Fire and Fuels Analysis
for
Bridge Thin EA
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I. Introduction

This document describes the Fire and Fuels direct, indirect and cumulative effects for the Bridge Thin EA Proposed Actions on the McKenzie River Ranger District, Willamette National Forest. The Bridge Thin EA Purpose and Need describes improving stand conditions in terms of species composition, density, and structure over the long term in previously managed stands up to 80 years of age and in fire regenerated stands generally up to 120 years of age. The amended Willamette Forest Plan includes goals and objectives for managing stands with silviculture techniques to maintain stand health and vigor and provide multiple use benefits, moving the project area toward the desired future conditions. Therefore, actions are needed within the project area that would:

- Restore structural diversity in stem exclusion stands to enhance wildlife habitat;
- Accelerate late-successional conditions for stands within riparian reserves;
- Restore “open oak savannah” stands where they were historically present;
- Restore degraded roads infra structure;
- Protect and maintain water quality and reduce hazardous fuel levels in the watershed for communities in the wildland-urban interface;
- Improve the role of fire as a natural disturbance process in the ecosystem.

The Purpose and Need list specific actions to be evaluated for fire and fuels. This document will express the direct, indirect and cumulative effects from the following actions:

- Manage activity-created and natural fuels by underburning, machine piling, hand piling, and broadcast burning, to restore historical fire regime processes and to meet the Forest Plan Standards;
- Treat areas to improve defensible space within the wildland urban interface.

One non-significant issue that relates to fire and fuels in Bridge Thin Project Area is based on Wildland Urban Interface (WUI) and the Lane County Community Wildfire Protection Plan (CWPP). The Bridge Thin Project Area surrounds private land along the McKenzie River, the town of Blue River, the development of Rainbow, and several groups of homes and structures. These areas are considered WUI and because they are in Lane County, they are part of the Lane County CWPP. This CWPP was developed in 2005 by the Oregon Natural Hazards Resource Committee and adopted by Lane County. The implementation of this plan has not begun in all communities in Lane County yet the locations of Bridge Thin treatments coincide with the WUI and will be discussed.

Global climate change is another non-significant issue that involves fire and fuels. Forests are considered sinks for carbon and many references refer to the potential of large wildfires to be detrimental to our global climate (JFSP, 2007). The scale of analysis is large for climate change and many of the factors are still being researched and evaluated. The reduction of hazardous fuels and the reintroduction of fire help reduce the severity or size of future wildfires which could aid in reducing the combustion of sequestered carbon in trees.

II. Summary

This analysis shows the direct, indirect, and cumulative effects of using prescribed fire and reducing hazardous fuels. The use of prescribed fire will aid in returning the disturbance process historically present in this ecosystem. Additionally, this analysis explains how the fuels treatments (reducing fuels) through underburning, piling and burning, or chipping following commercial harvests will reduce the potential for wildfire effects in and near the area treated. Fuels treatments will reduce the hazardous fuels on the vertical and horizontal profile at the stand level and across the project area, thus reducing the potential wildfire severity. Additionally, underburns or fuels treatments are proposed in units that receive no commercial harvest. These units are located in the Wildland Urban Interface (WUI) and aim to provide safety for firefighters and support protection of structures during potential wildfires. Fuels treatments will meet Forest Plan Standard and Guidelines to reduce hazardous fuel loading while meeting air quality regulations.

III. Regulatory Framework / Management Direction

1. Willamette National Forest Land and Resource Management Plan (Forest Plan) FEIS and Record of Decision (ROD) establishes Management Standards and Guidelines (S&G) for treatment, maintenance, or reduction of hazardous fuels to achieve the desired future condition.
2. The Oregon Smoke Management Plan and the State Implementation Plan regulate the standards set by the 1990 Clean Air Act and 1977 Clean Air Act and its amendments. The Willamette National Forest closely follows this plan to maintain air quality standards during prescribed fire treatments and wildfire.
3. Wilderness Act established policies in the Forest Plan for reducing particulate matter intrusions from July 1 – September 30 each year. These S&G are managed in prescribed fire planning to reduce intrusions into the Wilderness especially during this time frame and work with Smoke Management Forecasters prior to burning.
4. The National Fire Plan (NFP), developed in August 2000, identifies five key points and two apply to this project: *Key point 3 – Hazardous Fuel Reduction* and *Key point 4 – Providing Community Assistance.*
5. McKenzie River Ranger District follows The Northwest Oregon Fire Management Plan – an interagency plan established to provide additional guidelines for prescribed and wildfire activities.
6. A detailed, nationally approved Interagency Prescribed Fire Burn Plan is a requirement for any activity involving prescribed fire. This plan identifies management objectives specific to the Forest Plan, details about the stand to be burned, prescription parameters, contingency, safety hazards and mitigations, and public notification. The District or Forest Line Office is required to sign and approve the burn plans before implementation.

IV. Sequential flow of information and analysis

The McKenzie River Ranger District Interdisciplinary Team (IDT) identified and analyzed the Purpose and Need and Proposed Actions. Information from the IDT was used to suppport modeling and analysis for predicted fuel loading. Fire behavior, Fire

Regime Condition Class, changes in WUI areas, and air quality particulate emissions were then calculated using models at large and project level scales.

V. Desired Future Conditions (DFC)

Forest Plan Standards and Guides (S&G) establish levels of allowable woody material following timber harvest. Two specific guidelines related to fire and fuels are Forest Wide (FW) 212 and 252 which state 7-11 tons/acre of 0-3" diameter fuels in stands post-harvest. These guidelines are to enable better control of wildfire, performed safely by firefighters, because the conditions limit flame length and thus fire behavior. The DFC in the Bridge Thin Project Area also aims to return the natural role of fire as a disturbance process on the landscape. Over time implementing proposed fuels treatments, especially underburns will make steps toward changing Fire Regime Condition Class (FRCC) from FRCC 2 to a desired FRCC 1.The desired condition of the Oregon white oak (*Quercus garryana*) proposes to reduce the encroaching conifers in the area through prescribed fire underburns. This fuel treatment will aid in allowing shade intolerant oak to grow unhindered by more rapid growing conifer trees. Underburns in the oak should continue over time to maintain the historical conditions of this unique and rare habitat.

VI. Analysis Methods

For terminology and descriptions please refer to Attachment F1.

A. Models and Data

The following is a list of models and analysis techniques used for this report:

- ArcMap/GIS – program to utilize spatial data for fuel models, vegetation, FRCC, alternatives, etc. Data was gathered on the ground or from Willamette NF, FSVeg, LANDFIRE, and NW Oregon FRCC corporate GIS layers.
- BehavePlus 3.0 – program to determine a range of fire behavior characteristics including surface fire and passive or active crown fire to show how desired treatments change or reduce the intensity and severity of wildfire; change or reduce the effects from wildfire.
- Fire Behavior Prediction System Fuel Models (FBPS) – photo and data reference for quantifying fuel types.
- Fire Regime Condition Class (FRCC) – Northwest Oregon GIS coverage (from LANDFIRE) that determines stand characteristics and historical/current fire regimes. The current vegetation is from a combination of GIS vegetation queries, aerial photos, and local knowledge.
- FOFEM – program used to determine the range of fire effects, including effects on soil, trees mortality, smoke emissions, etc.
- LANDFIRE – Nationally consistent data of fuel models, FRCC, etc. that can be altered to fit a particular area.
- Photo Series for Natural Forest Residue for PNW– used to identify current fuel loading in Bridge Thin Project Area. (Maxwell, et.al. 1980). Forty new fuel models are also available (Scott and Burgan 2005) but this analysis used the Standard 13.

- PredictDAS – local spreadsheet formulated by Darryl Ashcraft, a retired FS employee, using calculations from Handbook to Predicting Residue Weights of Pacific Northwest Conifers (Snell & Brown 1980) to predict post-harvest fuel loading.

B. Basis for characterizing conditions

Fuel loading on the vertical and horizontal profile is the basis for characterizing the fire behavior across the landscape. Fire behavior is analyzed at the stand level and expanded across the landscape based on topography, weather, and fuels. Changes in FRCC show the reintroduction of fire as a disturbance process across the landscape. The stratum FRCC allows for fire to be evaluated across an area it may naturally occur (without suppression efforts). Stratum FRCC is evaluated first and then stand FRCC is evaluated more at a field level using relationships between current seral stages. Stand FRCC allows assessment of treatments at a specific level so that proposed treatment can be evaluated at the smaller scale (Kertis et al. 2007 and Hann et al. 2001). WUI areas are defined more intricately at the field level due to locations of structures but GIS mapping was done to show a WUI boundary that extends from the structure 1.5 miles out (Silvis, website). Air quality measures are based on particulate matter emissions during the fuels treatments and potential intrusions into populated areas or Wilderness.

C. Basis for evaluating effects

The key measures used to analyze fire and fuels effects are: fuel loading in 1, 10, and 100 hour fuels size classes, crown base height (CBH), and fuel continuity horizontally and vertically across the landscape. Measurement criteria are consistent with the Forest Plan S&G. For pre-harvest fuel loading photo series were used to identify tonnage of fuel currently in each stand. For post-harvest fuel loading silviculture stand exams were used with the *PredictDAS* spreadsheet to identify potential fuel loadings. Prior to fuels treatments fuels will be identified on the ground using transects and/or photo series to gather specific fuel loading. Air quality analysis was based on the guidelines the Willamette NF follows. Particulate matter (PM) was evaluated with the potential fuel loadings post harvest. Prior to work on the ground PM will again be modeled to assure compliance with Air Quality regulations.

D. Scale of Analysis

This report identifies direct, indirect effects within the proposed treatment areas of 2,518 acres. The cumulative effects are analyzed the Bridge Thin Project Area of 20,657 acres. The project lies within the Quartz/Minor Watershed, a subwatershed in the Upper McKenzie River Watershed. Specific field data within the Project Area was gathered as stated above. Models were used that included project data and data from the large landscape level due to the nature of fire as a disturbance and how it moves across the landscape. To identify specific effects of fuels treatments, models zoomed into the area using field information and landscape level data.

VII. Existing Condition

A.1. Existing Condition - Fire on the Landscape

Fire has and will continue to play an active and vital role in our forest ecology. Historically, across the Willamette National Forest, fire created mosaic patterns within the vegetation as it occurred at different times in the year or locations which affected the intensity and severity of the fire. Fires were often caused by lightning, and there are references and stories of local Indigenous people historically using fire for managing resources and travel routes (Teensma 1987). Fire affects forest ecology in multiple ways through distribution of active ectomycorrhizal short roots, changes in forest vegetation structure, and diversifying areas for wildlife. Fire is a natural disturbance and the influences of human actions (development and resources) over the past century warrant management activities to aid in maintaining, providing, and reducing hazards. Teensma studied fire history in an area adjacent to Bridge Thin Project Area. The MRFI that he analyzed ranged from <100 years to 166 years.

VII.A.2 Existing Condition - Past Management

Past management activities that have changed the fuel profile or fire behavior are grazing, timber harvesting, fuels treatments following timber harvests, and fire suppression. In 1920 management in National Forests began suppressing fires and managing for resource products which altered the natural regimes of fire. Over the past 36 years from 1970-2007 46 fires occurred in the Bridge Thin Project Area. All fires were suppressed and most were contained to less than one acre with the largest recorded at 5 acres. Lightning accounted for about 30% of the fires in the Project Area and the others were human-caused. Based on the recorded data from Willamette National Forest, the fire frequency is 1.24 fires per year which implies that fire is a disturbance process in the forest ecosystem.

Grazing occurred through the Upper McKenzie Valley from the 1800’s to 1948 (UMWA 1995). Grazing reduced fuels in the open meadow areas and curtailed regeneration of many conifer species. Currently many of these open areas have transitioned to encroaching conifers among the grass and oak or into conifer dominated stands. Many of the proposed Bridge Thin units have been previously managed. Earlier commercial harvest, mostly regeneration harvests, left non-merchantable large woody material and fuels were not treated. Later harvest methods included yarding merchantable material and broadcast burning. Prior to the 1970’s, the scale of acres treated was much larger than the more recent practices. The number of acres harvested within the past 60 years in the Bridge Thin Project Area is approximately 2,848 acres. No natural fuels prescribed fire (prescribed fire without timber harvest) has occurred in the Bridge Thin Project Area in the past 50 years.

Teensma’s Dissertation shows how the natural fire rotation changed from times during Indigenous (Aboriginal) community, Anglo-settlement, and current fire suppression.

- 1772-1830 at 78 years
- 1851-1909 at 87 years
- 1910-current 587 years

VII.A.3. Existing Condition - Fire Regime Condition Class

Fire Regimes describe the natural frequency fire occurs across the landscape pre-settlement and includes the historic aboriginal use (Agee 1993). Five Fire Regimes are used at the national level Fire Regime I, II, III, IV, and V (Schmidt et al. 2002 and Hann et al. 2004). Within the Bridge Thin Project Area the following Pacific Northwest Region 6 Fire Regimes have been classified:

- Fire Regime I – < 0-35 year fire return interval; low severity
- Fire Regime IIIa – < 50 year fire return interval; mixed severity
- Fire Regime IIIb – 50-100 year fire return interval; mixed severity
- Fire Regime IIIc – 100-200 year fire return interval; mixed severity
- Fire Regime V – 150+ year fire return interval; high severity

Of importance in the Fire Regimes description is the use of mixed severity. This term on the Willamette NF explains the varying degrees of fire intensity that can occur given the topography, vegetation, and the ability of larger trees to withstand the intensity creating different levels of mortality. Mixed severity fires are not stand-replacing but rather create a patchy mosaic of different mortality across the landscape (Kertis et al. 2007).

In addition to the frequency and severity, fire disturbance is categorized into Fire Regime Condition Class (FRCC). FRCC describes the degree of departure of current vegetation from the historic fire regime and helps to establish reference and evaluate risks to the ecosystem (Hann, et.al. 2001). FRCC 1, 2, and 3 rank the degree of departure:

- FRCC 1
    - Fire regimes near historic range (departure is no more than one return interval)
    - A low risk of losing key ecosystem components
    - Vegetation attributes are functioning within historical range
- FRCC 2
    - Fire regimes have been moderately altered from historical range; moderate changes in fire size and intensity has resulted
    - Moderate risk of losing key ecosystem components
    - Vegetation attributes have been moderately altered
- FRCC 3
    - Fire regimes have been significantly altered from their historical range; dramatic changes in fire size and severity has resulted
    - Severe loss of ecosystem components
    - Vegetation attributes have been significantly altered

As stated in the document from the NW Oregon FRCC workgroup, FRCC evaluation is conducted by identifying the plant communities (biophysical settings, BpS) that would exist given the soils, climate, topography, and the natural disturbance regime. This is followed by identifying current vegetation in five seral stage categories (early, mid-closed, mid-open, late-open, late-closed). The percentage change in each seral stage across the stratum shows the change or departure from historical seral stages that existed in the historic fire regime. The stratum FRCC allows for fire, as a landscape level disturbance, to be evaluated across an area it may naturally occur. Stratum FRCC (4-6th field watershed) was evaluated first and then stand FRCC was evaluated more at a field level using relationships between current seral stages (Kertis et al. 2007 and Hann et al. 2001).

Insert maps of Fire Regimes and FRCC stratum!

Bridge Thin Project Area is categorized as a FRCC2 and concludes the area is moderately altered from the historical range of variability for fire interval; a moderate change in fire intensity and severity has resulted (Kertis et al. 2007 and Hann et al. 2001). Additionally, susceptibility to fire within the Bridge Thin Project Area should be tempered with the current continuous horizontal and vertical fuel profile, the main highway travel route, and the development of community and structures. An elevated risk of high severity fire due to the continuity of horizontal and vertical fuels exists across the area. Continuous canopy closure and increased fuel due to fire suppression create more of a potential for unnatural, severe fire.

VII.A.4. Existing Condition - Fuel Profile

Fuel models describe the fuel profile in the Bridge Thin Project Area. Fuel models are a quantitative way to describe surface fuel loading (amount of fuel in tons/acre), arrangement, structure, and calculate predicted fire behavior. The primary fuel that carries the fire is the general classification fuel models, i.e. grass, brush, timber litter, or timber slash. Fuel loading and depth correlate to the fire intensity and rate of spread. Horizontal fuels refer to ground or surface fuels, while vertical fuels refer to the ladder fuels such as limbs on the bole of trees, crown base height (CBH), regeneration, and brush.

Fuel loading and fuel models are described below. Both are used to calculate and predict expected fire behavior. Fuel loading is measured using size of fuel that relates to time frames based on how the fuel responds to moisture (how long it takes to dry and become consumable) and are then quantified using tons/acre. Measurements for fuel loading are:

- 0” – .24” diameter or 1 hour fuels
- .25” – .99” diameter or 10 hour fuels
- 1.0” – 2.99” diameter or 100 hour fuels
- ≥3.0” diameter or 1000 hour fuels

The Bridge Thin Project Area is composed of the following natural fuel models (FM):

- **FM 1**– Representative of grass meadows or openings. Fuel loading in the 0-3 inch diameter fuels is less than 1.5 tons/acre. Less than one-third of the area contains trees or shrubs. Fire spreads quickly in this fine fuel when it is cured or nearly cured. *Example – open oak savannah above Highway 126.*
- **FM 5** – Representative of timber plantations and natural regeneration between two and 10 feet tall. *Ceanothus velutinus* is the common understory brush. Shrubs or grass in the understory can carry the fire. Fuel loading in the 0-3 inch diameter for live and dead fuel is less than 3.5 tons/acre. *Example – second growth units under 30 years old that have trees ≤35’ tall and a shrub component along the 1501 or 2633 Road.*

- **FM 8 –** Mature short-needle conifer stands with light fuel loading in the 0-3 inch diameter fuels. This profile can be found in stands that were or were not previously harvested. Fire spread is generally slow with low flame lengths. Heavy fuel concentrations (jackpots) can flare up. Fuel loading in the 0-3” diameter for live and dead fuel is less than 5 tons/acre. *Example – area along Langasher Road with few understory shrubs or regeneration.*
- **FM 10 –** Representative of mixed conifer stands with heavy concentrations of large down wood, > 9” diameter. Fuel loading in the 0-3 inch diameter for live and dead fuel is less than 12 tons/acre. Ground fire behavior is higher in intensity than fuel models 8 because of the heavier fuel loading and the ladder fuels. Torching of trees (fire in the crowns of trees) occurs more frequently. *Example – units on the south side of King Road on the SE portion of Bridge Thin Project Area.*

Private land has FM11 and 12 (but they were not analyzed on the ground). These FM will also explain fuels post harvest on National Forest land.

- **FM 11 –** Light slash load resulting from light to moderate partial cuts or harvests which yard tops of trees attached to the last log. Fuel loading in the 0-3” diameter for live and dead fuel is <12 tons/acre. The continuity of the slash can increase fire behavior.
- **FM 12 –** Moderate slash loads resulting from moderate or heavy partial cuts. Fuel loading in the 0-3” diameter for live and dead fuel is < 35.6 tons/acre. Fire behavior can be rapidly spreading, especially with red needles still on the branch wood.

Table F1 below summarizes the acres of each Fuel Model on National Forest Land using the FSVeg.

Table F1: Existing Condition - Fuel Model within Bridge Thin Project Area

	FM 1	FM 5	FM 8	FM 10
Acres within Bridge Thin Project Area	471 Ac	5092 Ac	9015 Ac.	5833 Ac.

The term hazardous fuel is used in current publications, such as the National Fire Plan, and describes the current and potential hazardous fuels in the Bridge Thin Project Area:

- fine fuels (1, 10, and portions of 100 hour) generated following timber harvest and in forested areas that have been excluded from disturbance processes;
- vegetation structure with fine fuels on the ground, shrubs and small trees in the understory, lichen on larger trees, and tight canopy closure all contributing to rapid horizontal and vertical movement of fire;
- continuous fuel near structures that could easily cast embers onto the roof.

VII.A.5. Existing Condition - Fire Behavior

The Bridge Thin Project Area has a fire frequency of 1.24 fires per year. This shows that fire continues to occur naturally in this area. Fire behavior is a result of the fuels, topography, and weather conditions. Fire behavior was modeled using BehavePlus3 with fuels and topography inputs that correspond to the Bridge Thin Project Area and summer fire weather data representing the hot, dry fire weather (97^{th} percentile) similar to 2003 and 2006 is used to represent conditions where fires can escape initial attack and threaten areas in WUI or other resource values. Areas with light fuel loading, such as FM 8, exhibit low intensity fires with low severity (low mortality of dominant vegetation). Fuel Model 10 exhibits high fire intensity and high severity including crown fire with mortality. Fuel Model 5 is also high fire severity and fast rates of spread. FM10 and 5 are difficult to contain because:

- flame lengths exceed the safety of hand tooled firefighters (flame lengths over 4 feet in height require mechanized equipment, air resources, or indirect);
- rates of spread over 6 chains/hour (1 chain = 66 feet) and this exceeds the ability of a 20 person crew.

Larger fuels, > 9" diameter, are not often considered the carrier of fire. Large 1000 hour fuel will create longer lasting intensity, higher flame lengths and enable crown and high severity fires to progress. Standard fire suppression operations would require mechanized suppression resources when flame lengths reach heights over four feet. Firefighters are not able to safely suppress fires directly if the flame lengths exceed four feet.

VII.A.6. Existing Condition - Open Oak Savanna

Oregon white oak *(Quercus garryana)* is located above Highway 126 on the south facing slopes. The area is identified as a unique and rare habitat in Management Area 9d and resembles the characteristics of Fire Regime I. A series of aerial photographs dating back to 1936 show conifer trees encroaching into the open oak savannah over the past 70 years. The encroachment of conifers and the loss of open oak dominated hillside may be due to the lack of disturbance.

VII.A.7. Exisiting Condition - Wildland Urban Interface (WUI)

The Bridge Thin Project Area surrounds private land along the McKenzie River, the town of Blue River, the development of Rainbow, and several groups of homes and structures. These areas are considered Wildland Urban Interface (WUI) which is defined as a vicinity of 1.5 miles around structures (USDA 2001). These communities are in Lane County and are part of the Lane County CWPP. This CWPP was developed by communities in Lane County and Oregon Natural Hazards Workgroup in 2005 and adopted by the Lane County Board of Commissioners. The implementation of this plan has not begun in all communities in Lane County but should be in the near future (http://www.co.lane.or.us/Planning/CWPPtoc.htm). Many of the cabins leased from the Forest Service do not have defensible space as specified in *Living with Fire* or the Firewise website (www.firewise.org). Private homes have not been evaluated by Forest Service employees but appear to have the same issues as the Forest Service leased cabins.

VII.B. Proposed Actions - Fire and Fuels

The proposed fire/fuels treatments for Alternative B and C are shown on Table F2 below. The treatments are based on the type of stand, age and size of trees, topography, and location. These factors create the parameters to implement the treatment.

- UB – Underburn
    - Post harvest fuels on the ground will be underburned. Treatment will be done in spring-like conditions when 1000 hour fuels and duff are still

moist, mortality of residual trees will be ≤10% because majority of the trees will be >15" DBH. Hazardous fuels will be reduced to S&G levels. Mop-up follows directly after the unit is ignited.

- UB* - Underburn *
  - Following the harvest the stand will be evaluated again to measure the residual tree DBH. If the majority of trees are 14" DBH they will be more resistant to a light/moderate underburn and the mortality of ≤10% can be maintained. If a unit has the majority of trees 12" DBH mortality in an underburn may be difficult to hold at 10% or less due to the thin bark of the smaller trees. The treatments below will be the alternative.
- Natural Fuels UB – Unit 100
  - No commercial harvest but fuels will be treated through an underburn with mortality at 20%. Given the close location of houses the first treatment may be to do a fuels thin as stated below. Prescription parameters, especially weather will help to decide the NF UB or the FT. Hazardous fuels will be reduced to S&G. Mop up will follow directly after ignition.
- GP – Grapple pile
  - With in units, cover and burn the piles in the winter, and reduce hazardous fuels to S&G.
- HP – Hand pile
  - Within the unit or along the road to reinforce the road as a fire break, cover and burn piles in winter, and reduce hazardous fuels to S&G.
- FT –Fuels thins
  - Reduce standing vegetation <7" DBH. The fuels will be either hand or machine cut then hand piled, grapple piled or chipped/mulched depending on cost or location. The treatment of chipping/mulching will not remove the fuel from the site, but it will change the fuel loading to a more compact profile. No commercial harvesting in these units
- WT – Wildlife Thin broadcast burning
  - One to three acre gaps will be created during the timber harvest. Units 40, 42, and 68 will be underburned, and gaps will be burned at the same time. Units 43, 44, and 45 the fuels treatment may be an underburn, if the DBH does not allow then only the gaps will be broadcast burned within the unit in order to stay within the mortality guidelines for fuels treatments.

Table F2 shows the fuels treatment, fuel loading following timber harvest, and the harvest treatment proposed for each unit and alternative.

Table F2: Fuels treatment and fuel loading post harvest

Unit	Acres	Treatment Alt. B and C	Fuel Loading in tons/acre	Harvest
1	14	**HP**	24	HT
2	140	**GP/HP**	19.1	HT
3	47	**GP**	20.8	HT
4	57	**GP/HP**	17.3	HT
5	73	**UB*/GP/HP**	19.9	HT
6	87	**UB*/GP/HP**	20.8	HT
8	60	**GP**	18.1	HT
10	37	**UB**	17.2	HT
11	37	**HP**	17	HT
12	21	**HP**	18.8	HT
13	21	**HP**	18.8	HT
14	27	**HP**	23.4	HT
15	79	**HP**	21.3	HT
17	24	**HP**	18.4	HT
18	27	**HP**	17.8	HT
20	66	**UB**	22.1	MT
21	12	**GP**	17.1	MT

23	12	**GP**	21.1	MT
24	5	**GP**	16.8	MT
25	26	**HP**	23.9	HT
26	14	**UB**	19.8	MT
27	5	**UB**	26.4	HT
28	7	**GP/HP**	33.3	HT
29	47	**UB*/GP/HP**	19.5	HT
30	38	**GP/HP**	23.8	HT
31	19	**UB*/HP**	18.5	HT
32	123	**UB**	20.2	MT
34	5	**UB**	20.1	MT
35	54	**GP/HP**	24.6	HT
36	36	**HP**	23.3	HT
37	43	**HP**	19.8	HT
38	27	**UB**	18.5	HT
39	20	**UB*/HP**	20.9	HT
40	27	**UB**	20.8	WT
42	32	**UB**	12.9	WT
43	44	**UB*/GP/HP**	22.7	WT
44	45	**GP**	22.9	WT
45	38	**GP/HP**	19.2	WT
46	41	**UB*/GP/HP**	14.1	HT
47	32	**HP**	31.7	HT
48	17	**GP**	22	HT
49	7	**GP**	27.3	HT
50	6	**FT**	16.3	FT
51	20	**HP**	30.8	HT
52	11	**UB*/HP**	30.8	HT
53	3	**UB**	13.8	HT
54	10	**GP**	35.3	HT
55	25	**UB*/HP**	23.9	HT
56	43	**UB**	29.2	HT
57	15	**UB**	25.5	HT
58	16	**UB*/HP**	17.5	MT
59	22	**UB**	40.2	HT
60	24	**UB**	17.6	MT
61	16	**UB*/GP**	24.1	HT
62	19	**UB**	17.4	MT
63	29	**HP**	23	HT

64	42	**GP/HP**	21.8	MT
65	10	**HP**	22.5	MT
66	11	**UB**	20.8	MT
67	22	**UB**	20.7	MT
68	41	**UB**	17.3	WT
69	33	**UB*/GP/HP**	21.7	HT
70	3	**UB**	15.7	MT
72	28	**UB**	13.2	HT
80	*10*	***UB – B***	*24.3*	*WT*
81	*14*	***UB – B***	*21.4*	*MT*
82	*35*	***UB – B***	*21*	*HT*
83	17	**UB**	40.7	HT
84	32	**UB oak**	20.4change	OT
841	26	**UB**	20.9	HT
85	12	**UB oak**	10.5	OT
86	7	**UB with oak unit**		OT
87	2	**UB with 88 or 83**		OT
88	*36*	***UB – B***	*21.9*	*HT*
89	6	**FT**	Change	FT
91	*38*	***UB – B***	*14*	*HT*
95	27	**FT**	25change	FT
96	10	**FT**	26.7change	FT
97	5	**FT**	17change	FT
98	4	**FT**	16change	FT
99	13	**FT**	19.9change	FT
100	42	**Natural Fuels UB**	18.8change	FT
101	12	**FT**	17.8change	FT
102	33	**FT**	20.9change	FT
103	26	**FT**	??	FT

HT – heavy thin; MT – moderate thin; WT – wildlife thin; OT – oak thin; FT – fuels thin
Age of Units #1-72 are 80 years or less;
Age of Units #80-103 are 100 years or more
Units in *italics* are for Alt. B only.

VII.C. Environmental Consequences

VII.C.1. Effects of Alternative A – No Action

1.a. Direct, Indirect and Cumulative

In the Bridge Thin Project Area the No Action Alternative would not support returning fire as a natural disturbance process to the ecosystem due to fire suppression responsibilities and life, structure, and resource priorities. Through time, fuel loading would continue to increase and vegetation would continue through successional pathways. Stands would continue to grow increasing fuel loading on the ground and canopy closure thus escalating the potential wildfire behavior. Areas near private residences would not have any reduction in fuels to aid in reducing wildfire intensity and mitigating hazards for firefighters. In the absence of prescribed fire and treatments, ladder fuels and canopy closure would be high, thus providing propellants for severe, high intensity wildfires. FRCC would not be maintained at a FRCC1, again reducing the natural forest resiliency to disturbance. No Action would not create the DFC, reduce firefighting risks, or be cost effective due to suppression of high severity fires.

VII.C.2. Effects Common to Alternatives B and C
2.a Direct and Indirect Effects

Harvests increase fuel loading in a unit which increases the wildfire behavior potential. Following the harvest a greater hazardous fuels condition exists for 0-5 years because of the red needle slash. This slash has high ignition and spread potential. This would be reduced with the fuels treatment 1-2 years post harvest. Across the landscape the lack of variability in the horizontal and vertical fuel profile also increases the spread potential and intensity of wildfire. The proposed fire and fuels Actions in Alternative B and C would change the fire and fuels environment by:

- returning the historical disturbance process of fire with prescribed fire treatments;
- reducing hazardous fuels to levels of S&G and create variability in the horizontal and vertical profile;
- creating a mosaic and distribution of seral stages present in a mixed severity fire regime taking steps towards change from FRCC2 → FRCC1;
- increasing fire tolerant conifers and reducing shade tolerant conifers;
- creating safe and cost effective protection of life, structures, and resources through reducing the risk of potential high severity fires.

All prescribed fire treatments would create variability across the landscape and return a vital disturbance process to the ecosystem. The distribution of seral stages that determine the FRCC would not completely change the Bridge Thin Project Area from a FRCC2 to a FRCC1. However, the treatments would begin the steps towards reaching the FRCC1. Future treatments would need to take place in order to reach that goal and create the early, mid, and late seral stage distribution that is needed under a FRCC1.

The proposed action timber harvests will create varying amounts of timber slash in each unit (see Table F2). The increased fine fuel loading may reduce the success of initial attack suppression operations due to the fast rate of spread and the flame lengths at >4 feet. Activity fuels (slash) treatments would reduce the amount of fuel created from the harvests to the S&G fuel loading of 7-11 tons/acre for 0-3” diameter fuel. Fuels treatments are proposed to be within 1-2 years after the harvest. The reduction in fuel loading would reduce the potential wildfire behavior.

Table F3 displays the changes in fire behavior within the unit of treatment for existing, post harvest, and post fuels treatment conditions. Fire behavior that exceeds 4 foot flame lengths require machinery or aerial support to reduce the risks to tooled firefighters.

Table F3: Existing fire behavior

	Rate of spread (chains/hour)	Flame length (feet)	Crown fire with % mortality	Spotting potential (miles)
FM5	117 ch/hr	13 feet	Active 99% mort	Yes at 0.6 miles
FM10	38 ch/hr	11 feet	Active 37% mort	Yes at 1.5 miles
FM12	37 ch/hr	13 feet	Active 97% mort	Yes at 0.6 miles
Post Fuels Treatment	5 ch/hr	2 feet	Active 12% mort	Yes at 0.6 miles

- Crown fire activity is displayed as *Active*, which means that fire is present in both the surface fuels and canopy fuels.

- Post fuels treatment examines the fire behavior as FM8 because units will have lower fuel loading, higher CBH, and varying canopy density.

In all the units where fuels treatments take place S&G would be met.

- reducing fuel loading of 7-11 tons/acre for 0-3" diameter fuel;
- maintaining duff coverage of 85% or more;
- weight of equipment and machinery would be with in range;
- downed woody debri minimum of 240 linear feet of 20" DBH;
- IDT decision to keep mortality at 10% or less.

Underburns in Units 84, 85, 86, and 87 aim to restore the unique and rare habitat of the open oak savanna. The DFC would be to burn every 5-15 years in order to reduce the conifer encroachment and maintain oak as the dominant species (Regan and Agee 1996). With the lack of disturbance the faster growing conifers would progress faster than the oak. The fire regime in the oak habitat, on the south facing slope, shows as a Fire Regime I. Returning the disturbance of fire and reducing the conifers would invigorate the oaks to maintain their habitat.

Fuels thins would occur in Units 50 adjacent to the private property, 95-99 are located between Highway 126 and McKenzie River Drive, and Unit 101, 102, and 103 are north and south off of King Road; all are in WUI. These units are directly next to houses. Potential wildfire behavior would be reduced due to decrease surface fuel loading, increase in CBH through the reduction of ladder fuels, and variability in vegetation continuity post treatment. The treatment of chipping/mulching would not remove the fuel from the site, but it would change the fuel loading to a more compact profile, condensing the lofty fuels where rates of spread would be less. These changes create part of the defensible space next to the private land and along the highway where human caused fire, such as burning rubbish thrown from cars, can ignite wildfires. Following the treatments the fuel profile would aid in protecting the private property if a wildfire were to approach the area and reduce the risks to firefighters.

The proposed treatment of Unit 100 would be a natural fuels underburn. This unit is also along King Road next to private land. A natural fuels underburn would provide a reduction in the hazardous fuels, decrease the movement of wildfire from the ground to the canopy by reducing the ladder fuels, and creating variability in the canopy density. Mortality in these stands would be around 20% or less. Recreation mitigations will be taken to close the trail during the burn and also initiate light severity ignitions along the trail. The UB would be completed on the east side of the trail. With the UB the fire behavior would change from FM10 to a FM8 in wildfire conditions. Underburning is a preferred method of treatment not only to reduce hazardous fuels but to return fire to the ecosystem.

Treatments in units located near private residences aim to protect and improve the defensible space in the WUI. The proposed treatments would occur on 176 acres and reduce the spread of a wildfire near the homes through the reduction of ground and ladder fuels. This profile decreases the potential for ground fire to carry into the canopies and produce embers that can land on roofs which is one of the main ignition sources in the

WUI. Life, private property/structures, and resources are the highest priority to protect during wildfire suppression.

Treatments to create more defensible WUI would ultimately be a collaborative effort of public and private land owners. A reduction or change of vegetation next to homes (defensible space) or in vegetated pathways that lead to developments or structures (WUI) is important to aid State and Federal firefighters in suppression activities. Life and private property are the highest priority to protect during wildfire suppression. The locations of Bridge Thin treatments coincide with the interface and would help to begin the process.

Underburns would take place during the spring or during spring-like conditions where the soil and duff moisture are damp and fuel moisture in the large woody debris is high. These conditions slow or stop consumption which helps to retain sustainable levels of duff, soil coverage, and large woody debris often used by wildlife. Additionally, mortality of residual overstory trees can be controlled more specifically because of high live fuel moistures.

Underburns or wildlife broadcast burns may require handlines constructed around the perimeter. These are created prior to the burn and aid in containing the prescribed fire within the unit boundaries. Handlines are created by scraping fuel back to an 18” mineral soil line and scattering fuels that lie within 10 feet of the proposed line. If units are located on a steep slope waterbars are created within the fireline to reduce erosion.

Hand, grapple, and landing piles are covered with regulatory plastic following construction. This creates a drier pocket of fuel in the middle of the pile and enables them to be burned in the late fall or early winter when there is very low risk of the piles spreading into other fuels. Removing the plastic before burning is suggested in order to aid in reducing emissions from the plastic.

VII.C.2.*b Effects Unique to Alternative B*

Units 80, 81, 82, 83, 88, and 91 are proposed to be underburned post harvest. These units are located above Highway 126 and are within WUI. The fuels and variability in the horizontal and vertical profiles would change, thus reducing the potential severity of wildfire behavior. Being in the WUI this would also reduce the risks and hazards during fire suppression.

VII.C.2.*c Cumulative Effects Common to Alternatives B and C*

Cumulative effects are based on management activities that have or would occur in the Bridge Thin Project Area. The area analyzed displays the direct and indirect effects of fire on the treated units which translate to the variation of fuel profiles over the larger disturbance landscape. Proposed fuel treatments, in concert with harvest activities, would help to diversify the fuel profile across the landscape. Future wildfire suppression actions will continue, however the proposed treatments aid in returning the natural disturbance to the landscape. No other foreseeable future fuels management activities are planned within the Bridge Thin Project Area that would contribute incrementally to the cumulative effects from past or currently proposed activities.No adverse effects on the fuel profile or on fire behavior would result from the proposed fuel treatments.

VII.C.2.*d Conclusion to Effects of Alternative B and C*
Alternatives B and C fuels treatments would be conducted following S&G. Hazardous fuels would be reduced to meet the DFC. FRCC 2 would move closer to FRCC 1. WUI units would aid in creating safer conditions for firefighters and home owners. And all the treatments would reintroduce the disturbance process of fire to the ecosystem.

VII.*D.1. Existing Condition – Air Quality*
The State of Oregon has been delegated authority for attainment standards set by the 1990 Clean Air Act and the 1977 Clean Air Act and its amendments. To regulate these standards, the state developed the Oregon Smoke Management Plan and the State Implementation Plan. These are guidelines and regulations for prescribed fire smoke emissions in Oregon. The Willamette National Forest has adopted this plan for emission control in Oregon (LRMP, 1990).

Designated Areas and Class I Airsheds are priority areas regulated in order to protect air quality. The Willamette Valley (at the eastern side, Leaburg) and Oakridge are the closest Designated Areas to Bridge Thin Project Area (15 and 35 miles respectively). Three Sisters Wilderness and Mt. Washington Wilderness are the closest Class I Airsheds to the Bridge Thin Project Area (3 and 11 miles respectively). Class I Airsheds must be protected from visibility impairment July 1 through September 15.

VII.D.2 *Environmental Consequences – Air Quality*
2.a Direct, Indirect and Cumulative Effects of Alternative A – No Action
If no management actions take place in the Bridge Thin Project Area no air quality impacts would occur in a scheduled timeframe. However, the risk of wildfire would still exist. In the event of a wildfire, air quality impacts are considerably higher than prescribed fire. Smoke emissions are not short term and can often last for many weeks or months, as witnessed during the Puzzle and GW Fires in 2006 and 2007, respectively. Smoke emissions from wildfire are more likely to heavily impact communities and contribute to harmful, concentrated levels of PM 2.5 and PM 10. Table F3 displays emissions are considerably higher than prescribed fire emissions, posing risk to community residents, forest users, and firefighters. Acreage used for the above wildfire calculation was 2502 acres, the number of harvest and treated acres in Alternative B.

VII.D.2.*b Effects Common to Alternative B and C*
Prescribed fire of activity fuels in the Bridge Thin Project Area would comply with Oregon Smoke Management Plan regulations. Smoke emissions would be mitigated based on the timing of the burns, seasonality, forecasted transport wind direction, and weather. Regulations enforce specific days which are suitable to burn in relation to other land owners burning or weather forecasts. Prescribed fire would most likely be avoided between July 1 and September 15 in order to protect visibility standards for Class I Airsheds.

Recreationists and some local residents near Bridge Thin Project Area may be temporarily impacted by smoke from the prescribed fire underburns or pile burning. In the Oregon Smoke Management Plan, non-harmful concentrations of drift smoke are considered nuisance smoke (Oregon SMP 1995). Mitigation measures, such as signing along the road or near the treatment area, would be taken in order to reduce the amount of nuisance smoke and notifications to the public would be made prior to burning.

Smoke emissions were predicted using the estimates from the debris prediction tables and FOFEM (First Order Fire Effects Model version 5.0). This model calculates particulate matter emitted based on the amount of fuel consumed. Fuel inputs were from the predicted post harvest data and based on a percentage of fuels that would most likely be consumed given the prescribed fire window. That is, weather and fuels dryness would be measured to achieve the objective of reducing the fuel profile across the unit. From past experience, fuels treatments consume an average of 80% of the fine fuels (0-1 inch diameter), 60% of the 1-3 inch fuels and only about 20% of the 3-9 inch. LWD >9 inches is most often too wet to be consumed. FOFEM however consumes 100% of 1, 10, and 100 hour fuels in spring-like conditions. Table F3 summarizes particulate matter predicted for fuels treatment activities. Alternative C is not shown because it is less than Alternative B.

Table F3: Summary of particulate matter emissions for Bridge Thin Project Area for all treatments

	Alternative A – Wildfire	Alternative B	Alternative C
PM 2.5 total	1735 tons/acre	517 tons	484 Tons
PM 10 total	2048 tons/acre	610 tons	572 Tons

It is important to note these emissions levels do not occur at one time. Usually prescribed fire operations occur one unit at a time (in one day). For example, Unit 80 is predicted to have 24.3 tons/acre of 0-3" diameter fuel post-harvest. During the prescribed fire underburn, emissions are estimated at 2.37 tons/unit of PM 10 and 2 tons/unit of PM2.5.

VII.D.2.*c Cumulative Effects of Alternative B and C*

No adverse effects on the air quality would result from the proposed fuel treatments. The area defined for cumulative effects is the Bridge Thin Project Area where the treatments occur as well as the larger landscape where smoke emissions can travel. These are the locations of the Designated Areas and Class I Airsheds. Neither would be affected from the treatments. Smoke emissions would be short duration and mitigation measures would reduce the quantity of emissions during prescribed burns. Past management activities do not cumulatively add to air quality impacts from the proposed treatments. Proposed maintenance burns of Unit 80 should produce less smoke emission than before due to the quick prescribed fire return interval. No other foreseeable management activities that would affect air quality are scheduled to occur in the Bridge Thin Project Area.

VII.D.2.*d Conclusion of Effects of Alternative B and C*

Mitigation measures to reduce quantity of smoke emissions from burns would be to burn in spring-like conditions (as stated in the fuels treatment section) with LWD about 30% fuel moisture and damp duff. All these would meet the S&G and Air Quality Regulations.

VIII. Cost of Project Treatments

The expected loss table developed for the McKenzie River RD in 2007 was used in this analysis from the Fire Management Area Zone – Central Zone, non-wilderness. Treatment costs were established as follows:

- Underburning - $850/acre (this includes prep, burning, and mop-up)
- Hand piling - $900/acre (this includes construction, covering and burning)
- Grapple piling - $600/acre (this includes construction, covering and burning)
- Chipping - $400-1600/acre

Many complex objectives on each unit increase planning, preparation, and implementation time, thereby increasing the cost per acre. All treatment costs are less than the expected loss of resources and/or structures to wildland fire. Returning fire back into the ecosystem through the proposed actions would meet objectives defined in the Purpose and Need. Fuels treatments are selected on effectiveness at meeting resource objectiveness.

Table F4 below estimates the costs on the high end by Alternative. The UB acres are for the maximum number of acres that could be underburned. The resultant DBH in each unit post harvest would determine if the unit is UB or piled. The units proposed to have fuels thins are calculated in the chipping treatment. Some units would received both grapple piling and hand piling treatments depending on topography. The costs below are calculated for grapple piling on those units.

Table F4: Estimated Treatment Costs By Alternatives

		ACRES			**COST**		
Treatment	**Cost/ac**	**A**	**B**	**C**	**A**	**B**	**C**
UB	850	0	1488	1355	$0	$1,264,800	$1,151,750
Hand Pile/burn	900	0	455	455	$0	$409,500	$409,500
Grapple Pile/burn	600	0	403	403	$0	$241,800	$241,800
Chipping	1000	0	140	140	$0	$140,000	$140,000
Total Est. Costs					**$0**	**$2,056,100**	**$1,943,050**

IX. Monitoring

Fuels treatments would be monitored prior to treatments and also post treatments. Fuel loading would be evaluated, documented, and used in models to compose burn plans and also learn from treatments. Digital photos should be taken pre and post treatment in order to have a visible image of the changes that occur on the unit.

Attachment F1

Terminology

- Broadcast burn – prescribed fire
- Crown Base Height – the lowest canopy branches to the ground
- Fuel Loading refers to the amount of fuel present in terms of weight per unit area. Fuels are expressed by size and hours required to dry.
    - 0” – .24” or 1 hour fuels
    - .25” – .99” or 10 hour fuels
    - 1.0” – 2.99” or 100 hour fuels
    - ⩾3.0” or 1000 hour fuels
- Fuel Models quantify surface fuel loading (amount of fuel in tons/acre), arrangement, structure, and calculate predicted fire behavior. The primary fuel that carries the fire is the general classification key for fuel models, i.e. grass, timber litter, brush or timber slash.

- Handline – NFP glossary

- Hazardous Fuels –

- Ladder Fuels -

- New Fuel Models – 40 dynamic

- LANDFIRE –
- Fire Regime – describes the historic role of fire on the landscape. Fire regimes for Oregon and Washington are from the 1999 National Fire Strategy and are redefined for Region 6 based on common severity type, and the frequency of that expression on the landscape.

Fire regime group for R6	Frequency (Fire return interval)	Severity
I	0-35 years	Low severity (underburn)
II	0-35 years	High severity (stand-replacing)
III A	< 50 years	Mixed severity
III B	50-100 years	Mixed severity
III C	100-200 years	Mixed severity
IV A	35-100 years	High severity (stand-replacement), juxtaposed
IV B	100+ years	High severity (stand-replacing), patchy arrangement
IV C	100-200 years	High severity (stand-replacement)
V. A	200-400 years	High severity (stand-replacing)
V B	400+ years	High severity (stand-replacing)
V C	No Fire	
V D	Non-forest	

- Fire Regime Condition Class (FRCC) describes the degree of departure of current vegetation from the historic fire regime (Hann, et.al. 2003). FRCC 1, 2, and 3 ranks the degree of departure with the following:

- FRCC 1
    - Fire regimes near historic range (departure is no more than one return interval)
    - A low risk of losing key ecosystem components
    - Vegetation attributes are functioning within historical range
- FRCC 2
    - Fire regimes have been moderately altered from historical range; moderate changes in fire size and intensity has resulted
    - Moderate risk of losing key ecosystem components
    - Vegetation attributes have been moderately altered
- FRCC 3
    - Fire regimes have been significantly altered from their historical range; dramatic changes in fire size and severity has resulted
    - Severe loss of ecosystem components
    - Vegetation attributes have been significantly altered

- FRCC is mapped and calculated using three steps:
    - determination of vegetation-fuel condition class
    - determination of fire frequency/severity condition class
    - determination of stratum fire regime condition class

Attachment F2

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