East Hills

Fuels and Air Quality Report

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for:

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Fremont-Winema National Forest

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Introduction

This report analyzes the proposed activities of over- and understory thinning, piling of fuels, pile burning, jackpot burning and underburning. This analysis examines how these activities could change fire behavior impacts to various resources. It also discusses the effects of these activities on air quality. In addition, this report discusses how several of the site-specific amendments to the Land and Resource Management Plan (LRMP) proposed as part of alternative 2 would affect these impacts. The proposed LRMP amendment regarding the cutting of some trees over 21” in diameter was not analyzed. For this analysis area, the difference in expected fire effects between cutting or not cutting trees over 21” was negligible. Several proposed activities are similarly not analyzed in this report. Activities related to aquatic restoration were not analyzed because the activities proposed are unlikely to have significant effect on the ignition or spread of fires in the analysis area. Activities related to road network changes were not analyzed in this report because there is not a clear correlation between recreation activity or road status and the ignition or spread of fires for this area. Some published sources have pointed to the correlation of roads to human-caused ignitions, but the conclusions of these studies has been mixed, with some pointing to increased ignition risk from increased road density and others pointing to decreased fire risk with increasing road density due to quicker emergency response time and an increased number of barriers to fire spread (Narayanaraj and Wimberley 2011,2012). For this analysis area, fires with causes that may be related to roads or recreation (those fires caused by smoking, campfires, equipment use or arson) comprise a small portion (approximately 5%) of the fire starts in the past 50 years.

Resource Indicators and Measures

For this analysis, alternatives were compared on the basis of fire resilience of the area, as measured by expected response to wildfire. This indicator addresses the Purpose and Need for the project by measuring the resilience of the analysis area to future wildfire. This indicator was chosen because it more directly addresses fire resilience than indicators related to fire behavior (i.e. flame length or crown fire activity). There are stand types within the analysis area that are adapted to be resilient to infrequent, mixed or severe fire (e.g. lodgepole stands of varying types) and wildlife that use these stands for habitat. This indicator recognizes that more severe, intense fires can be beneficial in some areas and detrimental in others. It also allows for examination of the effects of proposed activities on several concerns brought up during public scoping. In addition, the individual components of this expected outcome were examined individually. This allowed an examination of the impacts of activities on specific resources where these impacts might otherwise have been glossed over in the averaged overall expected value outcome.

It is important to note with each of these indicators, that they measure expected impacts from future fires in the analysis area and not impacts from the actions proposed under each alternative. The effects to these resources from the proposed actions are examined in the reports for each respective resource. For example, the indicator of “Expected impact on late/old seral structure” does not measure how much late/old seral structure will be left/created by the actions proposed. That information can be found in the Silviculture report. Instead, this indicator measures how resilient the late/old seral structure left (or created) by proposed actions will be to future disturbance by fire.

Table 1: Resource indicators and measures for assessing effects

Resource Element	Resource Indicator	Measure	Used to address: P/N, or key issue?
Resilience to wildfire	Expected outcomes of fire	Expected value of fire effects	Yes

Resource Element	Resource Indicator	Measure	Used to address: P/N, or key issue?
Resilience to wildfire	Expected outcomes of fire	Expected fire impacts to wildlife habitat (LOS-dependent/mortality-dependent)	Yes
Resilience to wildfire	Expected outcomes of fire	Expected impact on invasive plant populations	No
Resilience to wildfire	Expected outcomes of fire	Expected impact on infrastructure	No
Resilience to wildfire	Expected outcomes of fire	Expected impact on boundary lands	No
Resilience to wildfire	Expected outcomes of fire	Expected impact on late/old seral structure	Yes
Resilience to wildfire	Expected outcomes of fire	Expected impact on moving stand structure toward HRV	Yes

Expected value of fire effects

This indicator gives an overall expected value outcome of future wildfire effects in the analysis area. The number given is an average number across the area within the proposed project area. The number is on a scale of -100 to +100, where -100 represents very harmful outcomes and +100 indicates greatly beneficial outcomes. 0 represents a neutral outcome; neither benefit nor harm. It is an average of the expected outcomes of the various resources analyzed, which are examined individually below. It is based on the occurrence of fires throughout the area's typical fire season (May through October).

Expected fire impacts to wildlife habitat

This indicator measures the expected effects of future wildfires on two main types of wildlife habitat: habitat for those species dependent on late/old-seral structures (including, but not limited to bald eagles, northern goshawk, pileated woodpecker and white headed woodpecker) and habitat for those species dependent on high levels of tree mortality (including black-backed woodpecker and three-toed woodpecker). In many places in the analysis area, these habitats overlap and the same fire may have benefit to one type of habitat and harm the other. This indicator was chosen to address the need for the project to "Conserve, improve, and restore habitat for wildlife and botanical species." It uses the same scale as the previous indicator.

Expected impact on invasive plant populations

This indicator measures the expected outcomes of future wildfires on the spread of invasive plants. While this indicator uses the same scale as the previous indicators, it is important to note that in this case "benefit" is defined as having little or no spread of invasive plants (i.e. it is benefit to the ecosystem, not to the population of the invasive plant). While invasives were not directly addressed in the purpose and need for the project, this indicator was chosen to address a portion of the need to "Conserve, improve, and restore habitat for wildlife and botanical species." For purposes of this analysis, fire was assumed to always result in some degree of spread of invasive plants, though low fire intensities were expected to result in less spread since they typically expose less soil than higher intensities.

Expected impact on infrastructure

This indicator measures the expected impacts to infrastructure from future wildfires. For this analysis, infrastructure included structures (on federal and non-federal lands) and energy transmission lines inside the analysis area or within one quarter mile of the area. Resilience of infrastructure to future fires was not directly addressed in the purpose and need for this project, but is a desired condition as laid out in national direction (see Management Direction – Desired conditions). In addition, the need to "reintroduce fire on the landscape" was identified and infrastructure concerns can present a barrier to that reintroduction. This indicator uses the same scale as the previous indicators. Since fire was not judged to enhance infrastructure in any case, the values for this indicator run from 0 (no impact) to -100 (complete destruction).

Expected impact on boundary lands

This indicator measures potential impacts to adjacent landowners from fires on federal land. This indicator was chosen in response to concerns brought up during public scoping and because concerns about fire impacts to non-federal lands can represent a barrier to the reintroduction of fire on the landscape. Lands within one quarter mile of an adjacent non-federal landowner were analyzed. The exception to this is the boundary with the Sycan March Preserve owned by The Nature Conservancy. This boundary was not included in this indicator. The policies of the preserve and the history of cross-boundary cooperation on projects mean that this border is not judged to present such a barrier to the reintroduction of fire.

Expected impact on late/old seral structure

This indicator measures how resilient the late/old seral (LOS) structure in the analysis area is to future wildfire disturbance. This indicator was chosen to measure how well each alternative meets the purpose and need of the project to "maintain and promote development of LOS habitat consistent with the historic range of variability (HRV)."

Expected impact on moving stand structure toward HRV

This indicator measures whether future fires are likely to move the distribution of various stand structures on the landscape toward the historic range of variability (HRV) (or maintain them in that historic range). This indicator was chosen to address the needs for the project to: "Maintain and promote development of late/old seral (LOS) habitat consistent with the historic range of variability (HRV)"; "Create spatial heterogeneity within stands and across the landscape"; "Create age class diversity in climax lodgepole pine stands"; and to "Enhance and restore non-forested habitat diversity." For this indicator the amount of each stand type and stage was compared to the amount of that type in the HRV. Then, the way that each stand type and stage would be changed by fires of various intensities was determined. Finally, the change that each stand type and stage would undergo was rated on a scale of -100 (very harmful) to +100 (great benefit) based on whether that change would move the analysis area closer to or further from HRV. For example, in the "Ponderosa pine-dry" type, stands dominated by ponderosas 9"-21" DBH in a closed canopy are present on the landscape at levels far above the HRV for this type. For this stand type and stage, low-to-moderate intensity fires were judged likely to open the canopy somewhat, moving the stand into a type that present at levels far below HRV. This change was rated as very beneficial (+50 to +90 depending on fire intensity). For this same type, high intensity fires were judged likely to move the stand back to an early-seral stage , which is already present in levels similar to HRV. This would also prevent the stand moving into later-seral stages that are deficient as well. This change was rated as harmful (-20 to -80 depending on fire intensity). This method was based on a published method for vegetation condition analysis used on the Bridger-Teton National Forest (Scott et al 2014) but uses the HRV developed for the

Fremont-Winema National Forest by the Pacific Northwest Regional Ecology Office in place of the Biophysical Settings models described in that publication.

Methodology

The method used to analyze expected response to wildfire has been described by Finney (2005) and others (Calkin et al 2011, Thompson et al 2013b) and employed in a number of analyses (Scott et al 2012, Thompson et al 2013a, Scott et al 2013, Salis et al 2013). This method is outlined in the "Appendix A: Comparative Risk Assessment" section of "A National Cohesive Wildland Fire Management Strategy - Phase I Report" (USDA and USDI 2011).

A weather station was chosen that is representative of the weather across the project area. For this analysis, data from the Calimus RAWS (Remote Access Weather Station) was used. Weather records going back to 2000 were compiled and analyzed. Four moisture scenarios and 5 wind profiles from these records were chosen as representative of the range of weather conditions during the months when fires typically occur in this area. For the details of RAWS selection criteria, moisture scenarios and wind profiles, see the accompanying documents "Climatology Methods" and "Calimus Moistures." For each combination of moisture scenario and wind profile, one thousand fires were simulated in the analysis area. These simulations provided the probability that each 90m x 90m square area will burn at a given fire intensity. The effects of these fire intensities on seven resources of concern: stand structure compared to historic range of variability, late/old seral structures on the landscape, wildlife habitat (both for species dependent on late/old seral structure and those such as black backed woodpeckers that are dependent on abundant tree mortality), invasive plant species, water quality, infrastructure and adjacent non-federal lands. For each resource, a response function was generated which describes how that resource is impacted (beneficially or harmfully) by various intensities of fire. These response functions were combined with the probabilities of fire intensity to give an expected value of impact to each resource. The expected values of various resources were averaged to give an overall expected impact to these resources from fires in the analysis area.

Information Sources

Information designating fuel models was taken from LANDFIRE, then spot-checked and corrected from field observations. Several discrepancies were corrected in this way: In areas of recent large fires, LANDFIRE makes assumptions about how vegetation changes post-fire. These assumptions were incorrect in the footprint of the Lone Pine Fire. Fuel models in these areas were corrected using current imagery and field observations. LANDFIRE also classified many pine-dominated conifer stands within the analysis area as a fuel model 122 (Grass/shrub 2). This fuel model is far more sensitive to changes in live fuel moisture than these stands have been observed to be and the fuel model for these areas was adjusted based on field observations.

Information describing canopy fuels (tree crowns) was taken from plot data that measured tree stand structure. This data was used in place of LANDFIRE data because canopy data derived from satellite imagery has been observed to be less accurate in this area than field measurements, even when those measurements are imputed to other stands.

Response functions for various resources were generated by district resource specialists.

Weather data for the Calimus RAWS was acquired from the publicly-available weather data archives at http://www.wrcc.dri.edu/ .

Fire history data was obtained from several sources. Spatial data for large fires was acquired from the USDA Forest Service agency data repository. Location data for small fires was acquired from both federal records and Oregon Department of Forestry records. These two datasets have some overlap (i.e. the same fire appears in both datasets) due to the intermix of ownerships/jurisdictions in the area. The two datasets also often disagreed as to the location of particular fires, with the two sources sometimes recording fires up to a half mile apart. Where this occurred, the location specified in federal records was used.

Incomplete and Unavailable Information

All necessary information required to complete this report was available, however there is inherent uncertainty regarding the potential impacts of climate change which is addressed below.

Climate Change Consideration and Uncertainty

Climate change forecasts for the area generally indicate an increase in average and maximum temperatures both in the summer and winter of 4°-5°F by 2060. These are expected to result in an increase in the number of frost-free days each year by about 40 days by 2060. These together with an expected decrease in yearly precipitation of 2” that time are expected to result in an increase in the frequency and severity of drought which may increase bark beetle attacks, and is expected to increase the severity, size, and intensity of wildfires (Spies et al. 2010). These more extreme and longer droughts may result in more intense die offs of forests under stress (Van Mantgem et al. 2009). In preparation for the 5th annual report of the Intergovernmental Panel on Climate Change (IPCC), an updated generation of climate simulation and projection models was created. This effort was collectively labeled the Coupled Model Intercomparison Project (fifth phase) or CMIP5. The climate forecast information for this analysis comes from an ensemble of 17 climate prediction models selected by the USDA Forest Service Rocky Mountain Research Station and downscaled to 1-km resolution by the Forest Sciences Lab at Moscow, ID.

There is some uncertainty in published literature of exactly what these climate shifts may mean for future wildfires. For this analysis, potential climate changes influenced the selection of weather conditions for fire behavior modeling. For this analysis, fire modeling used a range of past observed weather conditions. The distribution of weather conditions used in modeling was altered from the historic distribution to show a slightly increased likelihood of hotter/dryer conditions.

Affected Environment

Existing Condition

Since comprehensive records began in 1950, large (generally over 10 ac) wildfires within 2 miles of the project boundary have burned just under 5,030 acres within the project area (Table 2).

Table 2: Large fire history in the East Hills vicinity

Fire Name	Fire Year	Fire Cause	Total fire size	Acres burned in project area
Taylor Butte	1968	Debris burning	89	89
Snow Course	1970	Arson	19	19
Little Butte	1974	Equipment	301	0
Riverbed Butte Spring	1974	Debris burning	46	46
Chic 2	1977	Lightning	116	116

Fire Name	Fire Year	Fire Cause	Total fire size	Acres burned in project area
Klipple Lake	1978	Debris burning	148	39
Mill Creek	1983	Miscellaneous	124	0
Frying Pan Spring	1984	Debris burning	62	62
Huck	1986	Miscellaneous	104	104
Dicks	1989	Lightning	36	36
Lone Pine	1992	Arson	29,722	4,520
Biggin	1992	Lightning	200	0
Quick	1994	Arson	1352	0
Mill Creek 97	1997	Debris burning	43	0
Ponina	1999	Equipment	17	0
Moccasin Hills	2014	Arson	2,535	0

In addition, there have also been 1,140 small fires that within the analysis area or within a 2-mile distance of the analysis area during that same time period. Approximately 5% of these were human-caused ignitions. 65% were caused by lightning. 23% did not have a recorded cause (primarily on non-federal lands). The remaining 7% had a recorded cause of "miscellaneous" which may include a variety of human-caused and natural ignitions. Fire ignitions were well distributed throughout the analysis area and no part of the analysis area is devoid of ignitions.

For the period of record, approximately 99% of fire starts have occurred under conditions mild enough to produce fire behavior that allowed the fire to be suppressed at a very small size (generally less than ¼ acre). The remaining 1% of fire starts have occurred under more extreme conditions, which produced fire spread or fire intensity too great for the fire to be caught at a small size. On the whole, this record represents far less area burned than expected, based on the historic fire regime for the area. This lack of fire, in combination with past timber harvest practices has resulted in stands that have many more trees and far fewer large, old trees. A study of forest inventory records from 1914-1922 (Hagmann et al 2013) showed the landscape of this analysis area dominated by stands with far fewer trees per acre than today, and with more large trees than currently seen. In addition, these forest inventory records showed the majority of stands in the area dominated by ponderosa pine; even those stands classified as mixed-conifer stands.

Portions of the southern end of the proposed project area were designated as wildland-urban interface (WUI) under the Klamath County Community Wildfire Protection Plan (KCCWPP). The Mid County WUI area from that plan overlaps approximately 7,600 acres of the proposed project area.

Table 3: Resource indicators and measures for the existing condition

Resource Element	Resource Indicator	Measure	Existing Condition (Alternative 1)
Resilience to wildfire	Expected outcomes of fire	Expected value of fire effects	+47 (scale of -100 to +100)
Resilience to wildfire	Expected outcomes of fire	Expected fire impacts to wildlife habitat (LOS-dependent/mortality-dependent)	+46 / -2
Resilience to wildfire	Expected outcomes of fire	Expected impact on invasive plant populations	-39
Resilience to wildfire	Expected outcomes of fire	Expected impact on infrastructure	-24
Resilience to wildfire	Expected outcomes of fire	Expected impact on boundary lands	-16
Resilience to wildfire	Expected outcomes of fire	Expected impact on late/old seral structure	+71
Resilience to wildfire	Expected outcomes of fire	Expected impact on moving stand structure toward HRV	+65

Expected value of fire effects

This indicator gives an overall expected value outcome of future wildfire effects in the analysis area. A rating of +47 on a scale from -100 to +100 indicates that, under current conditions, fires in the analysis area are expected to have moderate benefit overall. This may seem counter-intuitive given the behavior of other fires on the forest and current stand conditions. It is important to note that this rating assumes that fires occur throughout the fire season and occur under a range of conditions from mild to extreme. In contrast, the current practice in fire management is to extinguish all fires. Those which burn under more mild conditions (which typically produce the most beneficial outcomes) are nearly always extinguished. Those which burn under extreme conditions (and which typically produce the most harm/least benefit) are currently the only ones which are not extinguished.

Expected fire impacts to wildlife habitat

This indicator measures the expected effects of future wildfires on two main types of wildlife habitat. A rating of +46 for LOS-dependent species indicated moderate benefit expected from fires under current conditions. This is similar to the overall expected value of fire effects for the area and has the same caveats. A rating of -2 for mortality-dependent species indicates that fires are expected to have a nearly-neutral impact to this habitat. This suggests some low intensity fires are likely in the area (which could have negative impacts to this habitat) as well as some higher intensity ones (that would have benefit to this habitat). As noted for the previous indicator, these figures incorporate fires burning under the full range of conditions. If fires only burn under more extreme conditions, the benefit to LOS-dependent species is less likely to be seen, and by contrast, benefit to mortality-dependent species is likely to be higher.

Expected impact on invasive plant populations

This indicator measures the expected outcomes of future wildfires on the spread of invasive plants. A rating of -39 suggests that future fires in the analysis area are likely to have a moderately negative impact on invasive plants, suggesting moderate spread of these undesired species.

Expected impact on infrastructure

This indicator measures the expected impacts to infrastructure from future wildfires. A rating of -24 indicates moderate damage to infrastructure expected from future wildfires in the analysis area.

Expected impact on boundary lands

This indicator measures potential impacts to adjacent landowners from fires on federal land. A rating of -16 indicates that under current conditions, fire behavior in the areas within one quarter mile of adjacent landowners is expected to be generally low, presenting some hazard to those adjacent lands, but not at significant levels. As noted for previous indicators above, this includes fires burning under the full range of conditions. If only those burning under extreme conditions are considered, this threat is likely to be greater.

Expected impact on late/old seral structure

This indicator measures how resilient the late/old seral (LOS) structure in the analysis area is to future wildfire disturbance. A rating of +71 indicates that under current conditions, existing LOS stands are expected to benefit from fires in the analysis area. While the amount of LOS stands on the landscape are below the desired level, the stands that are there are more likely to see lower fire intensities that enhance LOS values. As noted with other indicators, this assumes that fires are burning under mild conditions as well as hot/dry ones. If the only fires allowed to burn are under more extreme conditions, the benefit to this resource is likely to be considerably less.

Expected impact on moving stand structure toward HRV

This indicator measures whether future fires are likely to move the distribution of various stand structures on the landscape toward the historic range of variability (HRV) (or maintain them in that historic range). A rating of +65 indicates that under current conditions, fires in the analysis area are likely to move the distribution of stand types/stages toward the historic range of variability. This is due primarily to an excess of stands that are more dense than were seen in HRV. This effect has been seen in ponderosa stands in the Southwest (Hunter et al 2011). These stands are likely to see fire intensities that kill enough of the standing trees to either open up the stand (to a type/stage that is currently lacking) or reset the stand to an early-seral stage. As noted with other indicators, if the only fires burning in the area are under extreme conditions, the outcomes are likely to be far less beneficial as more stands would be converted to an early-stage at the expense of later-seral stages.

Management Direction

Desired Condition

The Winema LRMP gives the short-term (10 year) desired condition as: “There will be a mosaic of residue levels as a direct result of managed timber stands and the use of prescribed fire. “ and the long-term (50 year) desired condition: “No dramatic changes in the number of acres burned by wildfire will be expected much of the Forest will have reached a near stable mosaic of residue levels as a direct result of managed timber stands and appropriate use of prescribed fire.”

The Fremont LRMP does not give a desired condition related to fire management or fuels.

The National Cohesive Wildland Fire Management Strategy (USDA and USDI 2014), developed at the direction of the Federal Land Assistance, Management and Enhancement (FLAME) Act of 2009, also gives desired conditions for fire management nationally (which includes the use of fire-related vegetation treatments):

- Restore and maintain landscapes: Landscapes across all jurisdictions are resilient to fire-related disturbances in accordance with management objectives.
- Fire-adapted communities: Human populations and infrastructure can withstand a wildfire without loss of life and property.

Environmental Consequences

Alternative 1 – No Action

Under this alternative, stand densities would continue to increase with the ingrowth of small trees. Increased competition for resources will continue to cause physiological stress that makes trees, especially large mature overstory trees, more susceptible to insects and pathogens and less resilient to wildfires. The same increased stand densities also increase the intensity of fires moving through the stand, resulting in greater loss of overstory trees. Until such time as a wildfire occurs, stands will continue to accumulate fuel in the form of dead branches, foliage and duff, since decomposition of woody material is extremely slow in the analysis area when fire is absent.

The overall effect would be for stands to become less resilient to future disturbances, especially wildfires. This would be seen in a tendency for the area to move further from its HRV. This is likely to be amplified by climatic shifts that increase competition for moisture and make conditions that produce intense fires more common.

Alternative 2 – Proposed Action

For a detailed description of the activities proposed under Alternative 2, see Chapter 2 of the DEIS.

Project Design Features and Mitigation Measures

No additional project design features related to fire/fuels are proposed as part of this alternative. Project design features to prevent or mitigate effects of prescribed fire on other resources may be found in the sections pertaining to those resources.

Direct and Indirect Effects

Thinning treatments (including overstory thinning, understory thinning and mastication) as proposed would have several direct effects.

Understory thinning treatments would increase the canopy base height (CBH) (which is the lowest height at which there is enough flammable material present in a canopy to allow fire to move upward) by killing or removing small trees and shrubs. Overstory thinning would also reduce the canopy bulk density (CBD) (a term for how much flammable material is present in the canopy of a stand) by removing some overstory trees. Taken together, these changes make it less likely that future wildfires burning through the area would consume the crowns of trees. This means stands would be more resilient to future fires. This increased resilience would last until understory trees and shrubs regrow to a height that allows fire to move into the tree canopy. For the project area, this is estimated to be a period of approximately 20 years.

These treatments would increase the amount of flammable material on the ground temporarily, which can cause fires burning in the area to produce more heat and therefore have greater impacts to vegetation and soil. There is potential for increased fire behavior in between the time that trees are removed and when surface fuels are treated with burning. There have been several cases where partially completed treatments were burned in fires. In some cases these areas burned faster and hotter than untreated areas nearby (Finney et al, 2003). In other areas the partially treated areas burned about the same as untreated areas or with lower intensities (Finney et al, 2003; Murphy et al, 2007). Since any increase in fire behavior would exist between when the removal of trees was complete and when the unit was treated with prescribed fire, it is expected to be short in duration.

These treatments would open up the canopy and understory. A more open canopy and understory can allow more wind and sunlight to reach the ground, which in turn increases temperatures, windspeed and lowers fuel moistures. If there were no treatments other than the removal of trees, this increased wind and sunlight could actually increase fire behavior in treated areas by drying out fuels and pushing fires more rapidly (van Wagtendonk, 2006; Countryman 1955). Several recent studies have measured the change in temperature and humidity that can be caused by different thinning treatments. Brooks and Kyker-Snowman (2008) measured temperature and humidity in thinned stands in Massachusetts. They found (at the greatest difference) a 1.6° C and 1.1% relative humidity difference between thinned and unthinned sites. Rambo and North (2009) measured temperatures at various heights in the canopy in understory thinning, overstory thinning, riparian and untreated areas. They found, (at the lowest heights measured) that in stands of overstory thinning, maximum summer temperatures were up to 1.2°C higher than in untreated stands. The summer minimum temperatures were 1.5°C lower in overstory-thinned stands than in untreated stands. The changes noted in these studies and others is not expected, however to have measurable impact on potential fire behavior (Bigelow and North, 2012). Increases in the amount of available light reaching the understory can also encourage the growth of grasses, forbs and shrubs. The response of shrub growth after treatments depends strongly on the water-holding capacity of the soil on which the treatment occurs (Soils report, Affected Environment).

Thinning treatments are not expected to have any measurable direct effect on air quality in the area. While thinning operations may produce vehicle emissions and fugitive dust, they are not expected to exceed the background amounts of these pollutants in the area. Normal forest use for administration, recreation, subsistence gathering, firewood gathering, or as a travel corridor also produces vehicle emissions and fugitive dust.

Prescribed fire treatments as proposed would have several direct effects.

Some vegetation would be killed during burning - especially understory forbs, grasses, shrubs and small trees. In the process of burning, a portion of this material is converted to smoke and released to the atmosphere. This would cause both a slight reduction in CBD (due to burned or scorched needles during prescribed burning) and an increase in CBH as limbs lowest to the ground are burned. On standing live trees, scorched bark and charred wood would be visible for more than 3 years after burning.

Burning would cause a decrease in flammable material on the ground. In units where prescribed burning is a part of the treatment proposed, this decrease in material is expected to more than offset any increased fire behavior from increased wind or temperature due to thinning (Agee and Skinner, 2005; Raymond and Peterson, 2005; Omi and Martinson, 2002; Weatherspoon, 1996). Prescribed burning will remove some existing snags from treated units. It will also partially or completely burn up some dead logs on the ground. This can be minimized by burning before summer, so that these large logs still have much of the moisture they absorbed over the winter. It can also be done by adjusting ignition patterns at the time of burning, or by removing fuels from around logs and snags before burning. Snags and logs that remain after burning are less likely to be burned up in any future prescribed burning or in wildfires. At the same time, prescribed burning is likely to create some standing snags, through the death of some overstory trees (as discussed above). It is also likely to create some new logs on the ground when some of the existing standing snags fall over (Harrod et al, 2009; Bagne et al, 2008; Innes et al, 2006; Stephens and Moghaddas, 2005a).

Burning would cause some soil to be exposed. From observations of prescribed burns on this forest, approximately 10% of area burned would have exposed soil, generally where logs or stumps have burned; approximately 10% of the area would remain unburned due to condition of vegetation and ground cover; and approximately 80% of the area would be partially burned, with some surface fuel consumed, but some still remaining in place often charred or blackened but still providing soil stability.

When treatments are complete in any unit, wildfires are expected to be less intense than before treatment (Stephens and Moghaddas, 2005b; Omi and Martinson, 2002; Martinson and Omi, 2003; Graham et al, 1999; Raymond and Peterson, 2005; Vaillant et al, 2009). Prescribed burning in treatment units removes some fuel in the form of leaves, branches, needles and duff from the ground. The actual amount of surface fuel or understory vegetation consumed by burning really depends on the weather conditions and fuel moistures at the time of burning. The removal of small trees and brush (through direct removal) and the removal of some low branches from large trees (through prescribed burning) reduces the chance of fires moving from the ground up into the branches of trees where it is generally more intense and kills more trees (Ritchie et al, 2007; Agee and Skinner, 2005). The removal of these low branches, combined with reducing the likely flame length of fires on the ground (so that they even less likely to reach the remaining branches) makes damage and death of the remaining trees less likely (Pollet and Omi, 2002). These effects are seen in the “Expected outcome” indicators, which measure fire resilience of various resources (Table 5 in this report).

In the absence of any further treatments or fires in the area, this reduction in fire intensity is expected to last at least 10 years. This is based on studies of how quickly leaves, needles and branches accumulate on the ground (Van Wagtendonk and Moore, 2010; Keifer et al 2006; Vaillant et al 2015) and on observations of small tree and shrub growth from other past projects on this forest.

The direct effect of prescribed burning on air quality will be a two to three day increase in emissions from smoke and a reduction in visual quality to the local airshed. This direct effect is expected with each instance of prescribed burning.

The direct effect of the proposed amendment to the Winema LRMP to allow prescribed fire treatments to be visible in scenic areas would be the treatment of 6,944 additional acres with prescribed fire that would not otherwise have been treated. These areas would receive prescribed fire treatments and see the same beneficial outcomes as other areas treated under this alternative.

The proposed treatments would also have several indirect effects. For all units, treatments are expected to have a beneficial indirect effect on immediately adjacent, untreated stands for a short distance. In case studies of the effectiveness of fuel treatments exposed to wildfires, treated units modified the behavior of fires for up to 300' beyond the unit (Murphy et al, 2007; Safford et al, 2012). In all proposed units, treatments would decrease the number of trees present in the stand, decreasing competition for light and water. Treatments would also expose some mineral soil in each unit. These have the potential to increase the growth of tree seedlings, brush and herbaceous plants in the understory. The response of shrub growth after treatments depends strongly on the water-holding capacity of the soil on which the treatment occurs (Soils report, Affected Environment).

The reduction of material on the ground, combined with increased sunlight on the ground (as described in direct effects) often results in more plants of a variety of species growing on the ground (Webster and Halpern, 2010; Schwilk et al, 2009). Ingrowth is dependent on site-specific factors, but may over time increase the potential intensity of fires in the stand, requiring retreatment with prescribed fire to maintain desired stand conditions. Fires are expected to move more slowly through treated units. Studies have shown that a number of treatment units strategically placed within a landscape can slow the growth of large fires (Finney 2001, Finney 2006). While fires are a natural and necessary part of the ecology of this area, when conditions create the potential for fires of greater intensity and size than are normal for the area, having the option to suppress or mitigate such fires will be an important part of restoring this area to a more ecologically resilient condition.

The indirect effect of prescribed burning will be a one to two day increase in the amount of particulate matter dispersed into the atmosphere. This has the potential to degrade air quality in smoke-sensitive receptor areas (Table 4 in this report). To mitigate these effects units will be burned under conditions that will move smoke away from these smoke-sensitive areas to minimize any negative impacts. These conditions will be described in a site-specific burn plan. The plan will be implemented under conditions that minimize the possibility of the burn affecting air quality in Class I airsheds or other "smoke sensitive" areas in accordance with the Oregon Smoke Management Program (OSMP). Smoke produced during prescribed burning is expected to be considerably less than would be produced by a wildfire in the same area (Huff et al 1996, Liu et al 2017)

Table 4: Smoke-sensitive areas near the project

Smoke-sensitive area	Direction from the project area	Distance from the project area
Gearhart Mountain Wilderness	East	8.4 miles
Klamath Falls	Southwest	27 miles
Lakeview	Southeast	40 miles
Sprague River Highway	Southwest	5.5 miles
U.S. Highway 140	South	5 miles

The indirect effect of the proposed amendment to the Winema LRMP to allow prescribed fire treatments to be visible in scenic areas would be to allow treatment of additional areas with prescribed fire that, while allowed, would not otherwise have been treated for logistical reasons. The boundaries of the designated Foreground and Middleground scenic areas were not delineated along features that are logical boundaries for fire (rather they are the areas within a certain distance from a roadway, or the parts of a slope that can be seen from a road). Because of this, if scenic areas cannot be treated by prescribed fire, additional adjacent areas outside those scenic designations are not treated for lack of a way to keep fire from spreading into the scenic areas.

Each of the following indicators measures how the actions proposed under this alternative will cause each resource of interest to respond differently to future wildfires (or in other words, how resilient they will to fires after completion of the actions proposed).

Table 5: Resource indicators and measures for Alternative 2

Resource Element	Resource Indicator	Measure	Alternative 2
Resilience to wildfire	Expected outcomes of fire	Expected value of fire effects	63
Resilience to wildfire	Expected outcomes of fire	Expected fire impacts to wildlife habitat (LOS-dependent/mortality-dependent)	+75 / -16
Resilience to wildfire	Expected outcomes of fire	Expected impact on invasive plant populations	-17
Resilience to wildfire	Expected outcomes of fire	Expected impact on infrastructure	-12
Resilience to wildfire	Expected outcomes of fire	Expected impact on boundary lands	-3
Resilience to wildfire	Expected outcomes of fire	Expected impact on late/old seral structure	+87
Resilience to wildfire	Expected outcomes of fire	Expected impact on moving stand structure toward HRV	+86

Expected value of fire effects

This indicator gives an overall expected value outcome of future wildfire effects in the analysis area. A rating of +63 on a scale from -100 to +100 indicates that, under current conditions, fires in the analysis area are expected to have considerable benefit overall.

Expected fire impacts to wildlife habitat

This indicator measures the expected effects of future wildfires on two main types of wildlife habitat. A rating of +75 for LOS-dependent species indicates great benefit expected from fires under current conditions. This is a significantly greater benefit than expected under current conditions. A rating of -16 for mortality-dependent species indicates that fires are expected to have a slightly negative impact to this habitat. This rating indicates slightly worse expected outcomes for this habitat type under alternative 2 than under current conditions. This is due to an overall reduction in expected fire intensities in units treated under this alternative. The recognition that treatments of the type proposed could have undesired impacts to mortality-dependent species led to a change in the design of this alternative. Several large blocks of habitat for black-backed woodpecker and other mortality-dependent species were set aside as no-treatment areas under this alternative in order to prevent adverse impacts to these species (see Wildlife report, Management Indicator Species section).

Expected impact on invasive plant populations

This indicator measures the expected outcomes of future wildfires on the spread of invasive plants. A rating of -17 suggests that future fires in the analysis area are likely to have a slightly negative impact on invasive plants, suggesting some spread of these undesired species, but less than is expected under current conditions.

Expected impact on infrastructure

This indicator measures the expected impacts to infrastructure from future wildfires. A rating of -12 indicates light to moderate damage to infrastructure expected from future wildfires in the analysis area. This is less impact than is expected under current conditions.

Expected impact on boundary lands

This indicator measures potential impacts to adjacent landowners from fires on federal land. A rating of -3 indicates that under current conditions, fire behavior in the areas within one quarter mile of adjacent landowners is expected to be generally low, presenting little hazard to those adjacent lands.

Expected impact on late/old seral structure

This indicator measures how resilient the late/old seral (LOS) structure in the analysis area is to future wildfire disturbance. A rating of +87 indicates that under current conditions, existing LOS stands are expected to benefit greatly from fires in the analysis area. This is a considerable increase in benefit over current conditions since not only are the proposed acitvities expected to result in more LOS stands (Silviculture report – Environmental Consequences) but those stands are expected to receive even greater benefit from future fires.

Expected impact on moving stand structure toward HRV

This indicator measures whether future fires are likely to move the distribution of various stand structures on the landscape toward the historic range of variability (HRV) (or maintain them in that historic range). A rating of +86 indicates that under current conditions, fires in the analysis area are likely to move the distribution of stand types/stages toward the historic range of variability. This is due primarily to proposed activities under this alternative moving stand distributions closer to HRV and producing fire intensities likely to maintain those stand distributions.

Cumulative Effects

Spatial and Temporal Context for Effects Analysis

The spatial boundary used for analyzing cumulative effects to fire behavior and fire resilience was the boundary of the proposed project area. Empirical observations of fuel treatment areas impacted by wildfires has shown that there are no measurable changes in fire intensity (and thus fire resilience) more than a few hundred feet outside treatment units (Maleki et al 2007, Ritchie et al 2007, Safford et al 2009).

The exception to this is that smoke produced from prescribed burning activities has the potential to be cumulative with that of other pollution sources. However, since burning is done in accordance with the Oregon Smoke Management Plan and in coordination with the Oregon Department of Forestry's (ODF) smoke management program, adverse cumulative effects from smoke are unlikely. ODF's smoke management program officials give or withhold clearance for the Forest Service to conduct prescribed burns on a given day, based on whether there is a potential for adverse cumulative impacts. If such adverse effects are expected, they do not allow burning. This regulatory oversight and the temporary nature of smoke make cumulative impacts that rise to the level of significance highly unlikely.

The temporal boundary used for analyzing the cumulative effects to fire behavior and movement is 10 years. This timeframe is used because changes in fire behavior that result from proposed treatments are likely to persist fully for at least 10 years. After that time, continued tree and shrub growth and accumulation of dropped needles and branches from trees will gradually reduce the effectiveness of these treatments as time passes.

Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

The collection of field data to verify and correct fuel modeling data meant that the effects of all past activities in the project area were taken into account as part of the Existing Condition for this analysis. Those past management activities (including commercial harvesting, reforestation and prescribed burning) are judged to not have any ongoing effects.

Several ongoing activities were examined for potential cumulative effects on fire intensity, fire resilience and air quality. These ongoing activities included grazing, firewood collection, and powerline right-of-way maintenance.

Since firewood cutting is generally prohibited during times of high fire danger, the interaction of this ongoing activity is mainly in the amount of fuel on the ground available to burn in a fire. Firewood cutting generally results in less large woody material on the ground (which tends to decrease fire intensity and severity) but more fine material on the ground (which can increase the rate of fire growth). The changes in amounts fuel caused by firewood cutting are expected to be of low magnitude and limited in scope. Where firewood cutting occurs within units proposed for treatment under this alternative, proposed treatments will tend to reduce fire intensity and rate of spread from what it otherwise would be, meaning that the cumulative effect of proposed project activities with fuelwood cutting would be a reduction in expected fire intensity, which is judged to be beneficial in this area.

Grazing can interact with fire potential. Grazing removes grass fuels from grazed areas. Especially in openings and meadows. Because of the fast regrowth of grasses, grazing in openings is not expected to have any meaningful interaction with activities proposed in the East Hills project. Some studies have pointed out that grazing also reduces grasses that outcompete conifer seedlings and help spread frequent low-intensity fires (Belsky and Blumenthal 1997). Currently, grasses are not prevalent in the pine stands in the area. It is expected that proposed treatments under this alternative could result in an increase in grasses throughout the project area, which although not directly addressed is considered a benefit to habitat diversity. It is also expected that the interaction of ongoing grazing activities could offset some of that increase. The cumulative effect of proposed activites with ongoing grazing would still be a more beneficial outcome than expected if proposed activities did not occur.

Maintenance activities on power transmission line right-of-ways generally include treatments to reduce the amount of vegetation under power transmission lines, which reduces the threat of damage to the lines from wildfires. Treatments are proposed under this alternative that would also occur on these right-of-ways and would also reduce threats to this infrastructure from wildfires. Since power line right-of-way maintenance is an ongoing activity and vegetation in those areas is currently kept very low, there is unlikely to be any additive effect from proposed treatments. Rather, the cumulative effect of ongoing right-of-way maintenance and proposed treatments is expected to be a maintenance of these conditions into the future.

Some indirect effects may be cumulative with other treatments outside of proposed project area. These are not ones that can be quantified, but may be considered qualitatively.

Where projects have changed the rate of fire growth through treated areas, there is the potential for a cumulative effect on fire movement across the landscape. Current models are not capable of quantifying this effect in a meaningful way. Since the treatments proposed under this alternative of the East Hills project would reduce the rate of fire growth through treated units, the cumulative effect would be to reduce the rate of fire growth across the landscape to some degree.

Where multiple projects have reduced potential fire intensity in an area, they may also have a cumulative effects of increasing the range of acceptable options for managing fires in that area. The forest-wide standards and guidelines for fire management in the Winema LRMP note that “Prescribed fire may include both planned and unplanned ignitions” (LRMP chapter 4 8-6). The forest-wide stadards and guidelines for fire management in the Fremont LRMP state “Prescribed fire will be considered for use in meeting management objectives in areas where ecological studies show that fire has played a signficant role in ecosystem development” (LRMP chapter 4) and notes (in the Glossary) that a prescribed fire is “A wildland fire burning under specified conditions which will accomplish certain planned objectives. The fire may result from ether planned or unplanned ignitions." While this is an option for fire management, it is generally not done due to social risks associated with managing unplanned ignitions. Multiple projects which reduce fire intensity and growth rate in an area may have the cumulative effects of lowering the level of this social risk.

Alternative 3

For a detailed description of the activities proposed under Alternative 3, see Chapter 2 of the DEIS.

Project Design Features and Mitigation Measures

No additional project design features related to fire/fuels are proposed as part of this alternative. Project design features to prevent or mitigate effects of prescribed fire on other resources may be found in the sections pertaining to those resources.

Direct and Indirect Effects

The direct and indirect effects of Alternative 3 are qualitatively the same as those expected of Alternative 2. The magnitudes of effects expected differ from Alternative 2 and are outlined in Table 6 of this report . The exception is that no LRMP amendments are proposed under this alternative. The direct effect of not adopting the site-specific LRMP amendments would be that for each indicator, slightly less benefit is expected under this alternative than under alternative 2, due to slightly less area being treated. The indirect effect (which is not reflected in the indicators in Table 6) of not adopting any site-specific LRMP amendments would be that larger areas would go untreated by prescribed fire treatments due to logistical constraints. Prescribed burning requires the use of existing or created barriers to contain fires within the desired area. While containment lines can be created specifically for prescribed burning, this is more impactful than using existing barriers because these lines expose mineral soil. Use of existing barriers is also more efficient and cost-effective. Since the boundaries of the untreated scenic areas are arbitrarily bounded and seldom aligned with logical prescribed fire boundaries (such as roads, ridgelines and waterways), these would necessitate construction of lengthy containment lines or, more likely, result in units adjacent to scenic areas remaining untreated.

Table 6: Resource indicators and measures for Alternative 3

Resource Element	Resource Indicator	Measure	Alternative 3
Resilience to wildfire	Expected outcomes of fire	Expected value of fire effects	62
Resilience to wildfire	Expected outcomes of fire	Expected fire impacts to wildlife habitat (LOS-dependent/mortality-dependent)	+74 / -16
Resilience to wildfire	Expected outcomes of fire	Expected impact on invasive plant populations	-17
Resilience to wildfire	Expected outcomes of fire	Expected impact on infrastructure	-12
Resilience to wildfire	Expected outcomes of fire	Expected impact on boundary lands	-4
Resilience to wildfire	Expected outcomes of fire	Expected impact on late/old seral structure	+86
Resilience to wildfire	Expected outcomes of fire	Expected impact on moving stand structure toward HRV	+85

Expected value of fire effects

This indicator gives an overall expected value outcome of future wildfire effects in the analysis area. A rating of +62 on a scale from -100 to +100 indicates that, under current conditions, fires in the analysis area are expected to have considerable benefit overall.

Expected fire impacts to wildlife habitat

This indicator measures the expected effects of future wildfires on two main types of wildlife habitat. A rating of +74 for LOS-dependent species indicates great benefit expected from fires under current conditions. This is a significantly greater benefit than expected under current conditions and just slightly less than expected for alternative 2. A rating of -16 for mortality-dependent species indicates that fires are expected to have a slightly negative impact to this habitat. As with alternative 2, a recognition that treatments of the type proposed could have undesired impacts to mortality-dependent species led to a change in the design of this alternative. Several large blocks of habitat for black-backed woodpecker and other mortality-dependent species were set aside as no-treatment areas under this alternative in order to prevent adverse impacts to these species (see Wildlife report, Management Indicator Species section).

Expected impact on invasive plant populations

This indicator measures the expected outcomes of future wildfires on the spread of invasive plants. A rating of -17 suggests that future fires in the analysis area are likely to have a slightly negative impact on invasive plants, suggesting some spread of these undesired species, but less than is expected under current conditions.

Expected impact on infrastructure

This indicator measures the expected impacts to infrastructure from future wildfires. A rating of -12 indicates light to moderate damage to infrastructure expected from future wildfires in the analysis area. This is less impact than is expected under current conditions.

Expected impact on boundary lands

This indicator measures potential impacts to adjacent landowners from fires on federal land. A rating of -4 indicates that under current conditions, fire behavior in the areas within one quarter mile of adjacent landowners is expected to be generally low, presenting little hazard to those adjacent lands. This rating is just slightly worse than that of alternative 2.

Expected impact on late/old seral structure

This indicator measures how resilient the late/old seral (LOS) structure in the analysis area is to future wildfire disturbance. A rating of +86 indicates that under current conditions, existing LOS stands are expected to benefit greatly from fires in the analysis area. This is a considerable increase in benefit over current conditions and just slightly less benefit than is expected from Alternative 2.

Expected impact on moving stand structure toward HRV

This indicator measures whether future fires are likely to move the distribution of various stand structures on the landscape toward the historic range of variability (HRV) (or maintain them in that historic range). A rating of +85 indicates that under current conditions, fires in the analysis area are likely to move the distribution of stand types/stages toward the historic range of variability. This is due primarily to proposed activities under this alternative moving stand distributions closer to HRV and producing fire intensities likely to maintain those stand distributions.

Cumulative Effects

Spatial and Temporal Context for Effects Analysis

Spatial and temporal bounds for cumulative effects analysis of Alternative 3 are the same as those defined and described for Alternative 2.

Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

For the activities proposed under this alternative, the list of projects with the potential to have cumulative effects, and the qualitative nature of those effects is the same as discussed for Alternative 2.

Regulatory Framework

Land and Resource Management Plan - Winema

The Winema National Forest Land and Resource Management Plan (LRMP) provides standards and guidelines for fire protection and prescribed fire on those lands formerly designated as the Winema National Forest.

Air Quality

- Management activities shall be planned to maintain air quality at a level adequate for the protection and use of the national forest resources and to meet or to exceed applicable Federal and State standards and regulations (36 CFR 219.27[a][12]).
- The Forest shall coordinate with the appropriate air quality regulatory agencies. Prescribed burning operations shall comply with the procedures identified in the Smoke Management Operations Plan (Oregon State Forestry Directive 1-4-1-601).
- The best available predictive methods and models and the most cost efficient technology should be used to minimize the impact of prescribed burning on smoke-sensitive areas and designated Federal Class I areas.

Fire Management

- All wildfires shall receive an appropriate suppression response. The response shall be safe, timely, and cost efficient and shall meet management objectives for the area, including objectives for plant and animal diversity.
- Using the lowest cost suppression option, aggressive suppression action shall be applied to control and extinguish wildfires that threaten life, private properly, public safety, improvements, or investments
- Prescribed fire may be used in natural fuels: to reduce fire hazard; to enhance diversity in the structure and composition of plant communities: to enhance the production and protection of commercial timber yields: and to enhance other resource outputs such as wildlife habitat, forage, and browse. Prescribed fire may include both planned and unplanned ignitions.
- Fuel treatments shall conform with all Federal and State standards and regulations for air quality.
- Prescribed fire prescriptions shall be consistent with management area objectives.

Range Improvements

- Fire may be used as a tool to maintain or enhance forage production. Fire also may be used as a tool to control the encroachment of non-meadow vegetation.

Management Area

The Winema LRMP gives management area-specific direction related to fire/fuels for the following management areas. Not all management areas have direction specific to fire/fuels; only those that do are listed here.

MA 02 - Developed recreation

- Fuel treatment methods that minimize adverse effects like removal and chipping shall be used within developments. Treatment normally would occur during non-use or low-use periods.

MA 03A – Scenic management, Foreground retention

- Evidence of management activities from projects that produce slash (tree harvest) or charred bark (underburning) will not be noticeable one year after the work has been completed. (NOTE: In order for Alternative 2 to comply with the LRMP, the standards and guidelines for this management area must be amended as proposed).
- Harvest residues resulting from management activities should not be evident after residues treatment.

MA 03B – Scenic management, Foreground partial retention

- Evidence of management activities from projects that produce slash (tree harvest) or charred bark (underburning) should not be noticeable from two to three years after the work has been completed. (NOTE: In order for Alternative 2 to comply with the LRMP, the standards and guidelines for this management area must be amended as proposed).
- Harvest residues resulting from stand management activities may be evident but should blend, where possible, with the surrounding landscape characteristics.

MA 05 – Sycan National Wild and Scenic River

- Prescribed fire may be used to reduce hazardous fuel accumulations or to meet other resource objectives. Burning prescriptions will be consistent with management area objectives.
- Fuel treatment methods that minimize the use of heavy equipment shall be favored.

MA 08A – Riparian Areas Adjacent to Class I, II and III Streams

- Fuels shall be disposed of so that they will not reach stream courses. Slash piles shall not be located within the normal high-water flow area of either natural or created drainages.
- Only low intensity fire should be prescribed within 100 feet horizontal distance on either side of class I, II and III stream channels.

MA 08C – Moist and Wet Meadows

- Prescribed fire may be used as a tool to limit conifer encroachment on moist and wet meadows but shall be done under conditions such that reduction of organic peaty deposits does not occur.

MA 15 – Upper Williamson

- In areas along roads, wood residues from stand management activities may be present in low levels, such as an occasional large down log and scattered branches that appear natural. Slash should be piled and burned in areas of low visibility, and low impact methods should be used. Uprooted stumps are not desirable, and should be removed unless they are blended to appear natural in the landscape.

Land and Resource Management Plan - Fremont

The Fremont National Forest Land and Resource Management Plan (LRMP) provides standards and guidelines for fire protection and prescribed fire on those lands formerly designated as the Fremont National Forest.

Air Quality:

- The Forest will demonstrate reasonable progress in reducing Total Suspended Particulates (TSP) from prescribed burning.
- Planned prescribed burning ignitions which might adversely affect visibility in the Gearhart Mountain Wilderness (a Class I area) will be scheduled to avoid high use periods (Fourth of July through Labor Day) and holiday weekends, such as Memorial Day.
- Planned prescribed burning ignitions will be scheduled when weather conditions are favorable to quick smoke dispersion away from populated and Class I areas.

Protection (These same standards appear in the guidelines for Fire Management):

- Provide and execute a fire protection and fire use program that is cost-efficient, and responsive to land and resource management goals and objectives.
- All wildfire will receive an appropriate suppression response, utilizing a strategy of confine, contain, or control.
- Wildfires that threaten life, property, public safety, improvements, or investments will receive aggressive suppression action using a control strategy.
- Prescribed fire will be considered for use in meeting management objectives in areas where ecological studies show that fire has played a signficant role in ecosystem development.

Range Improvements

- Fire may be used as a tool to maintain or enhance forage production. Fire also may be used as a tool to control the encroachment of non-meadow vegetation.

Timber Management:

- Fuel treatment in ponderosa pine stands should usually be limited to prescribed underburning.
- Fuel treatment of pine-associated precommercial thinning slash, where more than 15 percent of the trees per acre are white fir, will not be treated by underburning.

Wildlife Management – Mule deer summer and transition range

- Where shrubs are park of the plant community wthin summer range, 10 to 20 percent of each project unit should be retained in shrubs to naturally restock the area Where shrubs are part of the plant community within transition range, 30 to 40 percent of each project unit should be retained in shrubs to naturally restock the area.
- Habitat improvement may include any of the following techniques after evaluation of effects on habitat and nontarget species is completed: seeding or planting desirable plants, including trees; fertilization; prescribed burning; mechanical ground and vegetative disturbance; treatment of undesirable plants; or water developments

Wildlife Management – Other special habitats

- Rio Grande turkey - Prescribed burning or natural fuels reduction should be restricted in known nesting areas from March 15 to May 15.

Recreational management – Dispersed recreation sites

- Slash or logging debris shall not exceed three tons per acre in the immediate foreground area. Protect sites from broadcast burning. Operational Consideration: Prescribed burning is acceptable only to reduce fuel loading or buildup.

Management Area

The Fremont LRMP gives management area-specific direction related to fire/fuels for the following management areas. Not all management areas have direction specific to fire/fuels; only those that do are listed here.

MA 1 – Mule deer winter range

- Where forage improvement or other resource management activlies not directly associated with manipulation of the tree stands (crushing and prescribed burning) are planned, treated acres will include unmanipulated islands. These islands should be 10 to 30 acres in size and not more than 600 feet apart.

MA 2 – Endangered and Threatened species – Bald Eagles

- Bald eagle management areas are highest priority for wildfire suppression if potential for damage to habitat is high.
- Fuel treatment by fire for bald eagle areas will take place only if objectives for treatment would benefit bald eagle habitat.
- Fuel treatment by fire around active nest sites will take place outside nesting season (March 1 to July 15) if fire activities and smoke would affect nesting eagles.

MA 2 – Endangered and Threatened species – Peregrine Falcon

- Fuels management activities (including fuels treatment) will be evaluated for effect on nesting peregrines or hack sites.

MA 3 – Dedicated Old-growth (These guidelines are the same for MA 14)

- Natural fuels management will take place in old growth areas only to meet old growth habitat objectives.

MA 5 – Timber and Range Production

- Timber harvest, fuels treatment, and site preparation activities should strive not to damage residual trees.

MA 6 – Scenic Viewsheds (All intensities)

- Land uses within the viewshed corridor must be in parity with the visual objectives of retention and partial retention. This includes treatment of wildfire and prescribed burns as directed in USDA Handbook 608 (National Forest Landscape Management, Volume 2, Chapter 6, Fire).

MA 13 – Developed Recreation

- Prescribed fire is permitted only under an approved vegetative management plan. Operational Consideration: Prescribe burn before or after season of use.

MA 14 – Old Growth Habitat to Provide Management Requirements for Dependent Species

- Natural fuels management will take place in old-growth areas only to meet old-growth habitat objectives.

MA 15 – Riparian

- Use of prescribed fire will be limited to burning of activity fuels located in the upland portion of the SMU and burning of natural fuels for the purpose of enhancing riparian dependant values.

Special Area Designations

Portions of the Sycan River within the proposed project area are designated as Wild and Scenic. In addition to the LRMP guidelines for this area, the Forest Service Manual gives direction for this area related to fire and fuels management (FSM 2354.42n):

- Conduct fire management activities so as to minimize landscape alteration and land disturbance, but otherwise manage fire in a manner compatible with adjacent National Forest System lands.

- Prescribed fire may be utilized to maintain environmental conditions or to meet objectives specified in the river management plan.

Federal Law

Clean Air Act as amended 1977 and 1990

42 U.S.C. 7401, 7418, 7470. 7472, 7474, 7475, 7491, 7506, 7602. Establishes a national goal to prevent any future, and remedy existing, visibility impairment in certain wilderness areas the Forest Service manages. It also directs the Forest Service as a Federal land manager to protect air quality related values from man-made air pollution in these same areas. Lastly, it obligates the Forest Service to comply with the Act's many provisions regarding abatement of air pollution to the same extent as any private person. In compliance with the Clean Air Act, the Forest Service is operating under the Oregon Administrative Rule OAR 629-43-043. The Forest Service is complying and will continue to comply with the requirements of the Oregon Smoke Management Program (OSMP) which is administered by the Oregon Department of Forestry. The Environmental Protection Agency has approved the OSMP as meeting the requirements of the Clean Air Act, as amended. See the following section on State and Local Law for a description of the permits through which this project will comply with the Clean Air Act.

State and Local Law

Burn Permit –County Air Pollution Control District

The Fremont-Winema National Forest complies and coordinates with appropriate air quality regulating agencies such as the Oregon Department of Environmental Quality. In compliance with the Clean Air Act, the Forest Service is operating under the Oregon Administrative Rule (OAR) 629-43-043. The Forest Service is complying and will continue to comply with the requirements of the Oregon Smoke Management Program (OSMP), which is administered by the Oregon Department of Forestry.

Other Guidance or Recommendations

Klamath County Community Wildfire Protection Plan

In 2007, the Klamath County commissioners approved an update to the Klamath County Community Wildfire Protection Plan (KCCWPP). This plan incorporates several existing community wildfire protection plans (CWPP's) and addresses several areas which were not covered in previously existing CWPP's. This plan gives (among other things) recommendations for federal actions on agency lands. The KCCWPP designates WUI areas in the county and outlines recommended priorities for treatments intended to reduce fire hazard in those WUI areas. The first two priorities are for treatments on private lands, and are outside the scope of the decision for this project. Priority #3 in that plan is for treatment of "Wildland areas around communities with a final [WUI hazard] rating of 'high'..." (KCCWPP 2007). The communities listed in the KCCWPP with a rating of "high" included the Mid County area within the East Hills project area boundary. An updated version of this CWPP is undergoing review at this time. The areas designated as WUI within the East Hills project area in that draft are unchanged. The recommended priorities for treatments to reduce fire hazard are unchanged in that draft. As this updated CWPP is in draft form, these items could change in the final version.

The National Cohesive Wildland Fire Management Strategy

In 2009, Congress passed the Federal Land Assistance, Management and Enhancement (FLAME) Act as part of the 2010 Department of the Interior, Environment and Related Agencies Appropriations Act. It required (among other things) that the Secretaries of Agriculture and the Interior produce a cohesive strategy for wildfire management. This strategy, known as the National Cohesive Wildland Fire Management Strategy was formed with the vision "To safely and effectively extinguish fire when needed; use fire where allowable; manage our natural resources; and, as a Nation, live with wildland fire" (USDA and USDI 2014). This strategy gives guidelines for planning and prioritizing projects with the goals described in the Desired Conditions section of this report.

Other Relevant Mandatory Disclosures

Compliance with LRMP and Other Relevant Laws, Regulations, Policies and Plans

Each alternative considered complies fully with relevant law, regulation and policy. Some alternatives may move closer to desired conditions in the Winema and Fremont LRMP's than others. Alternative 2 would not comply with the Winema and Fremont LRMPs as they currently stand. With the adoption of the project-specific amendments to the LRMPs proposed in Alternative 2, all alternatives would comply with the standards and guidelines of the LRMPs as amended.

Short-term Uses and Long-term Productivity

No tradeoff between short-term uses related to fire/fuels issues and long-term productivity is expected for this project. For this area, resilience to disturbance (especially fire) is a key part of long-term productivity. As such, for each alternative the indicators used can be considered surrogates for expected long-term productivity, which would be improved under alternatives 2 and 3.

Unavoidable Adverse Effects

No unavoidable adverse effects are expected related to fire, fuels or air quality resources with any alternative analyzed.

Irreversible and Irretrievable Commitments of Resources

No irretrievable or irreversible commitment of resources realted to fire, fuels or air quality is expected with any alternative analyzed.

Required Monitoring

No additional monitoring related to fire, fuels or air quality is required as part of this proposed project. . Some monitoring requirements are imposed by other regulation or policy. For example, monitoring of post-fire effects is required by agency policy whenever a wildfire burns through an area treated to reduce fire hazard (Forest Service Manual 5144) and monitoring of smoke dispersal during prescribed burning may be a condition of a smoke permit from the Oregon Department of Forestry.

Degree to Which the Purpose and Need for Action is Met

Each of the action alternatives (i.e. Alternatives 2 and 3) analyzed meets the purpose and need for the project, albeit to varying degrees. In terms of resource indicators related to fire/fuels, alternative 2 meets the purpose and need to the greatest degree. For these indicators, alternative 3 meets the purpose and need for the project to very nearly the same degree as alternative 2.

Table 7: Summary comparison of how the alternatives address the Purpose and Need

Purpose and Need	Indicator/Measure	Alt 1	Alt 2	Alt 3
Resilience to Wildfire	Expected value of fire effects	+47	+63	+62
Resilience to Wildfire	Expected fire impacts to wildlife habitat (LOS dependent/mortality dependent)	+46/-2	+75/-16	+74/-16
Resilience to Wildfire	Expected impact on invasive plant populations	-39	-17	-17
Resilience to Wildfire	Expected impact on infrastructure	-24	-12	-12
Resilience to Wildfire	Expected impact on boundary lands	-16	-3	-4
Resilience to Wildfire	Expected impacts to late/old seral structure	+71	+87	+86
Resilience to Wildfire	Expected impact on moving stand structure toward HRV	+65	+86	+85

Degree to Which the Alternatives Address the Issues

Table 8:Summary comparison of how the alternatives address the key issues

Issue	Indicator/Measure	Alt 1	Alt 2	Alt 3
Maintain/promote late/old seral stand structure	Expected impacts to late/old seral structure	+71	+87	+86

Summary of Environmental Effects

Table 9: Summary comparison of environmental effects to fire resilience of resources

Resource Element	Indicator/Measure	Alt 1	Alt 2	Alt 3
Resilience to Wildfire	Expected value of fire effects	Overall expected value of fire effects is moderately beneficial. This assumes that fires burn throughout the range of conditions – actual current practice is to suppress fires that are most likely to be beneficial. Observed value of fire effects is consequently significantly less.	Overall expected value of fire effects is strongly beneficial, with positive outcomes even under weather conditions that would produce undesired effects in current conditions. The realized value of effects will be lower (as in alternative 1) if fires only burn under conditions that preclude suppression.	Overall expected value of fire effects is strongly beneficial, similar to but less than in alternative 2. The same caveats apply.
Resilience to Wildfire	Expected impact to wildlife habitat (LOS dependent/mortality dependent)	Impact from fire is expected to be moderately beneficial to LOS-dependent species and neutral to species dependent on tree mortality.	Impact from fire is expected to be strongly beneficial to habitat for LOS-dependent species.General reduction in fire intensities maintains and promotes these habitats. Impacts from fire are expected to reduce the overall amount/quality of habitat for species dependent on high levels of tree mortality, but because of no-treatment areas, are not expected to cause an adverse effect.	Impact from fire is expected to be strongly beneficial to habitat for LOS-dependent species, though less than in alternative 2. General reduction in fire intensities maintains and promotes these habitats. Impacts from fire are expected to reduce the overall amount/quality of habitat for species dependent on high levels of tree mortality, but because of no-treatment areas, are not expected to cause an adverse effect.
Resilience to Wildfire	Expected impacts to invasive plant populations	Future fires are expected to expose some soil in the area of known invasive weed populations, resulting in a moderately negative outcome, in the form of expanded populations of invasives.	Future fires are expected to expose less soil in the areas of known invasive weed populations. Expected result is less expansion of those populations than under existing conditions.	Future fires are expected to expose less soil in the areas of known invasive weed populations. Expected result is less expansion of those populations than under existing conditions. Results similar to those under alternative 2.
Resilience to Wildfire	Expected impacts to infrastructure	Fire impacts are expected to cause moderate damage to infrastructure within the analysis area, resulting in moderately negative outcomes.	Fire impacts to infrastructure are expected to be considerably reduced under this alternative, though not eliminated entirely.	Fire impacts to infrastructure are expected to be considerably reduced under this alternative, though not eliminated entirely.

Resource Element	Indicator/Measure	Alt 1	Alt 2	Alt 3
Resilience to Wildfire	Expected impacts to boundary lands	Fire impacts are expected to be somewhat negative (-16/100), suggesting that fires on Forest Service land bordering other ownerships is expected to be generally low-intensity. As noted for the first indicator above, if fires are only burning under extreme conditions, considerably worse outcomes can be expected	Only very slightly negative fire impacts are expected, suggesting that under a wide range of conditions, fire intensites near property boundaries are expected to be low.	Only very slightly negative fire impacts are expected, suggesting that under a wide range of conditions, fire intensites near property boundaries are expected to be low. There is slightly less reduction in impacts to these lands expected under this alternative than under alternative 2.
Resilience to Wildfire	Expected impacts to late/old seral stand structure	Fire impacts are expected to be very beneficial to late/old seral structure under current conditions. As noted with other indicators however, this assumes fires burning under a range of conditions including mild ones. If fires only burn under extreme conditions, significantly less benefit would be expected.	Fire impacts are expected to be strongly beneficial to the maintenance of late/old seral structure; more so than under current conditions. This is due to lower expected fire intensities at a wider range of weather conditions under this alternative.	Fire impacts are expected to be strongly beneficial to the maintenance of late/old seral structure, though less beneficial than under alternative 2. This is due to lower expected fire intensities at a wider range of weather conditions under this alternative.
Resilience to Wildfire	Expected impacts on moving stands toward HRV	Fire impacts over the full range of burning conditions are expected to help move stands toward HRV under current conditions. For current conditions this is due to expected fire intensities that will either open up (overrepresented) dense stands into (underrepresented) open stands, or will mid-seral and mature dense stands into early-seral open conditions. This helps make up for existing deficiencies in early tree-less areas, but does not address lack of open mature stands in the area.	Fire impacts are expected to move stands closer to HRV and maintain them in that range. For this alternative this is largely due to proposed treatments moving stands into this range and lower expected fire intensities that are expected to maintain them there. This has the benefit of also making stands able to develop into more open stands dominated by large trees, a type that is currently scarce on the landscape.	Fire impacts are expected to move stands closer to HRV and maintain them in that range. The benefit from this alternative for this indicator is less than for alternative 2. For this alternative, benefits are due to proposed treatments moving stands into this range and lower expected fire intensities that are expected to maintain them there. This has the benefit of also making stands able to develop into more open stands dominated by large trees, a type that is currently scarce on the landscape

Acronyms

CBD – Canopy Bulk Density

CBH – Canopy Base Height

CFR – Code of Federal Regulations

CMIP5 – Coupled Model Intercomparison Project, 5th phase

CWPP – Community Wildfire Protection Plan

HRV – Historic Range of Variability

IPCC – Intergovernmental Panel on Climate Change

KCCWPP – Klamath County Community Wildfire Protection Plan

LOS – Late/Old Seral structure

LRMP – Land and Resource Management Plan

MA – Management Area

OAR – Oregon Administrative Rule

OSMP – Oregon Smoke Management Program

RAWS – Remote Access Weather Station

SMU – Streamside Management Unit

TSP – Total Suspended Particulates

WUI – Wildland/Urban Interface

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