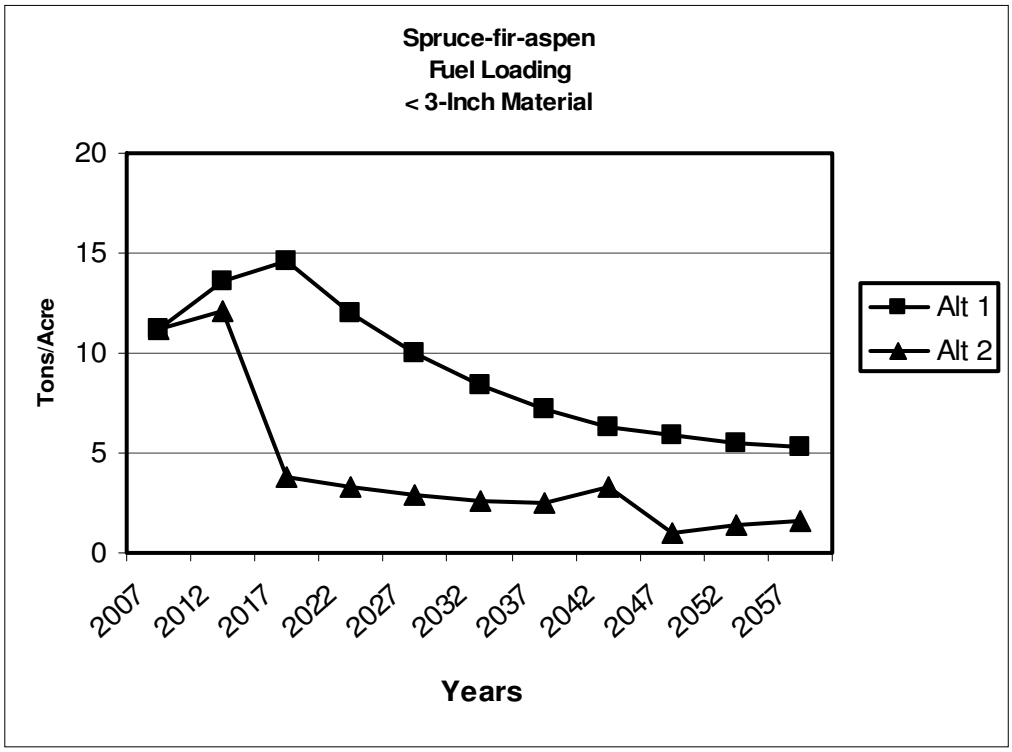
[2] Slow-burning ground fires with low flame lengths are generally the case, although the fire may encounter an occasional "jackpot" or heavy fuel concentration that can flare up. Only under severe weather conditions involving high temperatures, low humidities, and high winds do the fuels pose fire hazards. Closed canopy stands of short-needle conifers or hardwoods that have leafed out support fire in the compact litter layer. This layer is mainly needles, leaves, and occasionally twigs because little undergrowth is present in the stand. Representative conifer types are white pine, and lodgepole pine, spruce, fir, and larch.

[3] Rapidly spreading fires with high intensities capable of generating firebrands can occur. When fire starts, it is generally sustained until a fuel break or change in fuels is encountered. The visual impression is dominated by slash and much of it is less than 3 inches (7.6 cm) in diameter. The fuels total less than 35 tons per acre (15.6 t/ha) and seem well distributed. Heavily thinned conifer stands, clearcuts, and medium or heavy partial cuts are represented. The material larger than 3 inches (7.6 cm) is represented by encountering 11 pieces, 6 inches (15.2 cm) in diameter, along a 50-foot (15-m) transect.

until 2012 for Alternative 1 and will be above the 12-tons/acre thresholds for a fuel model 10. After 10 years fine fuels will decline but will still be above 5 tons per acre for the fifty years. At the same time the large fuels will be increasing due to the fall rate for dead spruce and Alternative 1 will remain at a fuel model 10.

Figure 7 represent the modeled changes to the fuel loadings by alternatives: The model includes spruce beetle mortality, in-growth of trees, harvest and post harvest treatments including pre-commercial thinning. Alternative 1 for the spruce/sub-alpine fir/aspen is simulated the fifty-year period and has the highest fuel levels. Alternative 2, the fine fuel loading is less than 5 tons per acre level after all treatments.

Figure 7 –Fine (<3-inch) Fuel Loading in Spruce-fir Type by Alternative over the next 50 Years.



Fire Susceptibility

The existing condition in the spruce-fir (after spruce beetle mortality) vegetation type is considered the base line data; this data was used to compare the existing fuel loadings with fuel loadings after fuel reduction treatments proposed in Alternative 2. In moderate fire conditions, the fine fuels (<3-inch) levels through year 2012 are at or above the threshold considered manageable and may exceed the capabilities of ground forces to suppress in four hours. For the severe conditions, fire susceptibility is over the threshold through year 2012. From 2012 through 2057 the fuel loadings, flame lengths and potential tree mortality continue to drop and are at a manageable level for Alternative 2.

Alternative 1 with no planned fuel treatments the fuel loadings increase in each individual stand, the potential for escape from initial attack resources and for larger than normal wildland fires will also increase. The high fine fuels will increase the rate of

spread until the fine fuels are reduced by decomposition and compaction over time. The number of dead trees and potential large down fuel component in the future will decrease fire fighter access, increase time needed to control a fire, limit defensible space and expose firefighters to hazardous dead trees.

The higher fine fuel loading in conjunction with increased exposure to local wind and topographical influences from the loss of the live tree canopy, could increase the probability of high intensity localized fire occurrences in extreme drought years for both alternatives. Changes in fire type over the next 50 years are displayed in Figures 8 and 9 for Moderate and Severe weather conditions.

The planned treatments would create openings in the general overstory canopy, provide safe access routes, and create fuel breaks of various age groups of trees. Initial attack forces would have access to the area; have time and defensible space to control the fire prior to the end of the 4-hour window, the reduction of post-activity fuels should, theoretically, increase the effectiveness of control efforts (e.g. less effort required to build fire line in and between former treatment units), increasing the probability of success of the control efforts. (Finney, Design of Regular Landscape Fuel Treatment Patterns for Modifying Fire Growth and Behavior, Forest 7 Science, 2001).

Fire Behavior

With the increase in fine fuel loadings following harvest there will be a short term risk that a fire will exceed the capabilities of initial attack crews and easily escape in all fuel groups. As stands are harvested during the estimated 2 to 3 years of the contract, stands will be released from the contract and slash treatment work will begin the next field season. This will stagger the short-term risk over an estimated 3 to 5 year period until all post harvest slash treatments are completed.

The planned slash treatments of jackpot burning and handpiling will reduce the activity fuel loading immediately and the current natural fuel loading within the treated stands to manageable levels (< 5-tons/acre) for initial attack forces to control. The planned slash treatment of chipping reduces the fire activity immediately due to changing the size and more importantly the orientation of activity fuels. Lopping and scattering of slash will reduce the activity fuel loading within 5 to 9 years as the material decomposes within the treated stands to manageable levels (< 5-tons/acre) for initial attack forces to control. The overall pattern of treatments will be done in a blocked or checkerboard pattern, which will reduce the overall rate of spread of a wildfire. This has the effect of slowing, stopping and/or redirecting a fire's movement as it spreads through a treatment area. This would reduce the rate of spread and give initial attack forces time and defensible space to directly attack a wildfire. (Finney, Design of Regular Landscape Fuel Treatment Patterns for Modifying Fire Growth and Behavior, Forest 7 Science, 2001

Following harvest and completion of slash treatment under Alternative 2 the average total fuel loading would decrease as depicted in the following charts. As fuel loadings decrease fire risk will decrease over time at different rates is indicated by the flame lengths. The following charts compare flame lengths for moderate and severe conditions

for both vegetation types. The threshold used for comparison is 4 feet; flame lengths exceeding 4 feet may exceed the capabilities of initial attack crews. Figures 8 and 9 illustrate the relative changes to flame length over the next 50 years by alternative, vegetation type, and weather conditions.

Figure 8 – Flame Lengths in Spruce-fir Type by Alternative over the next 50 Years with Moderate weather conditions.

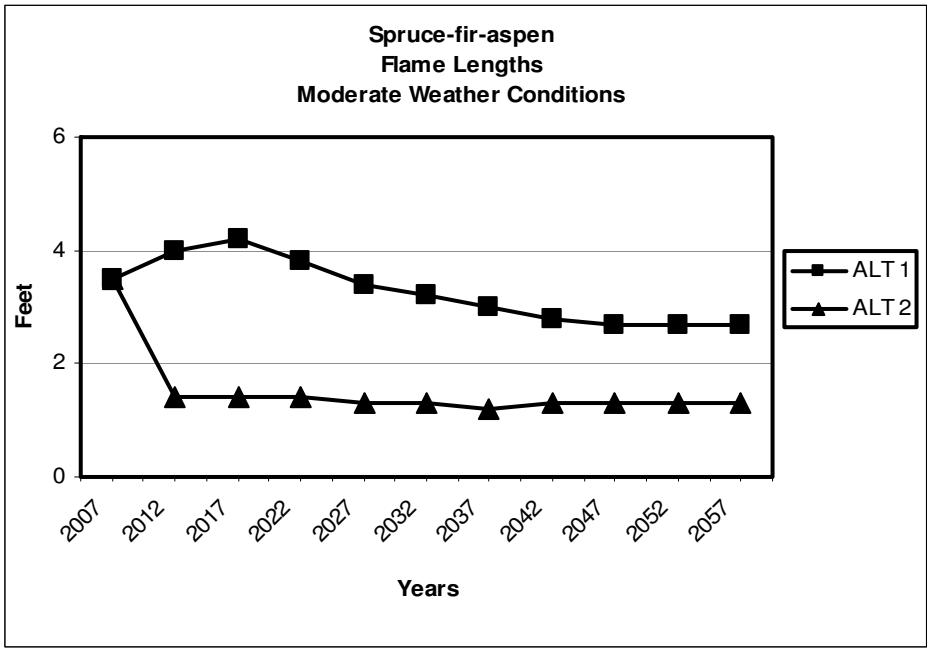
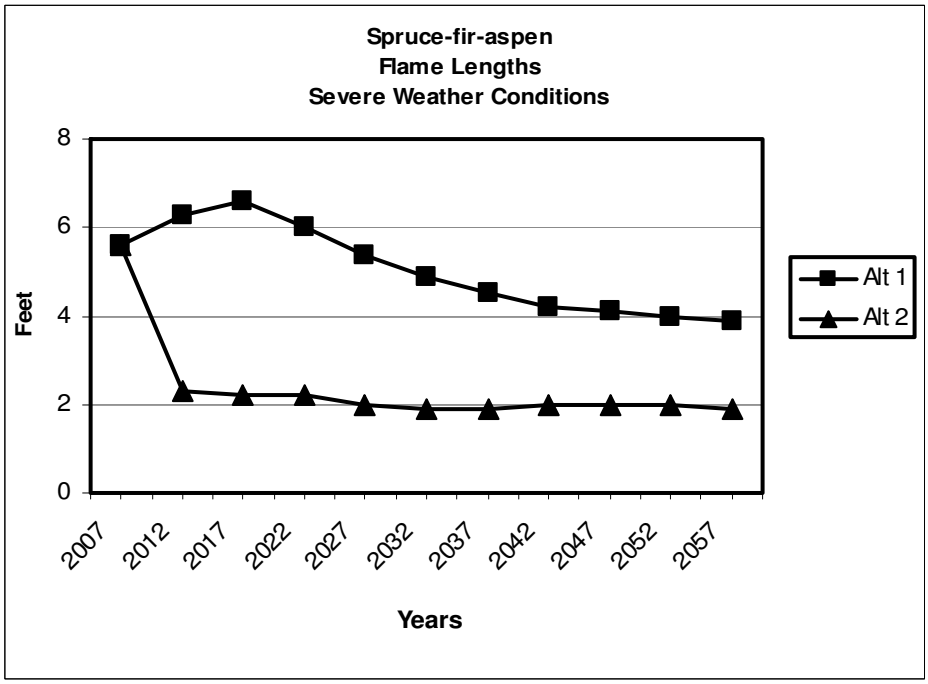


Figure 9 – Flame Lengths in Spruce-fir Type by Alternative over the next 50 Years with Severe weather conditions.



Fire Type – Crown fire potential is a key element for stand-replacement wildfires; two indicators will be used to evaluate the alternatives, Type of fire and potential tree mortality by percent. Three types of fire resulted from the modeling (Cote, Diane M., 2008, *Forest Vegetation Simulator Reports for Vegetation and Fuel*s); Surface fire - (fire that burns surface litter, dead woody fuels, other loose debris on the forest floor, and some small vegetation). Passive crown fire - (some crowns will burn as individual trees or groups of trees, ignited by the passing front of the fire). The second indicators are potential tree mortality by percent. Crown fire potential and potential tree mortality will be used to compare the alternatives under both moderate and severe fire conditions over 60 years.

Under the Moderate Fire Conditions after harvest and fuel treatment Alternative 2 in all vegetation types indicate less wildfire related mortality due to a large fire than the no action alternatives and a large fire is projected to stay as surface fire after all treatments are complete. Alternative 1 would have more mortality and is projected to become a passive crown fire by 2032. Figures 10 and 11 display the changes in Fire Type over the next 50 years under Moderate weather conditions.

Figure 10 – Changes in fire type under moderate weather conditions over the next 50 years in the Spruce-fir Vegetation Type.

	Alternative 1		Alternative 2	
Year	**Type of Fire**	**Percent Mortality**	**Type of Fire**	**Percent Mortality**
2007	Surface	47	Passive	48
2012	Surface	49	Surface	28
2017	Surface	51	Surface	27
2022	Surface	49	Surface	27
2027	Surface	45	Surface	27
2032	Passive	44	Surface	29
2037	Passive	42	Surface	30
2042	Passive	41	Surface	27
2047	Passive	46	Surface	26
2052	Passive	46	Surface	26
2057	Passive	40	Surface	27

Under the severe fire conditions there are only minor differences in fire related mortality until fuels treatments are completed. Alternative 2 indicates a surface fire with reduced mortality under severe conditions through 2057 as displayed by the fire model. Alternative 1 indicates a passive crown fire with mortality 70 percent and greater throughout the 50 years. As stated in the introduction: Large, severe stand replacement fires can occur in spruce-fir stands under the extreme conditions of drought, high winds, high temperatures and low humidity. Figure 11 displays the changes in fire type over the next 50 years both alternatives.

Figure 11 – Changes in fire type under severe weather conditions over the next 50 years in the Spruce-fir Vegetation Type.

	Alternative 1		Alternative 2	
Year	**Type of Fire**	**Percent Mortality**	**Type of Fire**	**Percent Mortality**
2007	Passive	70	Passive	72
2012	Passive	78	Surface	28
2017	Passive	84	Surface	27
2022	Passive	78	Surface	27
2027	Passive	75	Surface	27
2032	Passive	78	Surface	29
2037	Passive	77	Surface	31
2042	Passive	76	Surface	27
2047	Passive	82	Surface	27
2052	Passive	83	Surface	27
2057	Passive	78	Surface	27

Cumulative Effects

There are no cumulative effects beyond what has been described under direct and indirect effects. There are no additional slash or harvest treatments within the project area. For fine fuel and large fuel reduction, predicted Rate of Spread (ROS) and potential for Initial Attack (IA) escape there will be no change from what has been previously discussed.

Expected fire behavior will generally be confined in the stands containing dead spruce and sub-alpine fir. It could be anticipated to experience high severity and intensity wildfires burning in blocks ranging from 100 to 200 acres in size across the project area in the immediate years following an epidemic.

Reducing the natural buildup of fuels by harvesting and implementing slash disposal mitigations, and breaking up the continuous fuels and live over story canopy within stands would reduce the risk for a large intense wild land fire in each treated stand. The stands would be susceptible to intense, wild land fires when the following are present: low fuel moistures, low humidity's; high temperatures; and wind. The probability of these events occurring is low in any given year. However, over time, the probability is increased.

As crown spacing is increased it is presumed that there will be an increase of grasses and forbs including introduced species. Monitoring of wildfires has found increases in introduced species including noxious weeds. Low burn intensities have generally benefited the native species, while high severity fires create conditions ideal for non-native plant species, (Omni, Philip N. , Erick J. Martinson, (Colorado State University), Geneva W. Chong, (Colorado State University, US Geological Survey) - Effectiveness of Pre-Fire Fuel Treatments, December 31. 2006). Native species will in turn attract wildlife grazing and increased domestic grazing into the area with a corresponding reduction in fine herbaceous fuel loadings; which will mitigate the effect of higher fine

fuel loadings and increased exposure to local wind influences from the loss of the live tree canopy.

The proposed timber management activities in the project area have potential for reducing both present and future fuel loadings. If the pattern of cutting follows overlapping and staggered placement the treatments also have the ability to slow both ground and crown fires on these slopes. This would allow time and space to effectively fight a fire during extreme conditions. An example of this type of treatment is in the large blow down treatments in Michigan as developed by Mark Finney (Design of Regular Landscape Fuel Treatment Patterns for Modifying Fire Growth and Behavior) (Forest Science, 2001).

Through prediction modeling it is expected that without treatments it will take between 5 to 9 years for natural decay to bring fuel loadings to this level if no new down and dead fuels be added to the site from future tree mortality. But there will be continued fuel build-up to the site from future mortality along with the new developing canopy and its close proximity to the ground fuels due to the younger age of the replacement stand.

Activity fuels should be treated 2 to 5 years following timber harvest, through a combination of jack pot burning, chipping, hand piling and lop and scatter. To help mitigate increased short-term fire risk effects jackpot burning should reduce fuel loading to 5 tons per acre over 50 to 60 percent of the treated acres. Lop and scatter and chipping treatments will be used in some areas to break up fuel orientation, concentrations, continuity and lessen the effects of fire duration on soils where appropriate. Lop and scatter will not affect the fuel loading in those areas and would be expected to follow the 5 to 9 years for the decay processes in obtaining lower fire risk.

Wildland Fire Behavior

Fuel mitigation treatments of the spruce-fir stands could increase the potential to contain Wildland fires under moderate conditions. Predicted flame lengths are below four feet in height: (Fires can generally be attacked at the head or flanks by persons using hand tools). When weather conditions are extreme fires in untreated areas with heavy fuel loads; such as snags, steep slopes, and limited access have the potential to wear crews out, as regular line construction and burnout efforts are less effective. Consequently, under extreme weather conditions, fires in this area would pose a safety threat to hand crews. Suppression efforts would be indirect, as treated stands and areas of non-continuous fuels would be used to contain a large-intense wildland fire.

Consequently, it can be concluded that the chance of a 100 to 300 year stand replacement fire could increase in stands with large amounts of beetle kill down and dead fuels under a live canopy.

An increase in dead and down fuels from the dead Engelmann spruce would occur over time. The increased fuels in conjunction with low fuel moistures and high winds, would contribute to an increase in fire risk. Without implementation of fuel reduction techniques the dead spruce or other normal mortality will contribute to a long-term increase in risk of a large intense wild land fire.

Managed stands grow faster through time than un-managed stands. Planting trees, stocking control to reduce competition, improve growth of individual trees, intermediate treatments to maintain health and vigor of stands are silvicultural means to shorten the time required for stand replacement and could reduce fire severity.

Irreversible/Irretrievable Commitment of Resources

Alternative 1

Mortality of the Engelmann spruce from the spruce beetle is an irreversible effect that cannot be avoided. As a result of the Engelmann spruce mortality changes to the vegetation composition and structure of the spruce-fir and aspen-spruce-fir from the mortality of the Engelmann spruce due to the spruce beetle are an irreversible effect that cannot be avoided. Similar epidemics have occurred throughout the spruce-fir and aspen-spruce-fir types historically. Approximately 150 years would be required to bring stand structures back to conditions similar to those, which existed prior to a spruce beetle epidemic.

If a large, intense wildland fire were to occur under the described increase in fuel loading, this would place the lives of firefighters and possibly fire resources at risk for loss. The effects of such a fire would be intensified in the areas of wild land urban interfaces and watersheds due to the values at risk and subsequent higher degree of effort and the effects of those efforts by firefighters to save resources at risk. If a fire were to take place the majority of the live trees in the stands following the spruce beetle epidemic would be lost as well**.**

Alternative 2

Timber harvest and Jackpot burning would change plant succession, stand development, and species composition. If project requirements fail, some irretrievable commitments may include loss of vegetation for wildlife if noxious weeds become established. Some diversity of vegetative composition of the plant community could be lost to noxious weeds.

Under these circumstances the same principles from Alternative 1 would apply, but at a much reduced level with a greater possibility of success, and safety of initial attack resources.

Forest Plan Consistency

Alternative 1

Alternative 1 may be consistent with Forest Plan direction since the changes expected to the fuels and escaped wildfire would be the result of a natural spruce beetle epidemic. It could be debated whether inaction, would be consistent with specific vegetation management direction to maintain fuel conditions that permit fire suppression forces to meet protection objectives of the management unit.

Alternative 2

Alternative 2 would be consistent with Forest Plan direction. All action alternatives would comply with Forestwide direction to:

- Provide a level of protection from wildfire that is cost efficient and will meet objectives of the management unit.
- Maintain fuel conditions that permit fire suppression forces to meet protection objectives of the management unit.
- Use preplanned prescribed fire to accomplish resource management objectives (Fire Planning and Presuppression 01; Fuel Treatment 01; Vegetation Treated by Burning 01).

This project proposes to treat Engelmann spruce with the objective to reduce the number of dead spruce in the stand that could add to the fuel loading over time.

Alternative 2 treats the fuels that are the result of harvest to reduce the potential for large wild fires. The proposed treatments may be the most cost-effective means to achieve the fuel loadings that reduce the potential for large wild land fires. The Jungle fire suppression cost were approximately 1.2 million dollars, estimated forest cost for fuels treatments for lake is between 80,000 to 110,000 dollars, (personal communication with Brandon Hoffman north Zone FMO and Daron Reynolds North Zone Fuels Specialist,). Prescribed fire is planned on 384 acres to meet management objectives. Alternative 2 should result in conditions that are within the capabilities of local fire suppression personnel.

Smoke Management

The Forest Plan (p.III-43) requires that all projects meet State and Federal air quality objectives. The State Smoke Management Plan require the State Program Coordinator to consider project size and projected emissions, proximity to Class 1 and non-attainment areas, weather conditions when issuing a burn permit and scheduling ignitions. Burn plans will be completed before prescribed fire will be allowed.

High winds are common and dispersion in mountainous terrain is typically very good. However, calm periods are possible which allow smoke or engine emissions to settle nearby and even drift down-slope towards the valleys. The prevailing wind direction is from the west towards the east, which means that the community of Price is approximately 25 miles downwind. When the winds are from the East, the communities of Fairview and Mount Pleasant are approximately 8 and 10 miles down wind.

Visibility depends on the amount of materials suspended in the air (particulates). The project area has some of the best air quality, regarding particulates and least light extinction, in the United States (USDA Forest Service, 1992a). Visibility within the project area ranges from 40 miles to 120 miles throughout much of the year. Exceptions are usually caused by dust during windstorms.

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