Bull of the Woods Complex
Mt. Hood National Forest
Long Term Assessment and Implementation Plan
August 2010

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Executive Summary

- Near average precipitation and below average temperatures are projected for the remainder of August. Conditions through September are expected to reflect long-term climatological average precipitation and below normal temperatures. Fire season is most likely to end by mid-October, using a 'conservative' estimate or by late-September using a 'liberal' estimate. September also typically brings 1-2 several fire slowing precipitation events which are not season-ending events.
- Large fire growth days in this area are most often associated with hot, dry conditions. These conditions are more likely in August , and are unlikely after mid-September. Although short duration wind events that drive fire behavior are possible, most fire growth in September is through average daily spread which winds down with decreasing temperatures and day lengths. There is about a 50% chance of a large fire growth event in September, lasting 1-2 days. These events are signaled by periods of low overnight humidity recovery and a subsidence inversion.
- The risk of fire reaching points of concern including Bagby Hot Springs, the Bull of the Woods Lookout, campgrounds to the north, and powerlines to the south is low for the next 14 days. There is virtually no risk of the fire reaching private lands or to lands managed by the Warm Springs Agency. The fire has reached the wilderness boundary on the east.
- The plan includes a set of management actions that could be taken on this fire, along with decision points, costs, resources needed, and a risk assessment for each action. Not all actions will be needed, but some are recommended for immediate implementation.
- The team concurs with the use of an indirect strategy, relying on roads and natural fuel breaks, as the safest approach and one most consistent with wilderness management standards.

Introduction

This document presents the results of a long term assessment of fire growth potential and recommended actions for management of the Bull of the Woods Wilderness fires on the Mt. Hood National Forest. The assessment takes advantage of current fire modeling tools and techniques, supplemented with the expertise of experienced modelers and fire managers, in hopes of providing the Mt. Hood National Forest staff with a sound plan for management of these fires for the remainder of the 2010 fire season.

The Bull of the Woods Complex started from a lightning storm on August 17 that tracked up the Cascade crest. Several fires started in the upper portions North Fork of the Clackamas River and in the Bull of the Woods Wilderness. Two fires near Olallie Lake initially emerged as potentially large fires near View Lake and were prioritized for suppression action. The fires were combined into a complex and a Type III Incident Management Team (IMT) called to handle suppression operations. With the number of fires in Wilderness, the Forest recognized the potential for a long duration event and requested preparation of a long-term risk assessment.

The Long Term Assessment Team was ordered on Saturday August 21, and received an inbriefing on Sunday, August 22. The team received a letter of direction from the Agency Administrator (Bill Westbrook), and this direction was assigned 5 tasks to the team with the following statements:

1) Do your part to provide for public and firefighter safety by recommending appropriate actions and strategies, implementing LCES appropriate for your assignment, and managing fatigue within your team.
2) Develop a long term assessment for incidents in the Bull of the Woods Wilderness Area, including a projection of fire growth, risk assessment, estimate of costs, and recommendations for future actions and their associated triggers.
3) Base your recommendations on my priorities for firefighter and public safety, managing costs appropriate to the values at risk, recognizing and respecting the values of our neighbors and land management partner agencies, and managing fire to restore/maintain ecosystem processes within the Mt. Hood National Forest.
4) Work with the IMT and the local unit to help provide for protection of cultural, historic, developed sites, and other resource values indicated in the Mt. Hood National Forest Fire Management Plan and Land and Resource Management Plan or as requested by Agency personnel.

Objectives of Risk Assessment

In addition to the objectives given the team, we identified several other key questions for the long term assessment:

- How does fire season 2010 compare to other recent seasons of note? How severe is the 2010 season compared to average and severe years?
- How long until a season-ending event can be expected? What is a season ending event?
- What are the weather events associated with fire growth? How long do these events last, how frequently do they occur, and how can they be anticipated?

Risk Assessment Considerations

Values at risk were identified by the local unit, in collaboration with the LTAT. The following lists of values were then used by the LTAT to evaluate risks:

- Structures and improvements at Bull of the Woods Lookout, Bagby Hot Springs, and NF Campgrounds north of the Wilderness Area (Kingfisher and Little Fan Creek)
- Fire movement outside of the Wilderness Area into areas of the Forest that are more intensively managed
- Fire movement off of the Mt. Hood National Forest onto the Willamette National Forest and Warm Springs Reservation
- Powerlines located about 6 miles south of the Wilderness Area.
- Northern Spotted Owl nest sites

Fire Behavior

Observed Fire Behavior

There are six fires burning along the east aspect above Elk Lake Creek in the Bull of the Woods Wilderness area. Observed fire behavior for the period of 8/17–22/10 consisted of creeping and smoldering with occasional single tree torching. Backing fire spread has been very prevalent on the steep slopes with gravity/rolling material contributing to down slope spread. Very slow spread rates of 1 – 3 chains/hour and flame lengths of 1 – 2 feet were observed with flame lengths in the drainage bottom of less than 1 foot. At the end of the burn period on 8/22 the fires were estimated to be 60 acres.

Warmer and drier conditions started to influence the fire area on 8/23–25/10 with the passage of a hot and dry thermal trough. Observed fire behavior consisted of creeping and smoldering with an increase in single tree and small group torching, backing fire and some upslope spread with an increase in fire behavior to rates of spread 4 – 8 chains/hour with flame lengths of 1 – 3 feet. Other than gravity and rolling material causing short range downhill spotting, spotting has not been a big factor in the fires spread.

As the dry thermal trough conditions persist the burning period extends with continued fire growth overnight. The estimated fires size on the morning of 8/25/10 is 350 acres, an increase of approximately 250 acres on Tuesday 8/24.

On Wednesday 8/25 the thermal trough passage with very dry, unstable (Haines 6) conditions resulted in significant fire growth. Upslope runs with group torching and alignment with ridge top winds resulting in fire growth of 1150 acres. The approximate fire size on the morning of 8/26 is 1500 acres.

Expected Fire Behavior

On 8/26/10 a dry cold front is forecasted to pass through the fire area with much cooler and higher humidities. There is a slight chance of some light precipitation over the weekend. This cooler, fall like weather is expected to be in place until Tuesday (8/31) followed by a brief return to near normal conditions. The fire behavior during this cooler period is expected to reduce greatly with very little spread occurring. As warmer conditions return the fire behavior will respond accordingly. This pattern of up and down fire behavior is expected to continue into the fall.

Watch out for future thermal trough situations which could lead to another significant increase in fire behavior and growth.

Fire Intensity/Severity

There has been a wide range of fire intensities ranging from low intensity under burning to patches of stand replacement burns, resulting in a mosaic burn pattern across the landscape. The effects on critical habitat areas and values at risk will vary as well with higher fire intensity/severity occurring on the larger fire growth days. Generally the lower elevations have burned with lower intensity and the more exposed upper slopes have burned with higher intensities.

Topography

The Mt. Hood NF is located in the Cascades Mountains in northern Oregon, and the fires are located near the crest of this mountain range and very nearly on the border between Clackamas and Marion Counties.

The topography in the Bull of the Woods Wilderness near the fire area consists of steep, dissected terrain. It is very steep, rugged, and difficult country for fire fighters to work in safely and effectively. The fires are burning on an east to northeast aspect above Elk Lake Creek ranging in elevation from 2500 ft to 4000 ft. The highest ridges above the fire are approximately 5000 ft. The Elk Lake Creek drainage may serve as a barrier however it is a narrow enough canyon that spotting across the creek is very possible.

The immediate fire area is surrounded by higher ridges and appears to be sheltered from the ridge top winds.

Fuels

The fuels discussion occurs in two sections: 1) the natural fuel complexes associated with the immediate and 2) the surrounding areas.

Fire Vicinity

The fuels in the fire area consist of a mixed conifer mature over-story consisting of Douglas-fir, western red cedar, and western hemlock. Douglas-fir is the predominant tree species at the higher elevations with cedar and hemlock in the drainage bottoms. The understory consists of mixed hardwoods and shrubs with rhododendron and salal the most dominant species. The litter layer is predominately short needle litter layer and moss. The moss layer is rather continuous over the rocky soils in the area. The litter layer, particular the moss is the primary carrier of the fires spread. Fuel Model 8 is the representative fuel model and models the observed spread rates of the fires very well.

This is a very sheltered situation shading the fuels and reducing the winds significantly at eye level. This factor, as well as the fuels, tends to make this a rather slow spreading fuel.

In the northeast corner of the fire area below Schreiner Peak there is a series of harvest units outside of the wilderness boundary. The fuels in the harvest units are very brushy with various levels of tree

regeneration. These areas are either a FM-5, tall brush, or FM-8, short needle litter layer, based on the height of the tree regeneration. Both of these fuels models are rather slow spreading fuel models. However these harvest units are less sheltered and an increase in fire activity could be expected.

Surrounding Area
The fuels in most of the surrounding area, to the south and west, are generally very similar to the above mixed conifer FM-8 description above.

To the northwest of the fires is the 450 acre Lake Lenore Fire, which burned in 2008. This will serve as a barrier to fire spread; it is possible for spots to get established in the burn, however there is very low potential for the fire to spread beyond this burn scar.

As you move further from the wilderness, particularly to the north and east you move into a more managed forest environment with scattered harvest units across the area. The fuels within the harvest areas vary from bush (FM-5) to mixed conifer (FM-8). As the fire season progresses into September the live fuel moistures (LFM) of the brush species may lower enough to become more available to burn and contribute more to the fires spread. Slope and aspect will have an effect on how these areas will react as well, with possible upslope runs.

Measured LFMs are averaging 130% for conifer fuels and 150% for hardwoods and the 10 hour dead fuels are 13%. These LFM are generally not available fuels however they should continue to dry later in the fall.

Long Term Risk Assessment

Summary

The long-term risk assessment includes these primary findings:

- Near average precipitation and below average temperatures are projected for the remainder of August. Conditions through September are expected to reflect long-term climatological average precipitation and below normal temperatures.
- Spread events are associated with thermal troughs and wind events. Thermal troughs will decrease into September and wind events will increase in mid to late-September. Increase of wind events coincides with increasing probability of season-end.
- September has 1-2 fire-slowing events on average (rain 0.1-0.25") and though short duration wind events are possible, most fire growth in September is through average daily spread which winds down with decreasing temperatures and day lengths.
- Fire season is most likely to end by mid-October, using a 'conservative' estimate or by late-September using a 'liberal' estimate. Based on weather outlooks, the 'liberal' estimate is more likely this year.
- The risk of fire reaching points of concern including Bagby Hot Springs, the Bull of the Woods Lookout, campgrounds to the north, and powerlines to the south is low for the expected life of the fire.
- The fire reached the wilderness boundary on the east side as of the August 24th evening IR flight (see MAP 2).

Key strategic containment considerations include:

- Direct hand fireline construction is difficult and escape routes and safety zones are few in the wilderness area. Impacts to wilderness values would increase as more ground crews are deployed. Containment opportunities exist outside of the Bull of the Woods Wilderness boundary along roads and ridgelines.

Current Assessment

The current fire risk assessment analyzes fuels, weather and fire behavior for six of ten Bull of the Woods Wilderness fires. The unanalyzed fires burned out on their own to natural barriers or have never been found again since initial discovery. Should some of the other fires become active, analyses for those fires could be added to this report.

The purpose of this assessment is to describe long-term fire behavior and spread potential by examining:

- Current and projected seasonal severity,
- Probabilities of critical spread events,
- Probabilities of fire slowing events,
- Timing of season end and
- Risks to specific points of concern.

Seasonal Severity

Seasonal severity is based on various indicators of drought and fuel dryness that influence the probability that fires will start, grow and exhibit rapid and intense fire growth through crowning and medium- to long-range spotting. The more severe the season, the more likely that new starts will escape initial attack and that existing fires will be difficult to control.

The Drought Monitor integrates several different measures of short- and long-term drought such as stream and reservoir levels, soil moisture, snowpack, precipitation, and professional judgment by regional climatologists. According to the August 24 Drought Monitor (Figure 1), the Mt. Hood National Forest area is currently free from abnormal dryness or drought. The latest Drought Outlook, constructed in mid-August, indicates that drought conditions are not expected to develop in the area for the remainder of the fire season.

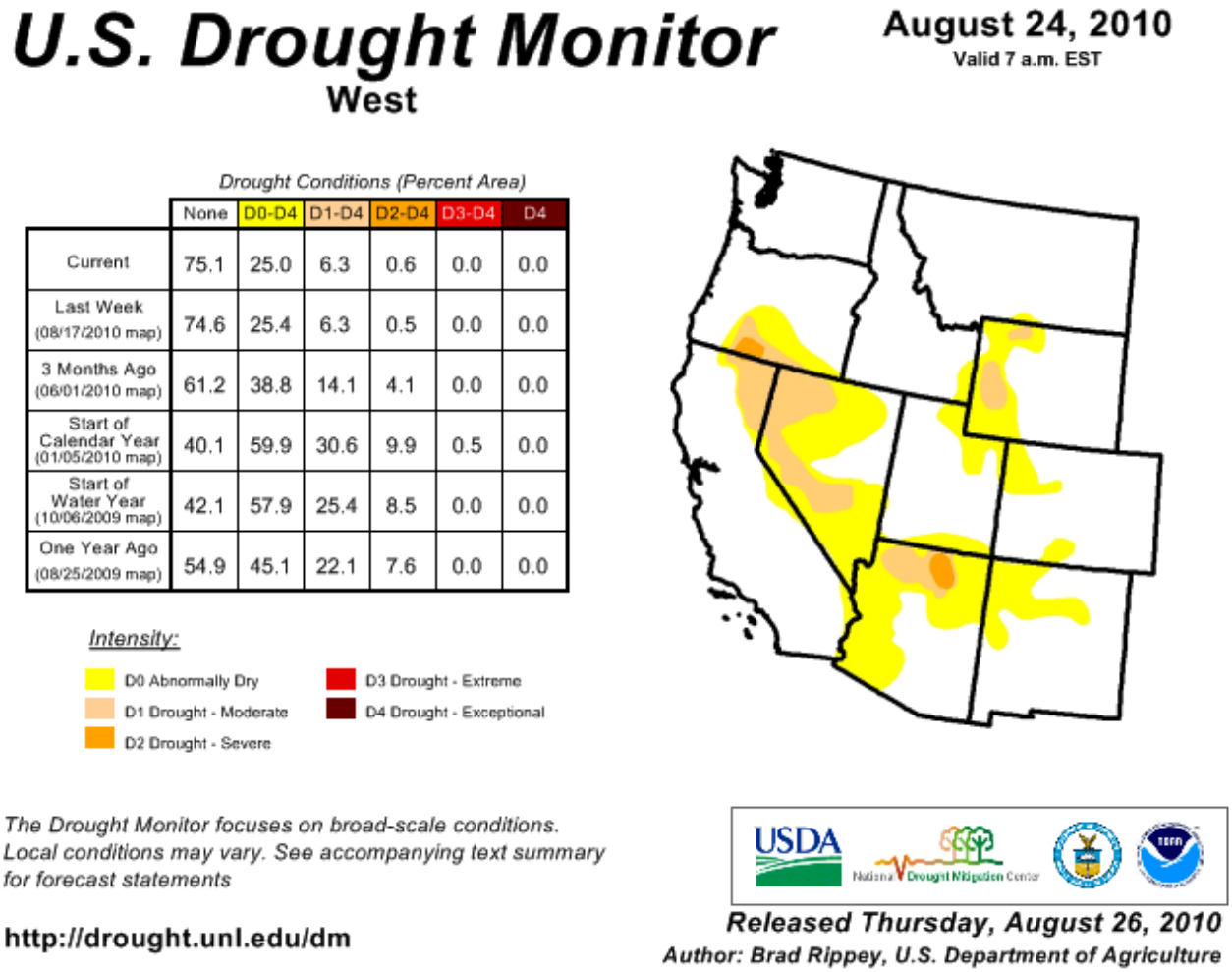


Figure 1. US Drought Monitor for August 24, 2010. No drought is currently present in western Oregon.

Snotel data from the Clackamas Lake SNOTEL site (Figure 2) show the current water year started out near average, but both precipitation and snowpack moved to below average in November and remained slightly below until May when late spring moisture in May and June moved precipitation values to near average. The most telling information is that the snow water equivalent has remained below average since November of 2009. Currently, water year precipitation amounts are just below average (95%).

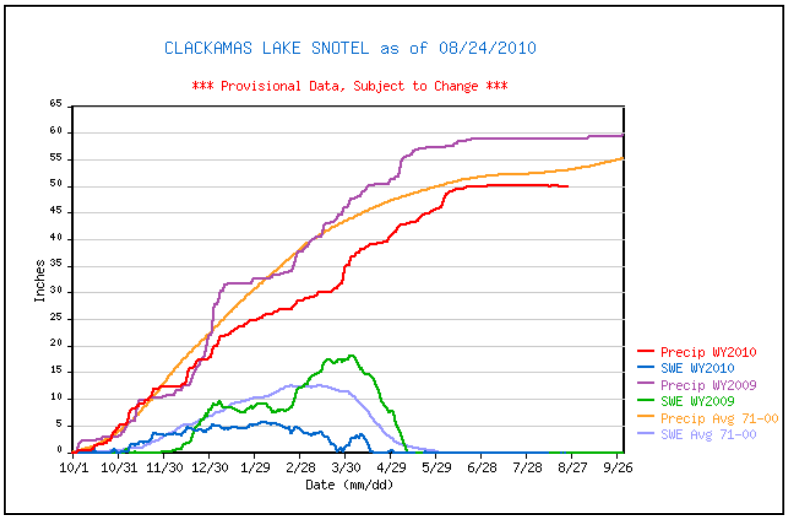
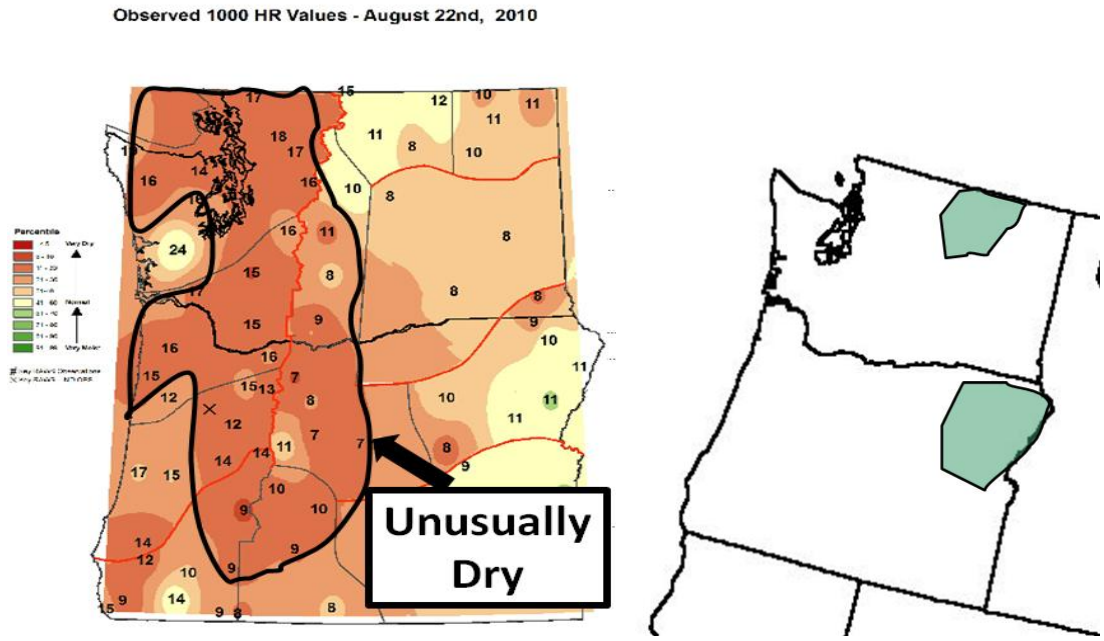


Figure 2. Snow pack remained below to near average in November then near the end of June little additional precipitation was realized.

NWCC September 2010 Monthly Summary Bullet Statements

- Temperatures were near or slightly above average in eastern Oregon and Washington in August 2010 while temperatures were generally cooler than average along the coastal strip west of the Cascades.
- August 2010 was quite dry. Little or no noteworthy rainfall was recorded over almost the entire geographic area. A number of fire danger reporting stations have gone for more than 60 days without wetting rain.
- Fire Danger Indices are generally near normal over much of the northwest geographic area east of the Cascades except in north central Washington (PSA E1) which is well below normal for late August and northeastern Oregon (PSA E4).
- West of the Cascades the fire danger indices in late August were proportionally greater than those on the east side, particularly areas W1 and W2. See graphic. This condition will remain until sustained rainfall occurs which is not expected in September 2010.
- Even though conditions are fairly dry over much of the area new ignitions from lightning drop dramatically in September.



Normal Large fire potential for September 2010 for the NW Geographic area except in North Central Washington and Northeast Oregon where significant fire potential is below normal.

NWCC OCT-NOV-DEC 2010 Seasonal Summary Bullet Statements

- Potential for large and costly wildland fires in the northwest geographic area historically diminishes rapidly in October to virtual insignificance. This is due to the seasonal onset of cool and wet weather which is expected to arrive even earlier than usual in the autumn of 2010. Even if conditions are warmer and drier than usual in autumn, lack of ignitions from lightning tends toward very low significant wildfire risk.

Below normal large fire potential for Oct-Nov-Dec 2010 for the NW Geographic Area (low wildfire risk).

Weather

The fire is in fire weather forecast zone ORZ607, in the Portland, Oregon forecast area. Weather forecasts and outlook specific to the management of the Wilderness fires are available at http://www.wrh.noaa.gov/firewx/?wfo=pqr.

Weather Stations

Weather data from remote area weather stations (RAWS) was analyzed for temperature, relative humidity, and wind direction. There are no weather stations located in the Wilderness, so this analysis primarily uses the Red Box RAWS. Wanderer's Peak, Horse Creek and Boulder RAWS were also consulted and some results are included here for comparison. Red Box is located 15 miles NNE of the current fire location and best represents wind and fire conditions witnessed on the fire. All weather stations analyzed reflect drier conditions than those at the fire site.

The period of record used in this analysis for Red Box is June 1-October 31, 1985 to 2009 with the current year overlain.

STATION	RAWS NUMBER	ELEVATION	DISTANCE
Red Box	350718	3250’	15 miles NNE
Boulder Creek	351909	3570’	11 miles SSE
Horse Creek	350727	3402’	18 miles WNW
Wanderer’s Peak	350726	4350’	17 miles NNW

Table 1. RAWS sites analyzed and compared to fire behavior in the Wilderness.

The wet weather pattern in May, June and early to mid-July is reflected in the seasonal Energy Release Component (ERC) trace for this year (Figure 3). Energy release component is a measure of the potential energy available to a fire and serves to indicate longer-term fuel dryness, particularly of large fuels and live fuels. Late July and August have been characterized by pulses of warm, dry weather interspersed with marine flow. These are well reflected below. Live woody and 1000-hour fuel moistures have tracked moister than seasonal averages until mid-August and are currently tracking at average. Current observations on the fire indicate incomplete consumption of heavy, dead fuels.

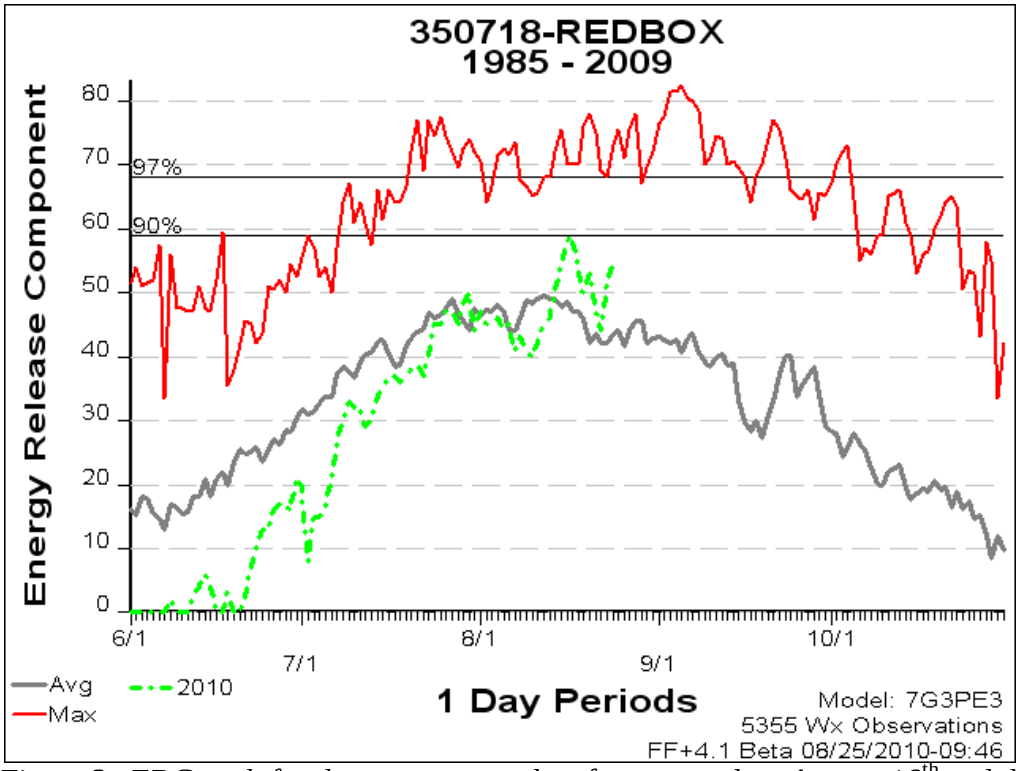


Figure 3. ERC peak for the current year thus far occurred on August 16th and the Wilderness fires began on the 17th as ERC reached the 90th percentile. Expect the current year index to drop to average with the cool, moist forecast for August 26-31. Models are indicating a potential thermal trough development next week, potentially Tuesday or Wednesday, August 31-September 2, which would increase ERC again.

Lake Lenore Fire 2008, Bull of the Wood Wilderness

The Lake Lenore fire started on August 17th, 2008 (same start date as current fires) and over the next month and a half grew to 406 acres. Figure 4 below shows the ERC trend for 2008 compared to current. Based on current and projected weather, similar trends could be expected for the 2010 Bull of the Woods Complex fires. Over the next 6-8 days, a cool, moist trend is anticipated and over the course of September temperatures are expected to run slightly below normal with normal precipitation.

For the period of record analyzed at the Red Box RAWS, twelve of twenty-five years have included mid-September events with temperature over 80°, relative humidity below 20% and average wind over 6 mph, likely conditions for larger fire spread days than would be expected for 'average' September weather.

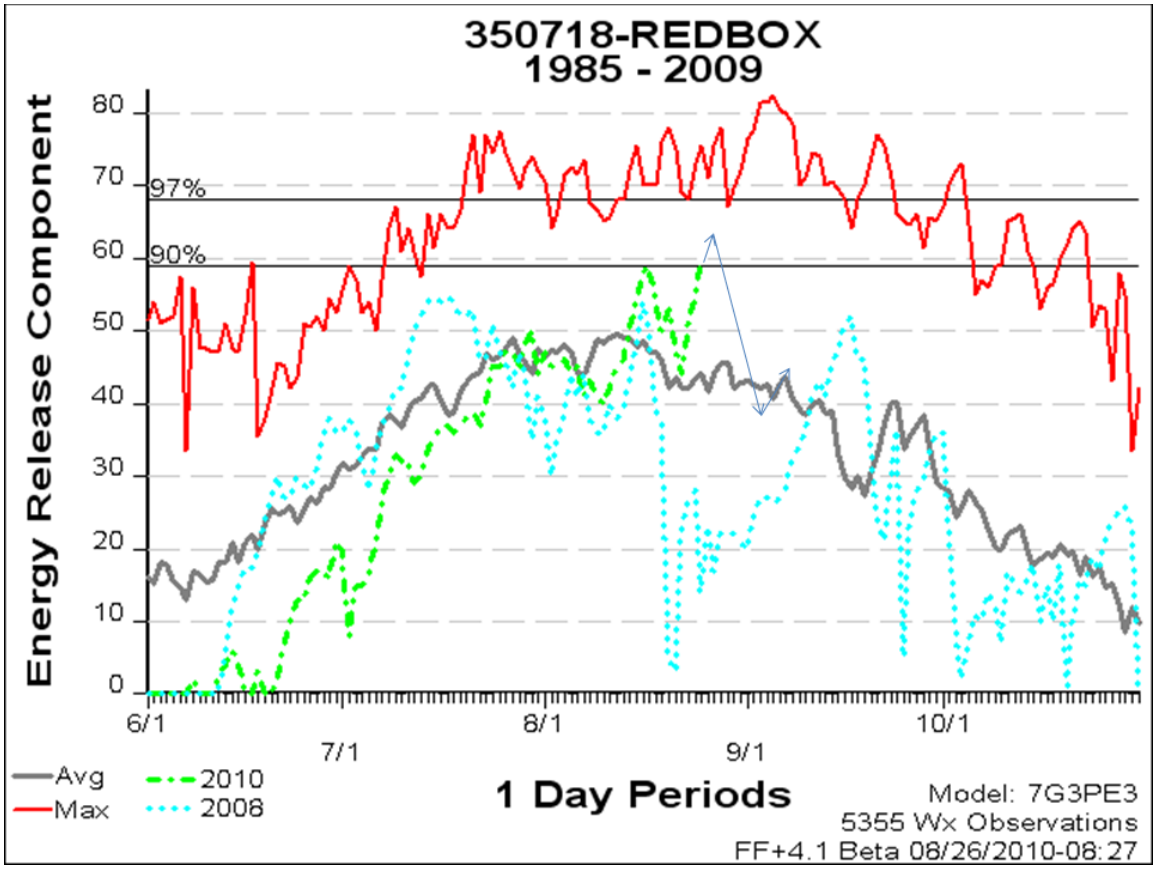


Figure 4. ERC at Red Box RAWS showing 2010 and 2008 for comparison with the Lake Lenore Fire. If similarities bear out, expect slow growth early in September with a 50% chance of 1-2 larger fire growth days in mid-September. Projected ERC is shown with blue arrows for the next 7-8 days from the August 24th ERC of 59.

Outlooks

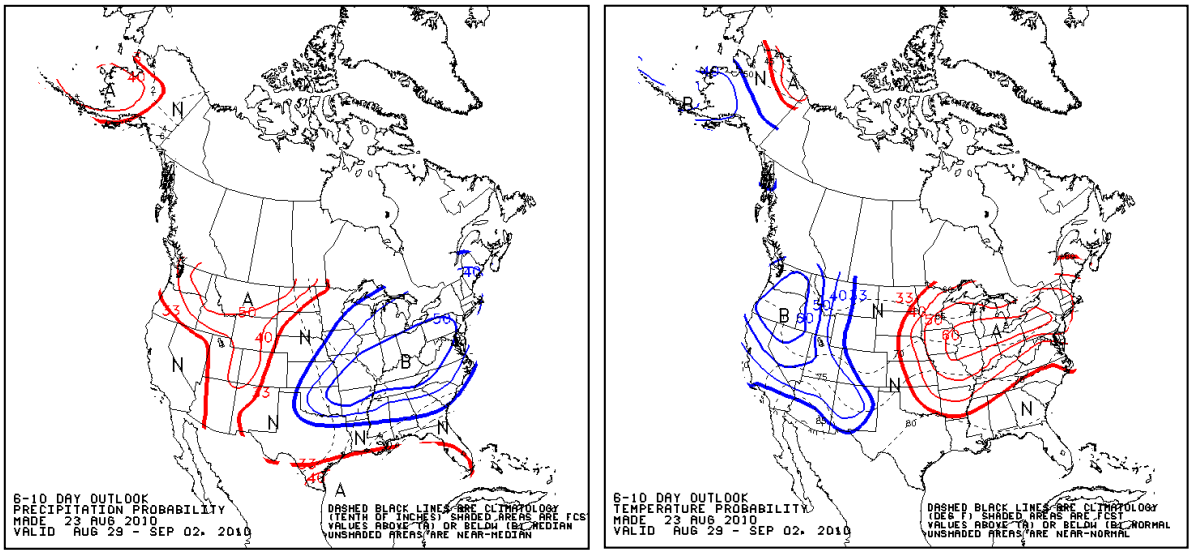


Figure 5. Six-ten day outlook valid August 29-September 02.

Figure 5 is the 6-10 day outlook for precipitation and temperatures compared to normal for the continental U.S. Below normal temperatures and above normal precipitation are forecast, though discussions with the local Fire Weather Meteorologist indicate very little precipitation is expected in western Oregon over the next few days.

Longer term outlooks are depicted in Figure 6 below for the month of September and the three month period September through November. September is forecasted for below normal temperatures and average precipitation. The three month period September through November is forecast for normal temperatures and above normal precipitation; this model likely depends upon the set-up of the predicted La Nina.

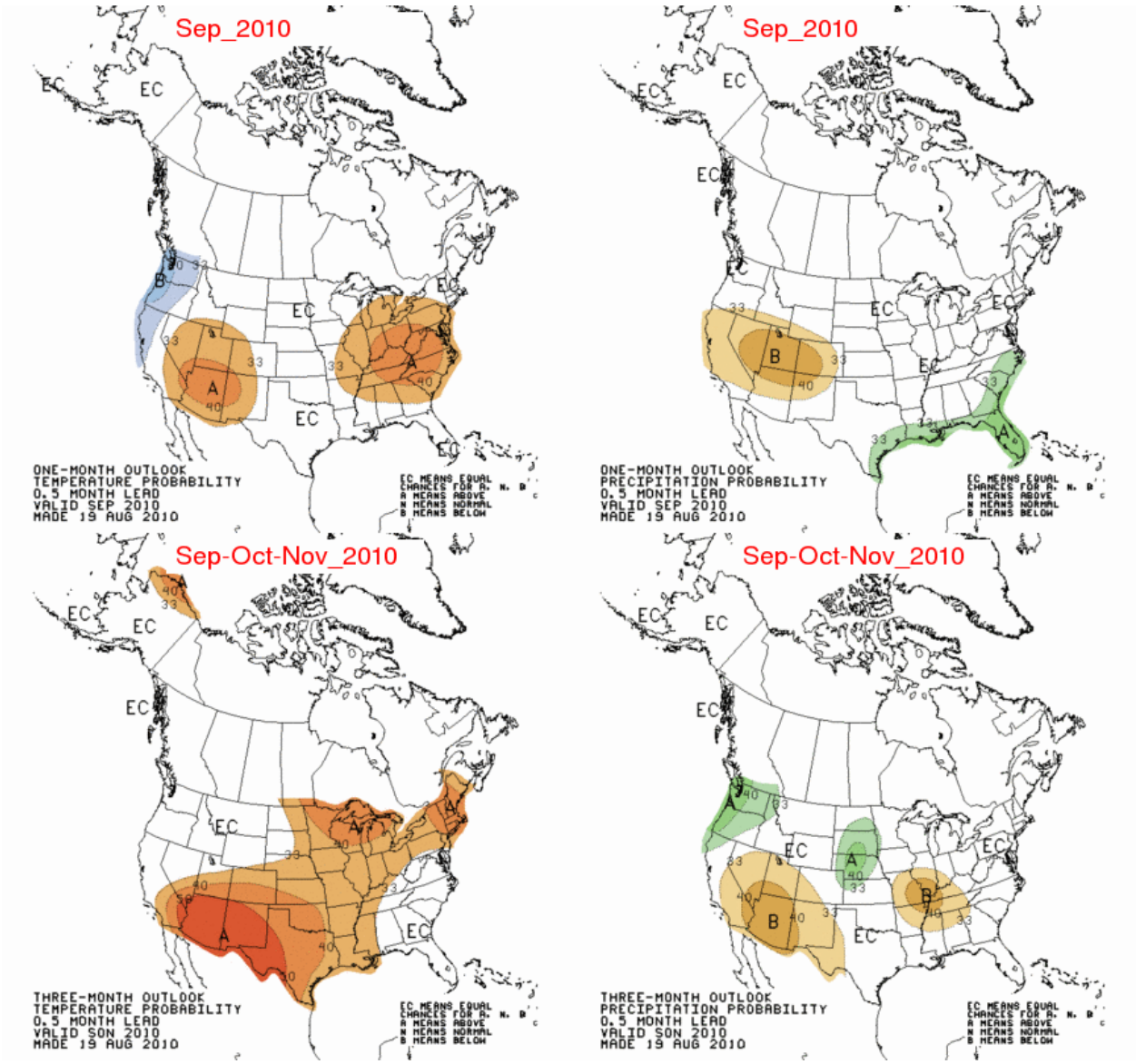


Figure 6. Four-panel temperature and precipitation outlooks for September and the three-month period September through November.

Critical Events

A long-duration fire faces several potentially critical events – periods of large spread, rain sufficient to slow fire spread for a few days and the end of the season.

Large Fire Growth and Season End

Large fire growth is largely wind driven and in this part of the forest, most often associated with east winds. East winds are generated when high pressure sets up to the east of the Cascades and low pressure to the west offshore or in the Willamette valley. East wind events do not show up in RAWS sites analyzed during the month of August, but do begin to manifest in mid-September. For purposes of locating wind events in September, 10 minute average winds greater than 6 mph were queried.

Wind roses are depicted below for the Red Box RAWS. East winds increase in frequency and speed in mid to late September, coinciding with cooling temperatures and shortening day lengths. Short duration runs are possible, but unlikely to extend beyond single burn period events after mid-September.

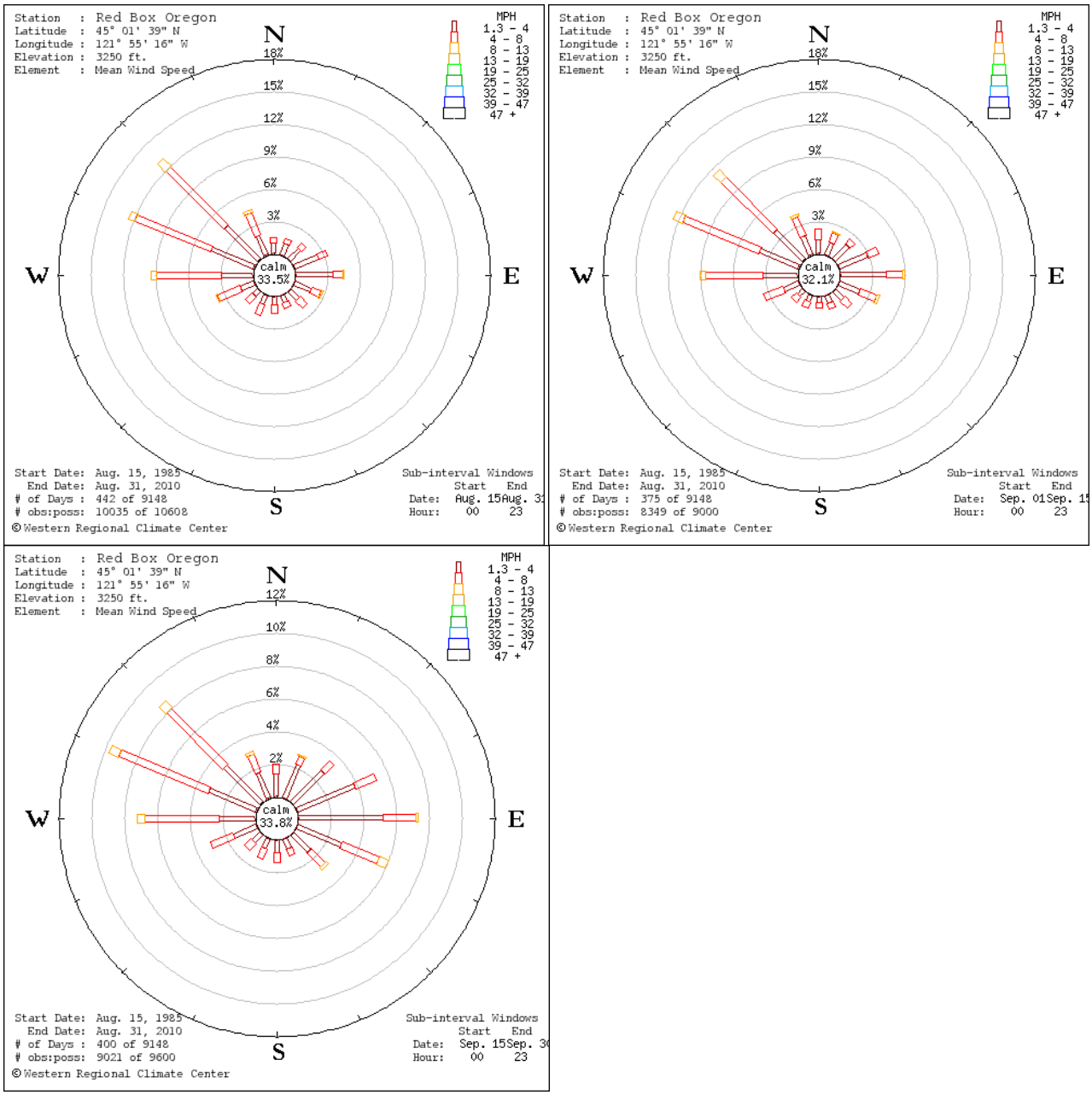


Figure 7. Wind Rose for Red Box RAWS depicting increase in east wind into mid and late September. Panels depict August 15-31, September 1-15 and September 15-30.

Large Spread Events

Large spread events in the Cascades and in the Bull of the Woods Wilderness tend to be driven by both wind and instability, these may act separately or together. The current fires have been largely driven by instability associated with thermal troughs in the sheltered areas below the ridges. Fire growth on August 25th moved with wind along ridgetops. These instability events are hard to discern in the weather record. In general, as the season progresses into September, thermal trough events will decrease with lower sun angle and decreased heating and east wind events will increase into fall. For the purposes of this analysis and to depict spread event probabilities for the remainder of the season, large spread events in September were defined for analysis in FireFamily Plus as temperatures greater than 80 degrees, winds greater than 6 mph and relative humidity less than 20%.

For the 25 year period analyzed at Red Box RAWS, 12 of the years (~50%) had events meeting the warm, dry and windy criteria in September. Years with 4-5 such September events include 1987, 1988 and 1994.

The 80th percentile maximum temperature at Red Box 81˚, the 10th percentile minimum relative humidity is 20% and the 90th percentile windspeed is 7 mph. These conditions tend to occur primarily as single day events in September, though the standout years above (’87, ’88, ’94) include 2 day consecutive events.

On the day the fires started (August 17), Red Box RAWS recorded a maximum temperature of 93˚ and 14% minimum relative humidity. The fires did nearly double in size on August 23rd when temperature reached 90 degrees and RH dropped to 13% at the Red Box RAWS. Winds recorded were SE at 3 with gusts to 11 mph, not a strong wind.

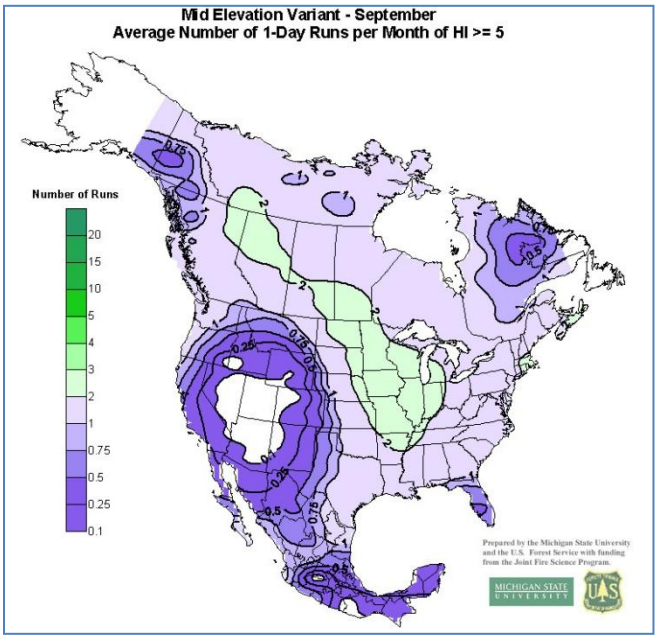
Onsite observations captured by the FOBS reflect the nature of shading and sheltering on the fires at their current location on the lower 2/3 of the slope; maximum temperature of 87 degrees, minimum RH OF 26% and calm to 2-4 mph upslope winds. Actual weather measurements higher on the slope have not been possible to date.

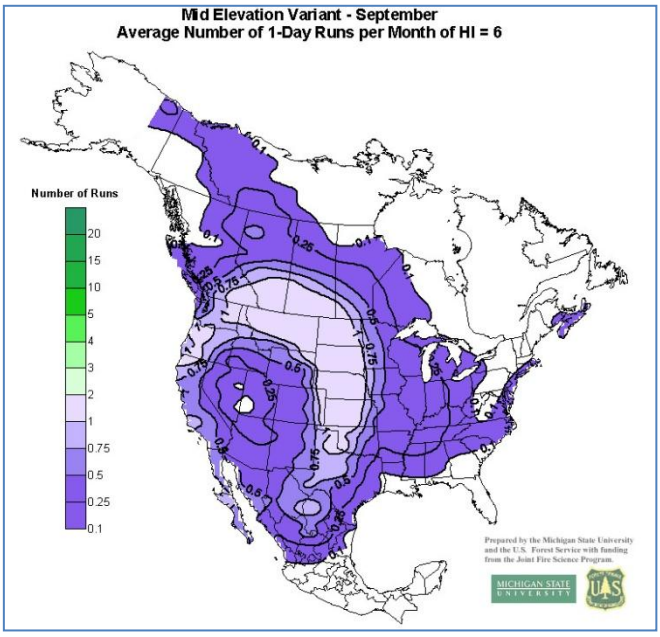
Haines Index and Fire Growth

Haines Index (HI) is a numerical value that indicates the potential for large wildfires to experience extreme fire behavior. The HI combines both the instability and dryness of the air by examining the lapse rate between two pressure levels in the atmosphere and the dryness of one of the pressure levels (definition from National Weather Service).

The significance of HI to the Bull of the Woods incident is how it may promote large fire growth prior to a season sending event. Considering the large amount of fuels in the fire area and the low probability of significant (+1”) moisture to reduce the fire intensity before the season ending event there is a opportunity for Haines condition to affect the fire.

Historically September produces at least one day that has a Haines Index of 5 and at least one day with Haines of 6. Figures 8 and 9 identify the likelihood of a Haines 5 or 6 based on data from 1961 to 2000.





Figures 8 and 9: Likelihood of Haines 5 or 6 for the United States.

This likelihood of a moderate (5) to high (6) Haines condition in this instance is significant. A fire that may have remained dormant, with little spread for many weeks could move explosively under Haines 5 or 6 conditions of one of two days.
Conditions to consider under Haines 5 or 6

- The amount of residual heat remaining inside the perimeter
- Where in the topography the fire has progressed to and how drainage patterns could influence the fires flow if it becomes plume dominated under a Haines 5 or 6

Fire Slowing Events

In terms of predicting fire growth over the remainder of the season, precipitation events that slow fire spread are as important as those events that cause significant spread. We used the two most common fire-slowing event types in the western United States for analysis:

- 0.10-0.25 inches – slows fire for 1-3 days
- 0.25-0.50 inches - slows fire for 3-6 days

We used the Event Locator tool in FireFamily Plus to find the likelihood of each type of event for the months of September and October. The probability of a fire-slowing event of any type would likely increase using 2 or 3 days cumulative precipitation instead of a single day, so the use of a single day provides a more conservative expectation.

	Slowing 1-3 days	**Slowing 3-6 days**
September	1	1
October	1-3	1-3

Table 3: Expected number of fire-slowing events for September and October by type based on data from Red Box RAWS.

Figure 10 below from the Three Lynx weather station corroborates the increase in precipitation probability through September into the fall season. Coop weather stations throughout the area have similarly increasing precipitation probability charts.

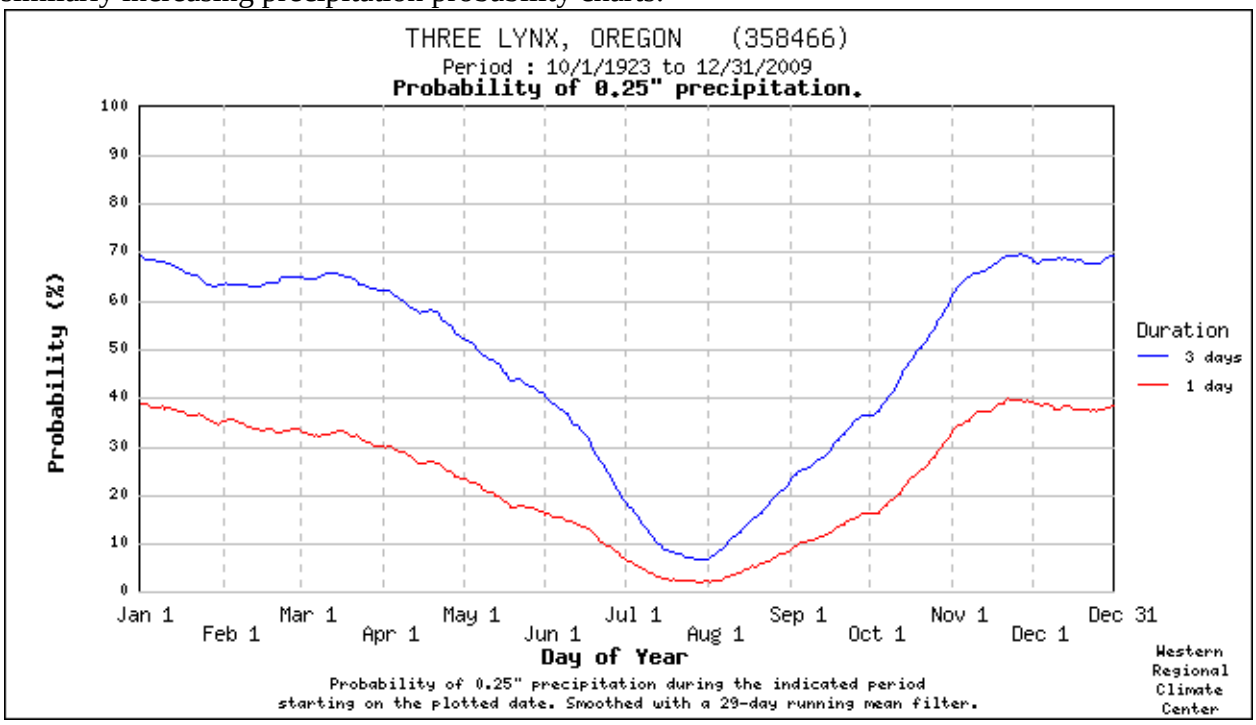


Figure 10: The chance of any precipitation is minimal in early to mid-August, but begins to increase in late August and continuing through fire season end (and beyond).

Season End

The season ending event criteria used was developed by the State and Regional Fire Ecologist Louisa Evers for the 2006 Mount Hood Complex. The conservative analysis evaluates ERC falling below the 75th percentile and not recovering for the remainder of the season. The liberal analysis evaluates the date of first fall below the 75th percentile regardless of whether it later recovered above that point. The purpose of the season end event in this type of assessment is to determine when critical spread events (100 acres or more) are unlikely either on new starts or ongoing fires. Fires can still start and spread after this type of event. Two term files reflecting the conservative and liberal approach were developed for the Red Box RAWS and may be found in the documentation package. Table 4 below highlights the season end dates from each approach. In general, season end occurs early October in the liberal approach and early November for the conservative approach.

Season End	**'Conservative' Approach**	**'Liberal' Approach**
80% probability	10/13	9/5
97% probability	11/7	10/1

Table 3. Season end dates for Red Box RAWS using two approaches for estimating when large spread events are unlikely to occur for the remainder of the fire season.

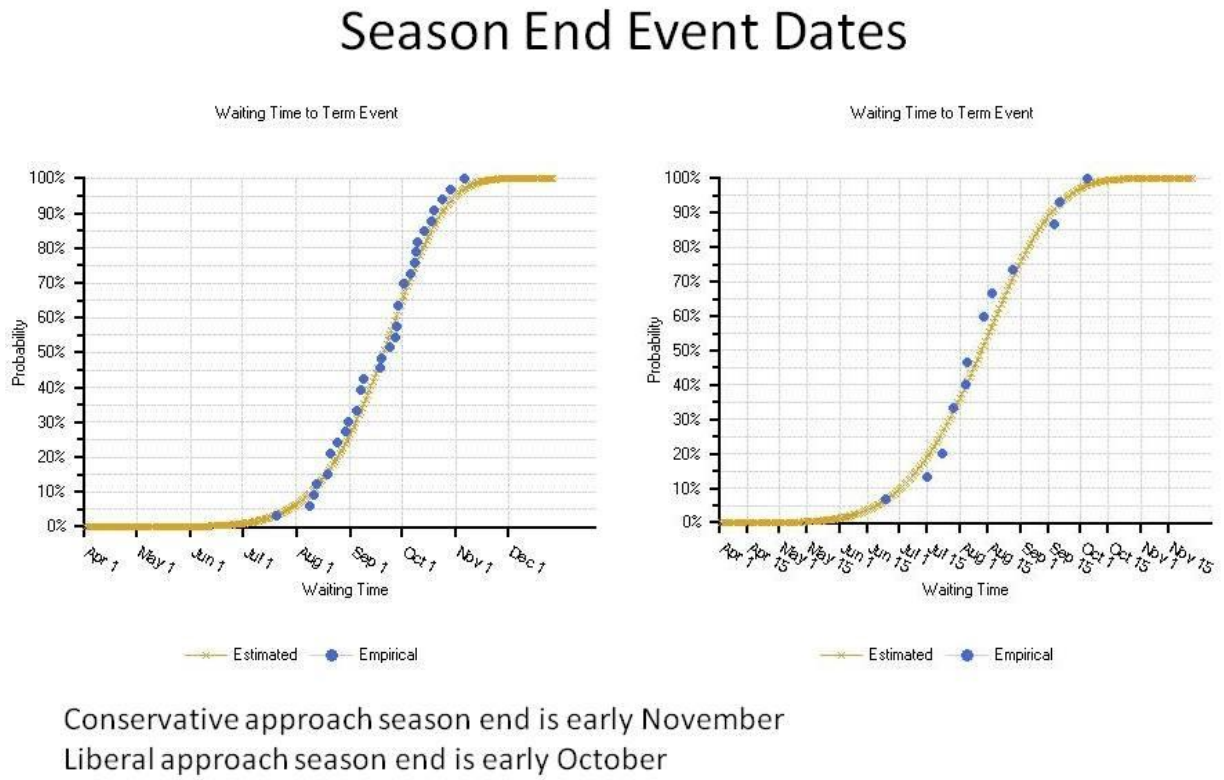


Figure 11. Waiting time to season end curves. 'Conservative' approach is on the left and the 'liberal' approach is on the right.

Along with changing temperatures and relative humidity, changing sun angles and day lengths contribute to the decay and eventual end of potential for large fire growth. Between August 15 and October 15, the maximum sun angle declines by 22.6˚, rising only to 35.8˚ above the horizon on October 15. This drop in angle reduces the sun's effectiveness in preheating fuels through radiant energy. The day length reduces by slightly over 3 hours in that same period with most of the loss (113 minutes) in the evening.

In addition to reduced solar heating of fuels and reduced burning periods, small rain events begin to have a significant impact on fire spread potential on the lower 1/3 of slopes and north and east aspects. North aspects in particular that receive a wetting rain after about September 15 are unlikely to dry sufficiently to carry fire except on the upper 1/3 of the slope. South and west aspects at the bottom of very narrow drainages may be similarly affected.

Conversations with local personnel indicate that with the exception of 'rare' years, fire season has wound down by early October.

Risk Assessment

Fire Growth Projections

The Fire Spread Probability (FSPro) model was the primary tool used to evaluate fire spread potential. FSPro is a spatial model that calculates the probability of fire spread in all directions from a current

fire perimeter or ignition point. FSPro models fire spread of hundreds or thousands of weather scenarios based on local climatological records to determine the probability of a fire spreading through an area over a given time period. The model is used to identify the probability that areas of concern could see fire. The outputs are helpful for developing priorities and analyzing values at risk.

The details of the FSPro assessment are found in Appendix B.

Modeling Discussion

Figure 11 is the graphic display of the FS-Pro modeling ran for this complex of fires. FSPro indicates modest spread to the north, northeast, and west. It is likely in the next 14 days that the fire will breach the wilderness boundary to the NE (near Schreiner Peak and Pine Cone Creek). Otherwise, there is a high probability that fire spread will remain in the Wilderness. Fire spread is moderated due in part to higher fuel moisture, availability of surface fuels, higher crown base heights, and sheltering from the ridges to the east (Janus Butte) and west (Pansy Mountain).

- Rare events (pink areas [i.e., < 8 fires out of 5,000 simulations]) show spread west, south and northeast. These significant advances are due to crown fire runs and long-range spotting.
- The ignition is from the evening of the 23rd. It does not account for the growth on Aug. 24th and 25th. It is recommended that a subsequent run be completed Aug. 26 or 27 after the current fire growth period pauses.
- Attention needs to be given to thermal trough development in the fire area. This weather phenomenon can result in rapid fire growth and is not reflected adequately in RAWS data, hence not modeled by FSPro.

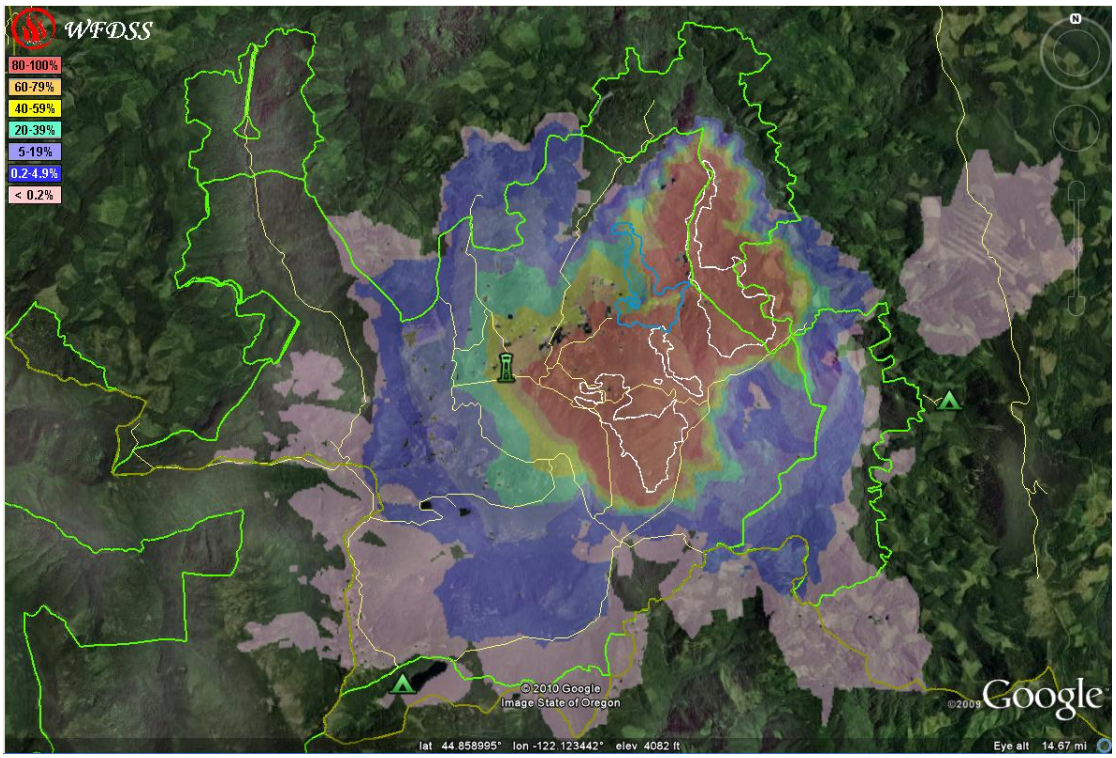


Figure 11: FSPro output for 14 days (Aug. 26–Sept. 8). The new and old wilderness areas are shown in green, trails in light yellow, and the Lake Lenore Fire (2008) in light blue.

Terrain can have a significant effect on the ability of winds to influence fire behavior. This sheltering is shown in a graphic created by WindWizard (Figure 10), displaying the effects of a wind blowing directly from the west. It is likely that fire intensity and spread will increase as the fires burn up the slope or channel north or south in Elk Lake Creek, but there are other portions of the fire perimeter well sheltered by the surrounding terrain and much less vulnerable to wind effects.

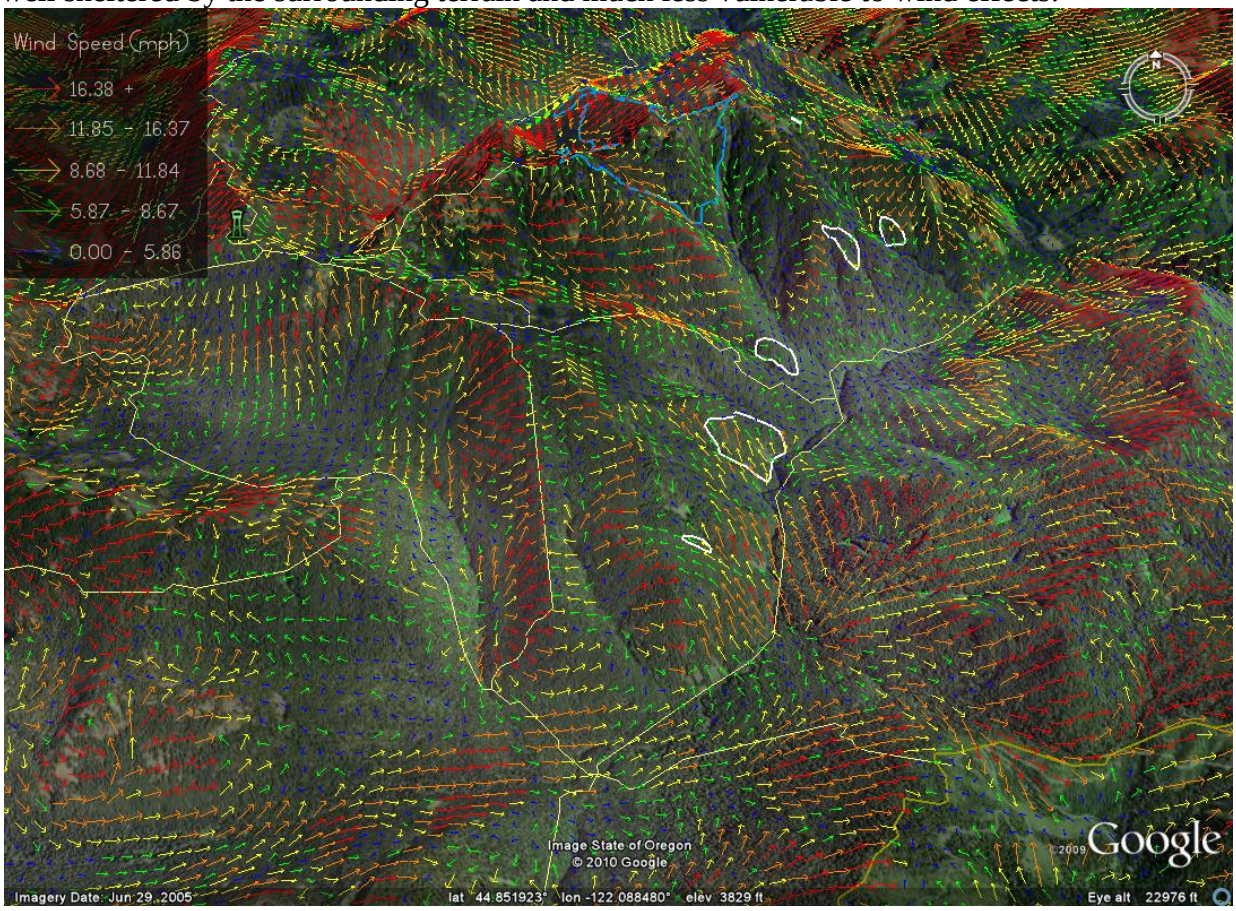


Figure 12: WindWizard output (winds from the west [270 degrees]). Note the lower wind speeds in the fire areas as a result of topographic sheltering.

Management Action Points (MAP) for the Bull of the Woods Wilderness Complex

Summary

MAP 1 – Pansy Creek The purpose of this MAP is describe the area around the Pansy Creek drainage and what resources might be needed to prepare for an eventual threat to the management area boundary. The recommendation is to use a masticator to create a shaded fuelbreak along the 6341 road.

MAP 2 – Dickey Creek This MAP consists of the Farm and Dickey Creek drainages to just south of Happy Creek. The recommendation is to use masticators to create a shaded fuelbreak from the 6340/6341 intersection to the 6370 and then south on the 6370 to the area between Happy and Blue Creeks. Without construction of a shaded fuelbreak, the only strategy to keep a fire west of the management boundary is to hope it stays west of Collawash River.

MAP 3 – Schreiner Peak The concern of MAP 3 is having fire come off of Schreiner Peak and down out of the wilderness to the 6370 road. Additionally, there is a chance that fire can move down the Elk

Lake drainage past the 6380 road. Fire is now established on both sides of Elk Lake Creek and on the east side of Schreiner Peak in the uppermost clear cuts. It is important to begin treating the 6370 road with masticators to build a shaded fuelbreak. This MAP is the highest priority to treat.
MAP 4 – Janus Butte MAP 4 runs along the 6370 road from Round Lake to the area of Scorpion Mountain. In order for the fire to reach MAP 4 it will have to spread over the top of Janus Butte and back down/roll out to Collawash River and spot across. There is a low likelihood of this occurring before a season ending event but there is a chance. For this reason it is important to complete the shaded fuelbreak on the 6370 road.
MAP 5 – Elk Lake This MAP has a low likelihood of being impacted by the fire. However for long term management of fires in the wilderness, it would be useful to have a shaded fuelbreak along the 4697 road from Elk Lake eastward to the southeast portion of the wilderness near Scorpion Mountain.

Summary - When there have been limited days with active fire spread it can be difficult to imagine the fire threatening the wilderness boundary or management area boundary. Rain and cooler temperatures are predicted for next week, and is critical to prepare now for the inevitable warmer days in September. The shaded fuelbreak can be made quickly and efficiently with heavy equipment on large chassis with masticating heads. The work can be done from the roadway and not cause any ground based resource damage. Handcrews can be used instead of the masticators but the material will have to be chipped or disposed of in order for the fuelbreak to be functional. A mechanically constructed shaded fuelbreak will be completed quickly requiring fewer personnel than one built with a handcrew. The roadside shaded fuelbreak should be thought of in terms of a long term investment for future fire seasons which will need to be refreshed periodically.
The locations of the selected roads are not optimal for safe and efficient firefighting efforts. Most are mid-slope and do not offer an optimal location for burn out operations. Ridge top roads exist east of the selected locations on MAPs 3 and 4 but they are 1 to 3 miles away and given expected fire behavior for the remainder of the season are likely not good choices. It is recommended that at a later date, those locations be brushed for possible future use as fuelbreaks as well. On the other hand, it is not expected that the fire will make an aggressive run towards the selected road locations down below. Considering the fuels and expected fire behavior, the selected shaded fuelbreak locations should suffice. If the district knows of better locations those possible changes to the selected locations should be made.
In addition to the shaded fuelbreaks, it is suggested that any potential firefighting efforts be limited and kept to slowing efforts by using burn out techniques and hand built check lines.
The Bull of the Woods lookout tower will need only minimal hand crew work to be safe from wildfire. A squad of firefighters should hike in annually to prep the tower in the early part of the fire season.

Recommendations

Recommendations:

- Place a portable Remote Area Weather Station (RAWS) near the fire to enable off-site monitoring of weather conditions. We recommend a site east of the fire area (Round Top, for example).
- The Bull of the Woods Lookout site is the improvement at most risk from the fire, although the risk is small (less than 5% within 14 days). We have done an assessment of the site, and made recommendations for protection of the site should the Forest determine that fire progression makes the protection necessary. See Appendix A for detail.
- We have identified Management Action Points in the form of road segments that could eventually be used as containment lines once they were adequately prepared – e.g., through the

thinning and removal of trees and other live and dead fuels. We recommend that MAPs 3 and 2 be prepared first

- The Wildland Fire Decision Support System (WFDSS) has been started for this complex of fires. We recommend that the decisions, analysis, strategic risk assessment, and periodic validations of strategy be posted and maintained on this site for these fires.
- Periodic reassessment – this assessment has a limited shelf life. We recommend that a reassessment be completed in14 days, or if situation changes dramatically. This reassessment is a relatively short exercise, even with new FSPro runs, because the base information and work has already been completed.

Long-term Assessment Team

Long Term Assessment Team Members

Bill Aney	Team Lead
Cyndi Sidles	Long Term Analyst
Brett Fay, Rick Stratton	Long Term Analyst trainees
Bobbie Scopa	Operations
Dennis Winkler	Fire Behavior Analyst
Mike Brown	Field Observer
Angie Bogut	Fire Effects Monitor trainee
Sara Savage	Field Observer trainee
Kim Viera	GIS Specialist

Appendix A- Management Action Points and Plan
Appendix B - Risk Assessment
Appendix C - Behave Summary

Appendix A - MAPs

Management Action Points (MAP) for the Bull of the Woods Wilderness Complex
Summary

MAP 1 – Pansy Creek The purpose of this MAP is describe the area around the Pansy Creek drainage and what resources might be needed to prepare for an eventual threat to the management area boundary. The recommendation is to use a masticator to create a shaded fuelbreak along the 6341 road.
MAP 2 – Dickey Creek This MAP consists of the Farm and Dickey Creek drainages to just south of Happy Creek. The recommendation is to use masticators to create a shaded fuelbreak from the 6340/6341 intersection to the 6370 and then south on the 6370 to the area between Happy and Blue Creeks. Without construction of a shaded fuelbreak, the only strategy to keep a fire west of the management boundary is to hope it stays west of Collawash River.
MAP 3 – Schreiner Peak The concern of MAP 3 is having fire come off of Schreiner Peak and down out of the wilderness to the 6370 road. Additionally, there is a chance that fire can move down the Elk Lake drainage past the 6380 road. Fire is now established on both sides of Elk Lake Creek and on the east side of Schreiner Peak in the uppermost clear cuts. It is important to begin treating the 6370 road with masticators to build a shaded fuelbreak. This MAP is the highest priority to treat.
MAP 4 – Janus Butte MAP 4 runs along the 6370 road from Round Lake to the area of Scorpion Mountain. In order for the fire to reach MAP 4 it will have to spread over the top of Janus Butte and back down/roll out to Collawash River and spot across. There is a low likelihood of this occurring before a season ending event but there is a chance. For this reason it is important to complete the shaded fuelbreak on the 6370 road.
MAP 5 – Elk Lake This MAP has a low likelihood of being impacted by the fire. However for long term management of fires in the wilderness, it would be useful to have a shaded fuelbreak along the 4697 road from Elk Lake eastward to the southeast portion of the wilderness near Scorpion Mountain.

Summary - When there have been limited days with active fire spread it may be difficult to imagine the fire threatening the wilderness boundary or management area boundary. Rain and cooler temperatures are predicted for next week. It is critical to prepare now for the inevitable warmer days in September. The shaded fuelbreak can be made quickly and efficiently with heavy equipment on large chassis with masticating heads. The work can be done from the roadway and not cause any ground based resource damage. Handcrews can be used instead of the masticators but the material will have to be chipped or disposed of in order for the fuelbreak to be functional. A mechanically constructed shaded fuelbreak will be completed quickly requiring fewer personnel than one built with a handcrew. The roadside shaded fuelbreak should be thought of in terms of a long term investment for future fire seasons which will need to be refreshed every 3 to 4 years.
The locations of the selected roads are not optimal for safe and efficient firefighting efforts. Most are mid-slope and do not offer an optimal location burn out operations. Ridge top roads exist east of the selected locations on MAPs 3 and 4 but they are 1 to 3 miles away and give up too much land to make them good choices. It is recommended that at a later date, those locations be brushed for possible future use as fuelbreaks as well. On the other hand, it is not expected that the fire will make an aggressive run towards the selected road locations down below. Considering the fuels and expected fire behavior, the selected shaded fuelbreak locations should suffice. If the district knows of better locations those possible changes to the selected locations should be made.
In addition to the shaded fuelbreaks, it is suggested that any potential firefighting efforts be limited and kept to slowing efforts by using burn out techniques and hand built check lines.
The Bull of the Woods lookout tower will need only minimal hand crew work to be safe from wildfire. A squad of firefighters should hike in annually to prep the tower in the early part of the fire season.

In order to be prepared, the shaded fuelbreak should be completed and a plan to mobilize holding resources with supervision in place.

Management Action Point Descriptions

MAP #	Objectives/Conditions	Actions	Resources Needed Cost
MAP 1 **Pansy Creek**	**Objective:** Keep fire from moving down Pansy Creek **Condition:** Fire would have to spread up drainage from its present location and over the top of Pansy Mountain to become established in upper Pansy Creek.	**Decision Point:** Fires become established in the Bull of the Woods Wilderness. **Action:** Mechanical masticators will be used on the 6341 road from Pegleg Falls day use area back to the intersection with the 6340 road. All mechanical work will be done from the roadbed to create a shaded fuelbreak. **Alternative Action:** If the 6341 road is threatened by the advancing fire, limited holding actions can be taken such as burning out and check hand lines. The proposed action is not meant to burn out the entire road, but only those limited areas where the line is immediately threatened. **Probability of Success: 90%**	**Resource Needs for Action**: 1 masticator with dozer boss for 5 days. **Cost:** $15,280 **Resource Needs for Alternative Actions:** 1 type 1 or type 2IA crew, 1 type 2 crew, 1 overhead 1 week **Cost:** $73,688
Risk of Implementation: Risks associated with this action are limited to firefighter exposure to heavy equipment during the masticating process. During the alternative action of burning out and building check lines there will be firefighter exposure to smoke, limited downhill line construction, and other typical risks associated with holding actions. **Consequences of not implementing:** If no roadside thinning/masticating occurs there is a risk of the fire moving out of the wilderness and across the management area boundary. Not creating shaded fuelbreaks along the road also affects firefighter safety in a negative aspect. It is critical to have safe areas to work from if firefighting resources are expected to take holding actions. **Recommendation:** Considering the time of year, there is little chance that the fire will get into Pansy Creek. However a shaded fuelbreak on the 6341 road will provide a level of safety for egress			

and ingress and a place to burn out from in case it is needed. This work has to occur prior to being needed. The actual work will take some time to complete so it should start soon.

MAP #	Objectives/Conditions	Actions	Resources Needed Cost
MAP 2 **Dickey Creek**	**Objective:** Keep fire from coming out of Dickey Creek and threatening the management area boundary. **Condition:** Fire would have to spread north of Knob Hill and Schreiner Peak and become established on the slopes above Dickey Creek	**Decision Point:** If fires are established within the Bull of the Woods Wilderness area. **Action:** Shaded fuelbreak construction along road 6340 to the intersection with the 63 road then south on the 63 road to a point between Happy Creek and Blue Creek. **Alternative Action:** At such time that the fire is potentially threatening the line, holding action can take place to keep the fire south and west of the lines. This could include burning out and limited line construction for checking action. It is expected that only small limited areas of fire may push the line at any one time. **Probability of Success:** 90%	**Resource needs for Action:** 2 Large Masticators, 2 dozer bosses, 1 Overhead for 1 week. **Cost:** $15,472 **Resource Needs for Alternative Action:** 2 type 1 or type 2IA crews 2 type 2 crews 3 overhead 1 week **Cost:** $308,488

Risk of Implementation: Masticating along the roads will expose firefighters to normal risks associated with operating around heavy equipment. There will not be any ground disturbance off the roadbed so no soil or resource damage should occur.

Consequences of not implementing: Not completing the shaded fuelbreak along the roads will expose firefighters and the public to risks associated with access issues in case of fire. If fire reaches the management area boundary and the road work is not completed, the chance for fire spread across the road is very high regardless of whether firefighters are present or not.

Recommendation: It is recommended that work begin soon on the roadside mastication. When the weather warms up again in at the end of August or in September, fire activity will increase again. It is important to have contingency lines in place and ready to use if fire spread threatens the

management boundary.

MAP #	Objectives/Conditions	Actions	Resources Needed Cost
MAP 3	**Objective:** Keep the fire from coming down off of Schreiner Peak and across the Collawash River and east of the 6370 road as well as coming down drainage from Elk Lake Creek and out to the Management boundary. **Conditions:** Fire would be established on the slope above the Collawash River below Schreiner Peak or at the wilderness boundary and Elk Lake Creek.	**Decision Point**: Once fire is well established below Schreiner Peak (IR indicated heat in this location on August 25) a decision should be made. **Actions**: Begin shaded fuelbreak construction along the 6370 road from the Dickey Creek MAP south to the vicinity of Round Lake. **Alternative Action**: If the line is being threatened by the advancing fire, holding actions will need to be taken. Burning out only where necessary and potential handlines can be used to check the fires spread. **Probability of Success:** 90%	**Resources**: 1 large masticator 1 dozer boss 1 week **Cost:** $15,280 **Resource Needs for Alternative Action:** 2 type 1 or type 2IA crews 2 type 2 crews 3 overhead 1 week **Cost:** $308,448

Risk of Implementation: Masticating along the roads presents low risk to the few firefighters who are directing the work. There is little environmental risk due to the equipment staying on the roadbed with only the articulated masticating head reaching out to chip the small trees and brush.

Consequence of not implementing: Not creating the shaded fuelbreak will increase the risk to firefighters in case holding operations on the road becomes necessary. Without completing the fuelbreak, there is really little chance to use the roads as a place to fire from or take any type of holding action. This MAP is the most critical to complete as soon as possible since fire is now established (August 25) across Pinecone creek below Schreiner Peak.

Recommendation: Begin the roadside shaded fuelbreak as soon as possible. Fire may stall on the hillside above the Collawash River for awhile following the cooler more moist weather, but it will surely become warmer and drier. The Forest will have little time to react if the fire moves down slope and spots across the river. FSPro predicts this area to be the most likely for fire spread and impinge upon the management area boundary. The fire (as of this writing) is already out of the wilderness.

MAP #	Objectives/Conditions	Actions	Resources Needed Cost
MAP 4 Janus Butte	**Objective:** Keep fire from moving south out of the wilderness across the 4697 road. **Condition** Fire would have to be well established in upper Elk Lake Creek west of Janus Butte.	**Decision Point:** If fire becomes established in upper Elk Lake Creek work should begin. For use in future years, the shaded fuelbreak should be completed well before it is needed. **Action:** Shaded Fuelbreak construction along the 4697 road from Elk Lake to Scorpion Mountain. **Alternate Action:** It is not expected to have to burn out this MAP this year. There is little chance of the fire moving this far up drainage with the time the fire season has left and the predicted weather.	**Resources**: 1 large masticator 1 dozer boss 10 days **Cost:** $20,160

Risk of Implementation: Risk is to the Dozer Bosses working with the masticators and the operators. Minimal exposure.

Consequence of not implementing: There is some risk of the fire coming over the top of Janus Butte since it has become established east of Elk Lake Creek. FSPro gives less than a .2% chance of the fire from reaching the wilderness boundary by September 8th. However, if there is a warm period in September which is typical, fire may continue to burn on the east slope of Janus Butte with the potential to spot across Collawash River. If this occurs and no preparation is done on the roads east of the Collawash River, the fire is likely to make some limited short runs upslope towards Round Meadow.

Recommendation: Complete the suggested shaded fuelbreak and monitor fuels, weather and fire behavior for possible holding actions.

MAP #	Objectives/Conditions	Actions	Resources Needed Cost
MAP 5 Elk Lake	**Objective:** Keep fire north of the wilderness boundary. **Condition:** Fire is established in upper Elk	**Decision Point:** If fire is established in upper Elk Lake Drainage and the weather is warm and dry or	**Resources**: 1 large masticator 1 dozer boss 10 days

	Lake Creek drainage.	predicted to be. **Action:** Complete the shaded fuelbreak along the 4697 road along the south wilderness boundary. **Alternative Action:** It is unlikely that any burning out or holding will be required for this fire season. FSPro predicts a less than a .2% chance that fire will arrive in this location within the next 14 days.	**Cost:** $20,160
Risk of implementation: Limited risk to a dozer boss while the heavy equipment is being operated as well as to the operators. **Consequences of Not implementing:** Low risk of not implementing the proposed action this year due to the lateness of the season and the predicted weather and fire behavior. There is high risk to Breitenbush Hot Springs and the Detroit Lake State Park in the future if a fire occurs and no work has been completed on any kind of fuel modification south of the wilderness area. **Recommendations:** It is recommended to complete this project for future fires. There are limited locations for firelines in the case of a fire in the upper Elk Lake drainage. Once a fire has started it is often too late to begin the work necessary to make nearby values at risk safe and there are no good opportunities between the wilderness boundary and the values at risk along Forest Road 46.			

MAP #	Objectives/Conditions	Actions	Resources Needed Cost
Bull of the Woods Lookout	**Objective:** Protect the historical structure from fire.	**Decision Point:** There is no decision point for this value at risk. The area around the lookout should be maintained in a way so that it is safe under most circumstances from fire. **Action:** The fuels immediately around the tower are relatively light. Some limited hand tool and saw work is necessary. More importantly the tower is in a state of disrepair and represents a hazard as a receptive fuelbed from	**Resources:** 5 firefighters for 1 day. **Cost:** < $5,000

		falling embers. There are three options to attempting to protect the structure. 1. First option is to wrap the structure. This will require laddering the building with personnel trained and equipped with the proper ladders and fall protection. 2. Sling a pumpkin, pump and sprinklers up to the site. 3. Treat the ridge top and structure with retardant prior to the expected fire and ember wash.	

Risk of Implementation: The risk of pre-treating the fuels with a squad of firefighters carries with it a low risk. Firefighters can be in and out of the site long before the fire arrives.
1. Wrapping - The risk of wrapping the structure is having personnel on ladders and working 30' and must be OSHA compliant with fall protection etc.
2. Pumps – Equipment will have to be slung in to the site and personnel will have to set up the pumps and sprinklers. A helicopter will have to fill the pumpkin. A major risk will be when firefighters start the pump prior to the fire arrival and will they ride out the fire at the tower or leave. Timing will be critical from a mission success and firefighter safety perspective.
3. Retardant – The risk of treating the tower with retardant is that exposure to the pilot while completing the mission.
Consequences of Not Implementing: The worst case scenario of not implementing any of the 3 scenarios is losing the tower.
Recommendation: Do not take any action other than treating the fuels around the tower.

Appendix B - Risk Assessment

FSPro Analysis for Bull of the Woods Complex (Mt. Hood NF)

Location: Sandy, OR | Date: Aug. 26, 2010 | Analyst: Rick Stratton (rdstratton@fs.fed.us)

Purpose

The purpose of this paper is to provide FSPro analysis for the Bull of the Woods Complex for inclusion in the long-term assessment plan. The FSPro analysis is tied to fire #259 in WFDSS.

Background

The Bull of the Woods Complex started from a series of lightning fires August 17th. From a helicopter recon, 11 fires were located in the wilderness and a GIS point layer created. Due to suppression and fires extinguishing, six fires were modeled in FSPro.

Model Inputs

- Number of days: 14 days (Aug. 26 – Sept. 8)
- Number of fires: 1,000
- Ignition information was obtained from an IR flight on the evening of Aug. 25th (2313 hrs).

Fuels

- LANDFIRE National (Sept. 29, 2009) and Rapid Refresh fuel model data was evaluated. National was selected because it (1) delineated the plantations adequately, and (2) National incorporates recent calibration workshops. Adjustments to the National data include: converting fuel model 185 (High load conifer litter) to 183 (Moderate load conifer litter) in the drainages, reducing canopy cover by 25%, increasing the crown bulk density (1.5 times), and accounting for the Lake Lenore Fire (2008)—converted to a 181 (Low load compact conifer litter).
- Default NFDRS calculated live and dead fuel moistures were used. The fire site is wetter than the RAWS site, but this was compensated for in the burn period.
- The burn period was significantly reduced to reflect moderate burning conditions in Elk Lake Creek.
- The defaults for spotting probability were used.

Weather

- Fuel moisture and historic weather and wind were obtained from Red Box RAWS (350718) (1985-2010). We also considered Boulder (2nd choice), Wanders Peak (in a saddle), and Horse Creek (lower elevation).
- A 3-day forecast was obtained from the National Digital Forecast Database via WFDSS. This forecast had ERCs in the 90th+ percentile and winds moderate out of the NE and NW.
- Winds were filtered by Aug. 15 – Aug. 31 form 1100 to 1900. 10-minute winds and gusts were used by selecting “both”(Figure B1).

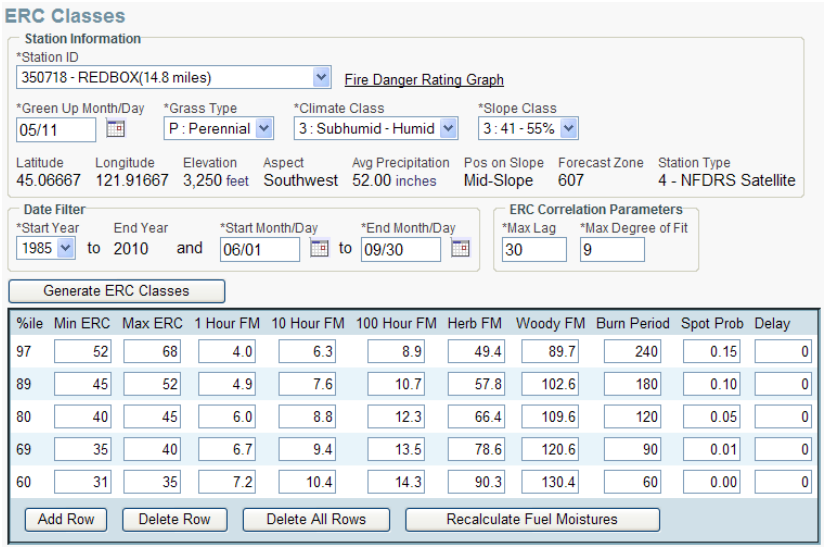


Figure B1 Screen capture of ERC Classes using Red Box RAWS.

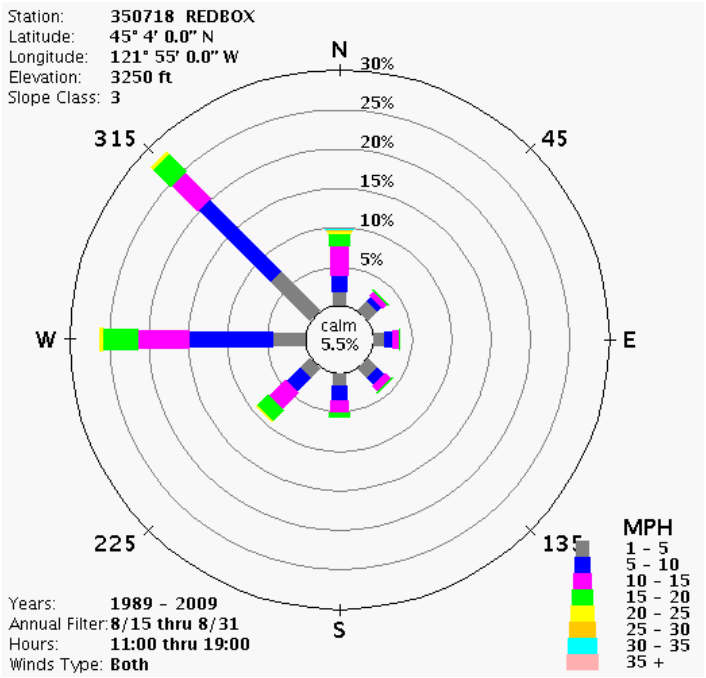


Figure B2 Wind rose for Red Box RAWS (1989 – 2009; 1100 to 1900).

Modeling Discussion

- FSPro indicates modest spread to the east, north, and west (Figure B2). It is likely in the next 14 days that the fire will breach the wilderness boundary to the NE (near Schreiner Peak and Pine Cone Creek) and impact the Bull of the Woods Lookout. Otherwise, there is a high probability that fire spread will remain in the Wilderness. Fire spread is moderated due in part to higher fuel moisture, availability of surface fuels, higher crown base heights, and sheltering from the ridges to the east (Janus Butte) and west (Pansy Mountain). This sheltering is shown in a graphic created by WindWizard (Figure B1). It is likely that fire intensity and spread will increase as the fires burn up the slope and is exposed on the ridge or channel north or south in Elk Lake Creek.

- Rare events (pink areas [i.e., < 2 fires out of 1,000 simulations]) show spread west, south and east. These significant advances are due to crown fire runs and long-range spotting.

- Attention needs to be given to thermal trough development in the fire area. This weather phenomenon can result in rapid fire growth and is not reflected adequately in RAWS data, hence not modeled by FSPro.

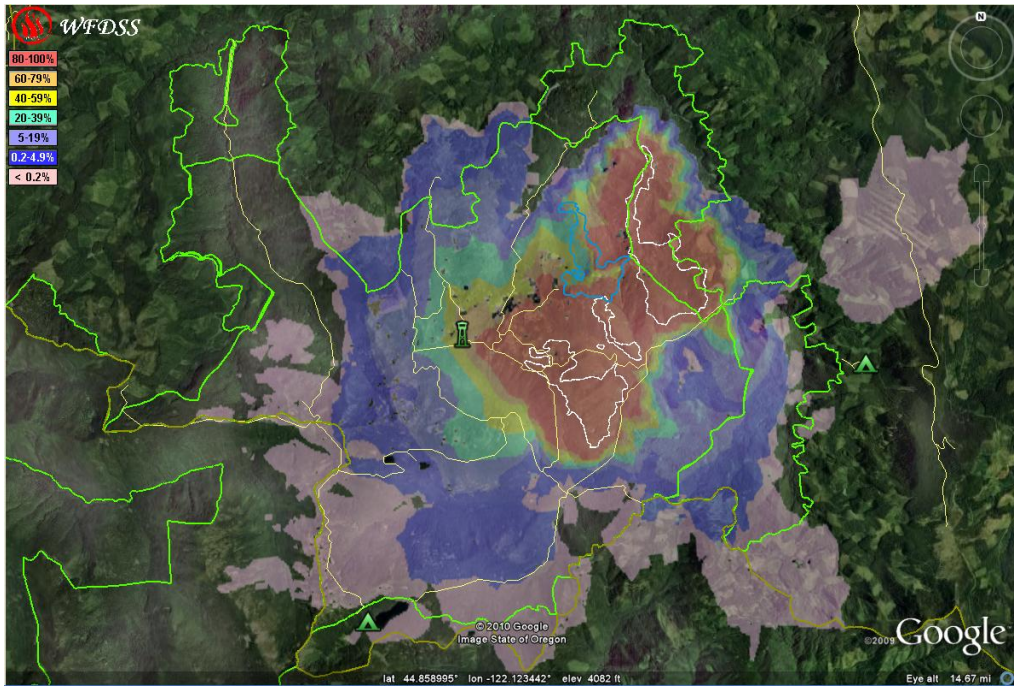


Figure B3: FSPro output for 14 days (Aug. 26 – Sept. 8). The new and old wilderness areas are shown in green, trails in light yellow, and the Lake Lenore Fire (2008) in light blue.

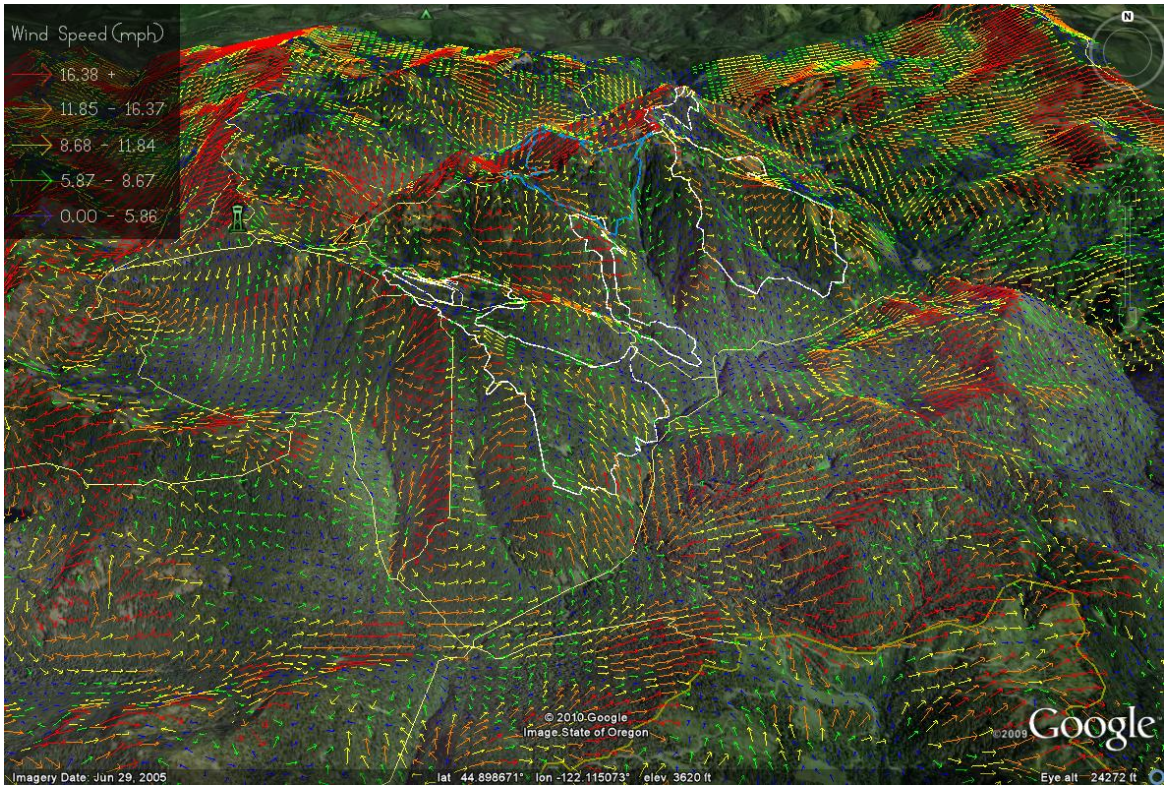
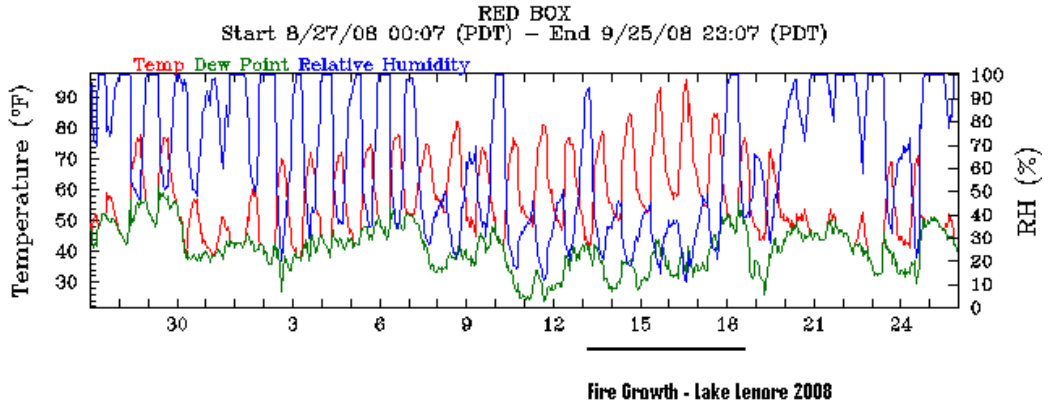
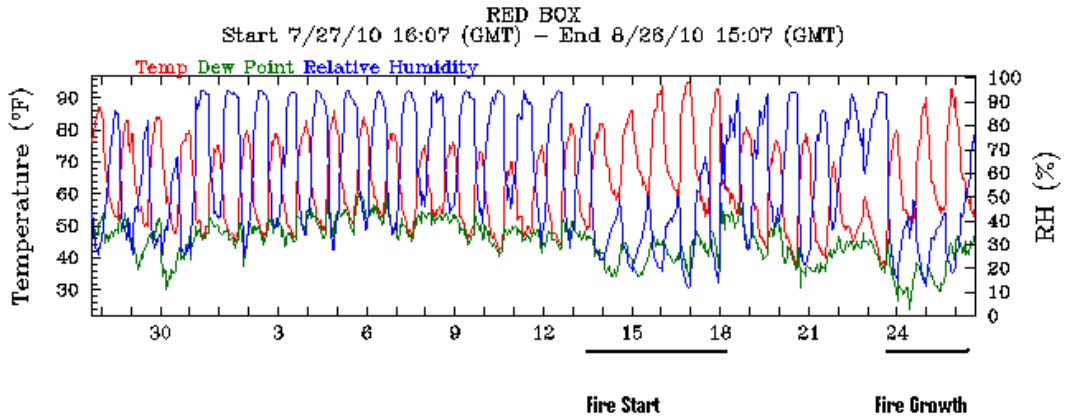


Figure B4: WindWizard output (winds from the west [270 degrees]). Note the lower wind speeds in the fire areas.


RED BOX
Start 8/27/08 00:07 (PDT) – End 9/25/08 23:07 (PDT)
Temp Dew Point Relative Humidity
Temperature (°F)
RH (%)
30
3
6
9
12
15
18
21
24
Fire Growth - Lake Lenore 2008


RED BOX
Start 7/27/10 16:07 (GMT) – End 8/26/10 15:07 (GMT)
Temp Dew Point Relative Humidity
Temperature (°F)
RH (%)
30
3
6
9
12
15
18
21
24
Fire Start
Fire Growth

Appendix C – BEHAVE Summary

8/23	Wet (grams)	Dry (grams)	Final (%)	Comments
Salal	28.1	16.0	153	Within fire perimeter. SE Aspect, North of Elk Lake Creek
Chinkapin	28.2	18.2	100	"
Douglas Fir	28.2	17.1	124	"
10 Hour	106.5	93.9	13	"
8/24	--	--	--	--
Unit # 1	--	--	--	Reprod stand adjacent to fire
Salal	28.1	15.5	170	On 6380 Road –East Aspect, 60%
Douglas Fir	28.2	17.6	113	On 6380 Road –East Aspect, 60%
Unit # 2	--	--	--	--
Salal	28.2	15.2	186	On 6380/130 spur, SE Aspect, 25% slope
Douglas Fir	28.1	16.8	130	On 6380/130 spur, SE Aspect, 25% slope
Unit # 3	--	--	--	--
Salal	28.1	15.3	178	On 6380 Road –West Aspect, 45%
Hemlock	28.2	16.0	156	On 6380 Road –West Aspect, 45%
--	--	--	--	--
Conifer Avg	--	--	**131%**	--
Hardwood Avg	--	--	**157%**	--
10 Hours	--	--	**13%**	--

BehavePlus 4.0.0 (Build 273)

Bull of the Woods Fires, max spread, w/spotting
Thu, Aug 26, 2010 at 08:45:09

Input Worksheet

Inputs: SURFACE, SIZE, SPOT, IGNITE

Input Variables	Units	Input Value(s)
Fuel/Vegetation, Surface/Understory		
Fuel Model		8
Fuel/Vegetation, Overstory		
Canopy Height	ft	30
Tree Height	ft	120
Spot Tree Species		PSEMEN
D.B.H.	in	24

Fuel Moisture

1-h Moisture	%	6, 8, 10, 12, 14
10-h Moisture	%	7
100-h Moisture	%	8
Live Herbaceous Moisture	%	120
Live Woody Moisture	%	120

Weather

20-ft Wind Speed (upslope)	mi/h	5, 10, 15, 20, 25
Wind Adjustment Factor		.3
Air Temperature	oF	80
Fuel Shading from the Sun	%	70

Terrain

Slope Steepness	%	60
Ridge-to-Valley Elevation Difference	ft	2000
Ridge-to-Valley Horizontal Distance	mi	1
Spotting Source Location		RT

Fire

Number of Torching Trees		3
Elapsed Time	h	4

Notes

Run Option Notes

Maximum reliable effective wind speed limit is imposed [SURFACE].

Calculations are only for the direction of maximum spread [SURFACE].

Fireline intensity, flame length, and spread distance are always for the direction of the spread calculations [SURFACE].

Wind is blowing upslope [SURFACE].

Results for: Surface Rate of Spread (maximum) (ch/h)

1-h	20-ft Wind Speed (upslope)

Moisture	mi/h				
mi/h	5	10	15	20	25
6	1.8	2.3	3.0	3.8	4.7
8	1.5	2.0	2.6	3.3	3.8
10	1.4	1.8	2.3	2.9	3.1
12	1.2	1.6	2.1	2.7	2.7
14	1.1	1.5	2.0	2.5	2.5

Results for: Flame Length (ft)

1-h	20-ft Wind Speed (upslope)				
Moisture	mi/h				
mi/h	5	10	15	20	25
6	1.0	1.2	1.3	1.5	1.6
8	0.9	1.1	1.2	1.3	1.4
10	0.9	1.0	1.1	1.2	1.3
12	0.8	0.9	1.0	1.2	1.2
14	0.8	0.9	1.0	1.1	1.1

Results for: Area (ac)

1-h	20-ft Wind Speed (upslope)				
Moisture	mi/h				
mi/h	5	10	15	20	25
6	2.1	3.1	4.5	6.5	8.9
8	1.5	2.3	3.4	4.8	5.9
10	1.2	1.8	2.7	3.8	4.2
12	1.0	1.5	2.2	3.2	3.3
14	0.9	1.3	1.9	2.7	2.7

Results for: Spot Dist from Torching Trees (mi)

1-h	20-ft Wind Speed (upslope)				
Moisture	mi/h				
mi/h	5	10	15	20	25

6	0.2	0.4	0.5	0.7	0.8
8	0.2	0.4	0.5	0.7	0.8
10	0.2	0.4	0.5	0.7	0.8
12	0.2	0.4	0.5	0.7	0.8
14	0.2	0.4	0.5	0.7	0.8

Results for: Probability of Ignition from a Firebrand (%)

1-h	20-ft Wind Speed (upslope)				
Moisture	mi/h				
mi/h	5	10	15	20	25
6	54	54	54	54	54
8	40	40	40	40	40
10	30	30	30	30	30
12	22	22	22	22	22
14	16	16	16	16	16

End