Shadow Lake Fire
Deschutes National Forest

Long-term Assessment and Implementation Plan
September 2, 2011

Table of Contents

Long-term Assessment Team:

Bill Aney – Team Leader	Bret Ruby – Strategic Operational Planner
Jen Croft – Long Term Analyst	Trevor Miller – LTAN (t)
Todd Rankin – FBAN (t)	Barry Shullanberger – OSC2
Bart Singley – OSC2 (t)	Scott McDonald – FOBS
Kat Russell – FOBS	Amanda Rau – FOBS (t)
Brian Maier – GSAN	Desraye Assali - GISS

Executive Summary

The 2011 season started with significant late spring precipitation and snowfall that delayed the seasonal green-up phase 3-4 weeks. Long range forecasts released 8/31/2011 indicate the current warming and drying trend will persist through the month of September, transitioning into cooling wet conditions in early October.

Fire growth in this area is usually associated with hot, dry, unstable atmosphere paired with moderate wind events (7-10 mph). Fire growth events are often accompanied by 2 nights of poor humidity recovery (<40%) paired with ERC's above the 60th percentile. These weather events can serve as indicators for large fire growth potential.

A risk assessment for 3 points of concern (Big Lake, Wagon Road Wilderness Boundary, and Cache Cr Private Lands) indicates that the fire has the greatest potential to reach Wagon Road Wilderness Boundary by the season ending event.

The potential for the fire to reach the Big Lake area is largely dependent on the timing the fire spread reaches the cascade crest/forest boundary.

It is recommended that local fire managers monitor forecasted weather and fire danger forecasts, and prepare for increased fire behavior when the forecast includes Haines Index 5-6 days, low overnight humidity recovery (<40%), ERC's above the 60% percentile and east winds.

Introduction

The Shadow Lake Fire was discovered on August 28, 2011 at 1428, smokejumpers were dispatched to the fire, but due to the extreme safety hazard posed by the numerous snags in the area the smokejumpers were not deployed on the incident. An indirect strategy was implemented that consisted of improving existing roads and old dozer lines from the GW Fire from 2007 to protect the private lands to the east of the fire area.

On August 29th a Long Term Assessment Team was ordered by the Forest to complete a Long Term Assessment for the Shadow Lake Fire.

The Shadow Lake Fire is burning in the Mt. Washington Wilderness on the Deschutes National Forest. It is currently burning to the north of Mt. Washington on the east side of the Cascade crest between 4600 and 5500 feet in elevation. The area is characterized as mixed-conifer timber with a heavy dead and down component and thick understory of conifer reproduction. A beetle infestation during the 1980 resulted in an abundance of standing dead Lodgepole pine. Approximately 40 to 60% of the standing trees are dead within the timbered areas. There is also an abundance of lichen and moss in the timber canopies that contribute to ladder fuels and the availability of aerial fuels.

Numerous large fire events that occurred during the past 10-15 years have created partial barriers to fire spread on the east and north side of the current fire area. Fuels in these areas consist of open areas of grass and brush with conifer reproduction of varying density, depending on the time

since the fire occurrence. There are also areas of lava flows south of the Mt. Washington that would provide natural barriers to fire spread. More specific information on fuels is included in the fuels section of the report (page 11).

Objectives – The following objectives were given to the team by the two Line Officers during the in-brief on August 29th.

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 of the Shadow Lake fire including a projection of fire growth, risk assessment, and recommendations for future actions and their associated triggers. Fire growth of greatest concern is to areas outside of the Wilderness, but particularly to private and developed lands to the east and to the Big Lake recreation area to the northwest.
3) Develop projections for wind events and potential duration of this fire.
4) Develop an estimation of smoke patterns and probabilities.
5) Assist the IMT and local units with establishment of trigger points for both firing operations and any possible evacuations.
6) Base your recommendations on our incident objectives.

Key Questions:

- What is the threat to the Values at Risk: Wilderness Boundary and Big Lake Recreation Area?
- Weather and associated fire spread event conditions and frequencies:
    - East wind events
    - Thermal troughs
    - Frontal passages
    - Timing of killing frost vs season ending event
    - Season slowing events
    - What are the analog years and how does 2011 compare (what is the likely character of the remainder of fire season)

Additional questions the LTAT team was asked to address:

- What fuel models represent the previously burned areas
- Analyze an option of burning out around the east side of Big Lake Recreation Area vs checking actions along the Cascade Crest.
- Analyze an option to utilize direct attack.

Risk Assessment Considerations

- Private lands including resort areas and commercial timber lands east of the fire.
- Big Lake Recreation Area west of the fire.
- Highway 20 north of the fire (economic impact to the community of Sisters).

Management Action Points (Mitigation Actions)

Four "Management Action Points" or "Prospects" were identified as strategies for the management of the Shadow Lake fire. Each MAP includes an objective that describes the general strategy analyzed for each MAP, the activities to be implemented, the probability of success of the actions, the resources needed to implement the action, the costs and consequences of not implementing the action.

Management Action Point Descriptions

MAP 1 – is designed to inform the agency administrators about the options and potential impacts of full suppression using direct attack of the fire. It is important to note that the majority of exposure hours displayed for this MAP would be very high risk. This MAP would require firefighters to work in and around extreme snag hazards that would be very difficult if not impossible to mitigate. Additionally, the immediate fire area has high ground fuel loadings that also pose a hazard to firefighters.

MAP 2 – is designed to inform the agency administrators about the options and potential impacts of indirect line construction and burn-out operations along existing roads and dozer lines near and adjacent to the wilderness boundary.

MAP 3 – is designed to inform the agency administrators about the options and potential impacts of indirect line construction along existing roads and existing dozer lines near and adjacent to the wilderness boundary. The primary difference between this MAP 3 and MAP 2 is burnout operations would only occur as the fire nears containment lines, the structure protection plan would be implemented at Big Lake.

MAP 4 – is designed to inform the agency administrators about the options and potential impacts of the fire moving beyond Big Lake to the west and north necessitating the use of natural barriers and the 890 road to check spread to the west and north beyond Big Lake.

MAP #	Objectives/Conditions	Actions	Resources Needed Cost
MAP 1	**Objective:** Full Suppression Using Direct Attack. **Conditions:** Considerations discussed for this MAP will layout the values at risk for this decision.	**Decision Point:** Contain the fire to minimize acres burned. **Action:** Traditional direct attack is one approach to managing fire perimeter control. **Alternative Action:** 1) Allow the fire to continue to burn freely while preparing for indirect and burnout alternatives. 2) Aggressive line preparation and burnout around Big Lake allowing fire to burn east and south towards the current fire perimeter. **Probability of Success: Low** **Mitigating the hazards and risks required to safely achieve the direct attack objective would be extremely difficult if not impossible. Fully mitigating the snag hazard would be impractical. The inability to remove this material from the fire area would greatly increase an already high ground fuel hazard.**	Resources needed for this option include: 4 Type 1 Crews 2 Type 2 IA Crews 2 Type 2 Crews 6 Falling Teams 4 Tenders 1 Fixed Wing ATGS Platform 3 Type 1 Helicopters 1 Type 3 Helicopter 30 Misc. Overhead **Cost: $2,070,900** **Total Exposure Hours: 48,272**

Risk of Implementation: Firefighter exposure would be extremely high due to the extensive amount of snags and dead/down fuels within the wilderness. The amount of chainsaw use required in the dense snag canopy would be very difficult to mitigate. Escape routes would be difficult to establish and rapidly navigate to safety zones due to the amount of dead and down fuel.

Consequences of not implementing: Not implementing a direct attack will allow the fire to spread in its natural progression. Current spread to the east is slowed by the 2007 GW Fire and the 1999 Cache Fire to the northeast. Spread to the south is also slow due to previous fire Incident 601. Fire spread will continue in a backing pattern to the west during normal weather patterns. Fire spread will grow to the north and west as weather patterns shift the spread in those directions.

Recommendation: Direct attack will put firefighters in harm's way nearly 14 hours per day for over 7 days. Over 90 hours of high risk exposure to over 130 fire personnel would have to be taken into consideration. Use of aerial resources for 8 hours a day for 7 days also extends the exposure and risk for this option. Inadequate escape routes, safety zones, large volumes of standing snags, dead and down fuels and overall stand density in the wilderness do not make the direct attack option conducive to firefighter safety.

MAP #	Objectives/Conditions	Actions	Resources Needed Cost
MAP 2	**Objective:** Indirect line construction and burnout along Old Santiam Wagon Road west to FS Road 960 on the east side of Big Lake. Construct dozer line from Old Santiam Wagon Road south along wilderness boundary. **Condition:** Considerations discussed for this MAP will layout the values at risk for this decision.	**Decision Point:** Minimize exposure to firefighters due to hazardous fuel conditions, dead and down fuel and extensive amounts of large snags in the Mount Washington Wilderness area and the entire MMA. This action would reduce the future risk of wildfire around the Big Lake Recreation Area. **Action:** Complete indirect line along FS Road 500/Trail 3413/ (Old Santiam Wagon Road) to keep the fire south of Highways 20 and 126. The 1967 Airstrip Fire should help aid in direct line construction should spot fires occur across the Old Santium Wagon Road trail. Construct dozer line from the 500 road south along the east flank to keep the fire west from Little Cache Mountain to Dugout Butte. Use natural features, lava fields and uncured fuels to reduce fire spread to the west. Allow the fire burn into the 2008 Dry Creek and 2006 Lake George fires. **Alternative Action:** If the fire progresses to the west of Big Lake, the Big Lake Structure Protection Plan should be initiated. MAP 3 **Probability of Success: High**	Resource needs for Indirect Attack 14 day assessment for MAP 2,3,and 4. Type 1 Crews 3 Type 2 IA Crews 2 Type 2 Crews 6 Fellers 7 Engines 5 Dozers 2 Type 1 Helicopters 3 Type 3 Helicopters 1 Overhead (Line) 30 Overhead (Camp) 20 **Total Cost: $2,661,253** **Total Exposure Hours: 62,706**

Risk of Implementation: Implementation of this MAP will lend itself to longer smoke duration for the surrounding areas. More firefighter exposure hours will be endured, however, the risk from over head hazards and heavy down fuels will be lessened for the firefighter.

Consequences of not implementing: Fire spread left unchecked will tend to allow spotting across the Old Santiam Wagon Road to the north and northeast private land will become compromised and as the fire becomes established the means for direct attack will become more difficult. Structure protection around the Big lake will be more difficult to defend. As the fire increases in size and intensity there will be more volume of smoke dispersal into the air shed.

Recommendation: When fire behavior and fire weather indicate fire activity will threaten the line this MAP should be considered. If the decision is made to initiate MAP 3 this MAP will have to be completed before or in conjunction with MAP 3.

MAP #	Objective / Conditions	Actions	Resources Needed Cost
MAP 3	**Objective:** Prep roads and trail for burnout opportunities and implement the developed structure protection plan to protect infrastructures around Big Lake Recreation Area. **Condition:** Considerations discussed for this MAP will lay out the values at risk for this decision.	**Decision Point:** This indirect option minimizes exposure to firefighters from the hazardous fuel conditions, dead and down fuel and extensive amounts of large snags in the Mount Washington Wilderness area. This action would reduce the future risk of wildfire around the Big Lake Recreation Area. **Action:** Prepare indirect line for burnout along FS road 960 on the east side of Big Lake. Improve trail that starts from the end of FS road 960 to FS road 2690 that will allow a visual buffer between the lake and burnout operations. Implement structure protection plan around Big Lake Youth Camp on the east side of lake. **Probability of Success: High**	Resource needs for Indirect Attack 14 day assessment for MAP 2, 3 and 4. Type 1 Crews 3 Type 2 IA Crews 2 Type 2 Crews 6 Fellers 7 Engines 5 Dozers 2 Type 1 Helicopters 3 Type 3 Helicopters 1 Overhead (Line) 30 Overhead (Camp) 20 **Total Cost: $2,661,253** **Total Exposure Hours: 62,706**

Risk of Implementation: Implementation of this MAP has risks that will need to be mitigated. Those risks include evacuation of the public visitors to the area. Access and egress to the Big Lake Youth Camp that is considered "one way in, one way out." The current 54 structures within the Youth Camp will require aggressive defense tactics with only a few requiring no attention. Approximately 50% of the structures have shake roofs. Successful defense will require structural triage, time for pre-treatment and highly mobile tactics. Burnout operations may also prove to be an effective tactic if resources and conditions are available. If a fire starts within or near the developed area; it may become necessary to switch the focus of tactical operations from preparation/pre-treatment to offensive fire control or active structure defense.

Consequences of not implementing: Fire spread left unchecked will tend to allow spotting into the recreation area and make direct attack operations become more difficult. Structure protection around the Big Lake will also be more difficult to defend. Important vegetation surrounding Big Lake Campground may be compromised altering the visual qualities that currently exist in a forest setting.

Recommendation: Past fire history shows the failure to anticipate fire growth has compromised many an IC's ability to effectively develop successful operational strategies to contain spread in this area. Inability to recognize time and space issues will bring more values into risk as the fire continues to mature in the Mt. Washington wilderness area. Aggressive road and trail preparation around Big Lake as well as implementing the structure protection plan for the Youth Camp will prepare for the successful implementation of MAP 3. In the event the Shadow Lake Fire is moving east towards Big Lake, burnout operations should be considered to prevent a frontal assault on the Youth Camp. The first trigger point to consider burnout of MAP 3 would be when the fire reaches the Deschutes/Willamette Forest boundary. The Incident Commander and Operations Section Chief will need to use their judgment to determine timing and conditions necessary to successfully implement the burnout operations, under some burning conditions the fire could travel this distance in a matter of hours. A second trigger point to consider burnout would be when the fire perimeter is within 1 mile of Forest Road 960 or the Youth Camp east of Big Lake. Again, judgment considering time of year, fire behavior, weather forecasts, and prediction models need to be considered.

MAP #	Objective / Conditions	Actions	Resources Needed Cost
MAP 4	**Objective:** Use roads, trails and natural barriers (lava fields, areas of uncured vegetation) for burnout opportunities to contain the fire. **Condition:** Considerations discussed for this MAP will layout the values at risk for this decision.	**Decision Point:** Minimize exposure to firefighters due to hazardous fuel conditions, dead and down fuel and extensive amounts of large snags in the Mount Washington Wilderness area and the entire MMA. This action would reduce the future risk of wildfire around the Big Lake Recreation Area. **Action:** Complete indirect line along FS Road 500/Trail 3413/ (Old Santiam Wagon Road) to keep the fire south of Highways 20 and 126. The 1967 Airstrip Fire should help aid in direct line construction should spot fires occur across the Old Santiam Wagon Road trail. Prep the Old Santiam Wagon Road west from FS Road 2690 to Highway 126 for burnout operations. **Alternative Action:** If the fire progresses to the west of Big Lake, the Big Lake Structure Protection Plan should be initiated. Indirect line construction should continue west along the 890 Road allowing for an opportunity to burnout off the road and tie the fire into the lava fields located in T14S R7E Sections 11,12,13,14,23& 26. **Probability of Success: High**	Resource needs for Indirect Attack 14 day assessment of MAP 2, 3, and 4. Type 1 Crews 3 Type 2 IA Crews 2 Type 2 Crews 6 Fellers 7 Engines 5 Dozers 2 Type 1 Helicopters 3 Type 3 Helicopters 1 Overhead (Line) 30 Overhead (Camp) 20 **Total Cost: $2,661,253** **Total Exposure Hours: 62,706**

Risk of Implementation: Implementation of this MAP will lend itself to longer smoke duration for the surrounding areas. More firefighter exposure hours will be endured, however, the risk from over head hazards and heavy down fuels will be lessened for the firefighter.

Consequences of not implementing: Fire spread left unchecked could allow spotting across the Old Santiam Wagon Road to the north and northeast, private land could be compromised and as the fire becomes established the option for direct attack will become more difficult. Structure protection around Big Lake will be more difficult to defend. As the fire increases in size and intensity there will be more smoke into the air shed.

Recommendation: If MAP 3 is initiated this MAP will need to be implemented.

Fire Behavior

Observed Fire Behavior

The observed fire behavior during the first few days of the fire (8/27-28) was reported as active fire behavior with surface fire burning downslope to the east with moderate rates of spread and spotting from torching trees contributing significantly to fire spread in all directions. The majority of fire growth to date occurred during this time for an estimated fire size of 450 acres by 8/29. Fire activity moderated on 8/29 and very little fire spread was observed between 8/30 and 9/1. Fire behavior was observed as smoldering and creeping in surface fuels with occasional torching due to lichen component in timber canopies. Flame lengths were generally less than 2 feet with spread rates in active areas less than 4 chains per day. Estimated fire size on 9/1 was 504 acres.

The fire has thus far resulted in a mixed-severity burn with areas of high intensity, stand replacement fire to areas of low intensity fire spreading solely in surface fuels to areas that are unburned altogether. The resultant mosaic burn pattern is largely desired in order to reduce fuel accumulations while promoting a healthy, fire dependent ecosystem.

Burning conditions and expected fire behavior are anticipated to increase during the few two weeks of September as warm, dry weather is forecast. Additionally, live fuel moisture will continue to decrease and continued drying in dead and down fuels will make them more available for combustion. However, the 2011 fire season has been unusually cool with a late snow pack and green up. While there may be increased fire activity and/or periods of high intensity fire due to critical weather patterns during September.

Topography

The topography in the Shadow Lake Fire area is relatively gentle with minor drainages and ridges and gentle slopes leading west up to the Cascade crest. Steeper slopes exist on the north aspects of Mt. Washington that may lead to small up slope runs should the fire spread to the south. Therefore, topography should have minimal influence on fire behavior.

Weather

The climate of the Sisters Ranger District is relatively arid, yet incorporates a variable rain gradient extending from the crest of the Oregon Cascades to the juniper-shrubland habitats of its eastern boundary. Winters are dominated by moist maritime air masses with occasional continental influences and at the upper elevations precipitation falls as snow. Summers are influenced by dry continental air masses. Summers typically display long periods of fair dry weather interrupted by thunderstorms. Annual precipitation can reach upwards of 85" (Santiam Pass) at the higher elevations. Annual drying starts in the spring, with the peak of fire season in early to mid August. Typical fire season averages are maximum temperatures 80 to 90, minimum relative humidity 15 to 23, and wind speed 4 to 6 mph.

The fire is in fire weather forecast ORZ 610, in the Pendleton, Oregon forecast area. Weather forecasts and outlooks specific to the management of wildland fires are available at http://www.wrh.noaa.gov/firewx/?wfo=pdt. Our analysis primarily uses Round Mountain and Pebble RAWS, which best represent conditions (current and potential) for the fire area. In some cases Colgate data was used for comparison purposes.

STATION	RAWS NUMBER	ELEVATION	DISTANCE
Round Mountain	352605	5900	40.4
Pebble	352554	3560	11
Colgate	352620	3280	10

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 decadent stands of mixed-conifer forests and areas previously burned during the 2007 GW fire. Conifer species within the unburned areas include lodgepole pine, white fir, white pine, grand fir, and western hemlock along with some ponderosa pine at lower elevations. The understory has dense areas of hemlock and fir regeneration along with scattered Western White Pine. Surface fuels are moderate to heavy short needle litter with large jackpots of dead and downed logs. There is an abundance of standing dead timber that resulted from a beetle infestation 10-15 years ago. This coupled with the presence of lichen and moss on tree boles and in canopies makes the aerial fuels available during times of low humidity and atmospheric instability. The lichen is a large contributor to fire spread by allowing the fire to spread into aerial fuels and increasing spotting potential. The large amount of standing dead trees also creates safety concerns for personnel working directly along the fire perimeter. Fuel models used to model fire behavior include timber with understory and timber litter models TU1, TU5 and TL5 along with TU4 that was used for modeling under extreme conditions.

The fire has burned into portions the GW Fire of 2007, most of this activity was caused by spotting. Fuels within the burn are generally sparse and/or too green to carry fire at this time. Fuel Model TL1 is a good representative of modeling in much of the 2007 burn area.

The shading and exposure of fuels depends on canopy cover and local terrain. Thousand hour fuel moistures were measured on site at 12-14% in shaded areas and 9-10% in exposed areas. The timber with understory fuel models have significant live fuel component, and the associated live fuel moistures (LFM) influences fire spread. Currently the LFM is relatively high with new growth still visibly green and conifer foliage estimated at 150%. Woody shrubs have ripe fruit present and the herbaceous layer is still green. The live fuel conditions are generally considered about 3-4 weeks behind in terms of curing as shown by NDVI greenness values. This is hampering fire behavior. However, the lichen component amongst the live fuel complex seems to allow fire activity to overcome the current LFM and allows vertical growth and single/group tree torching during critical weather episodes, i.e. low humidity, instability.

Surrounding Area

Fuels in areas adjacent to the current fire areas and in areas where the fire may spread are relatively similar to fire area. There are 5 recent fires on the landscape that have altered the fuel complex and, depending on the time since burned, these fuels can be represented with a grass/shrub model or low litter timber model. Some of the old fires may carry fire, especially once herbaceous and woody shrub fuels begin to decrease as September progresses. Dead and down fuel along with abundant snags in the old fires could pose problems to control operations and safety.

Fire Growth Events

Typically, large fires in western forests gain most of their growth on relatively few days during the life of the fire with more modest or even minimal fire growth on most days. Specific conditions deemed closely related to large fire growth days on the Sisters Ranger District include poor overnight humidity recovery, high winds, low 1000 hour fuel moistures, and ERC values above the 60th percentile (using Round Mountain RAWS).

The team evaluated three recent large fires on the Sisters Ranger District in similar fuel types as the Shadow Lake fire in an attempt to demonstrate how local weather events are associated with fire growth days, and then evaluated historical weather records to estimate how many similar growth events can be expected before the end of the season.

The B&B Fire of 2003 started in mid-August, grew rapidly during initial attack, and then grew tremendously on August 25 and 26. Table 1 displays fire weather conditions during these two periods; what should be noted are the low heavy fuel moistures, poor overnight humidity recovery, and high ERC values. Historical observations of the B&B Fire on August 25-26 described a west wind, usually associated with a large high-pressure ridge. These conditions were accompanied by a Haines Index of 6.

Attribute	**8/21**	**8/25-26**
1000hr fuel moisture	10%	10%
ERC	66	63
Overnight humidity	31%	45%
Winds	15G25	15G30

Table 1: Fire weather conditions during two periods of rapid fire growth, B&B Fire, 2003.

The GW fire of 2007 and the late season Wizard Fire of 2008 show very similar metrics associated with fire intiation and growth. As seen in Table 1 a conditioning period of poor humidity recovery accompanied or followed by high winds shows a likelihood of high fire potential.

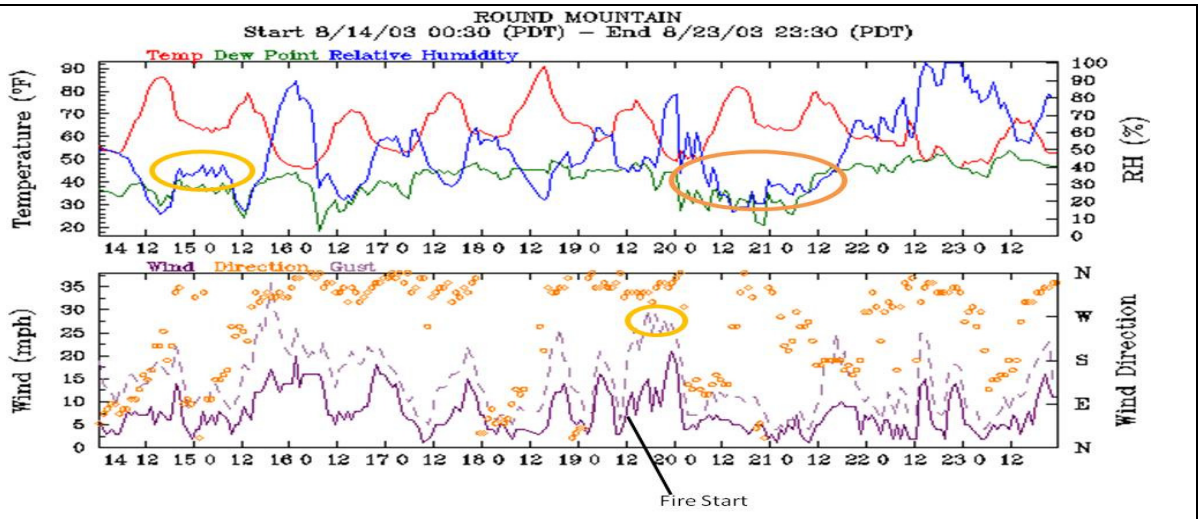


Figure 1: B&B Fire (2003), trace RAWS note combination of poor humidity recovery and high winds

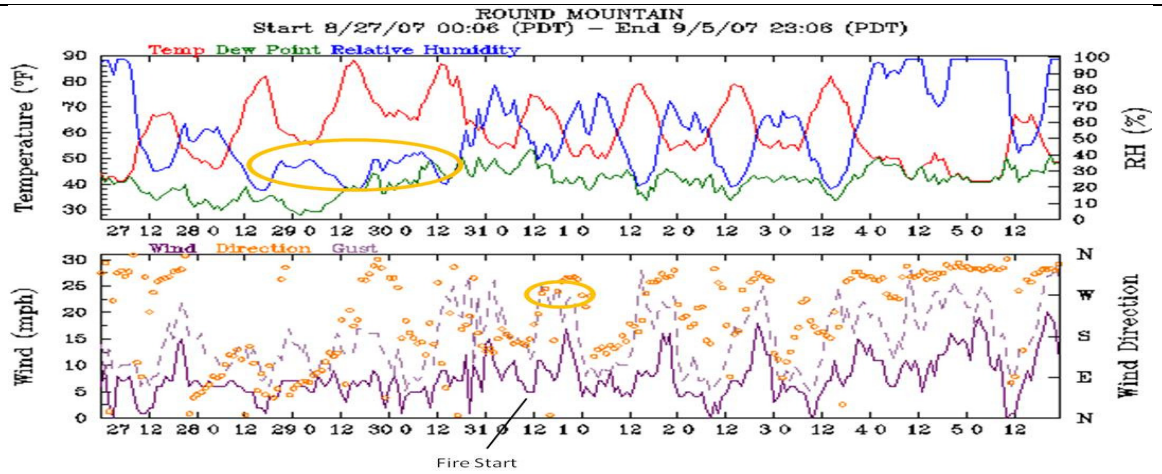


Figure 2: GW Fire (2007) trace RAWS showing a period of low recovery followed by high winds

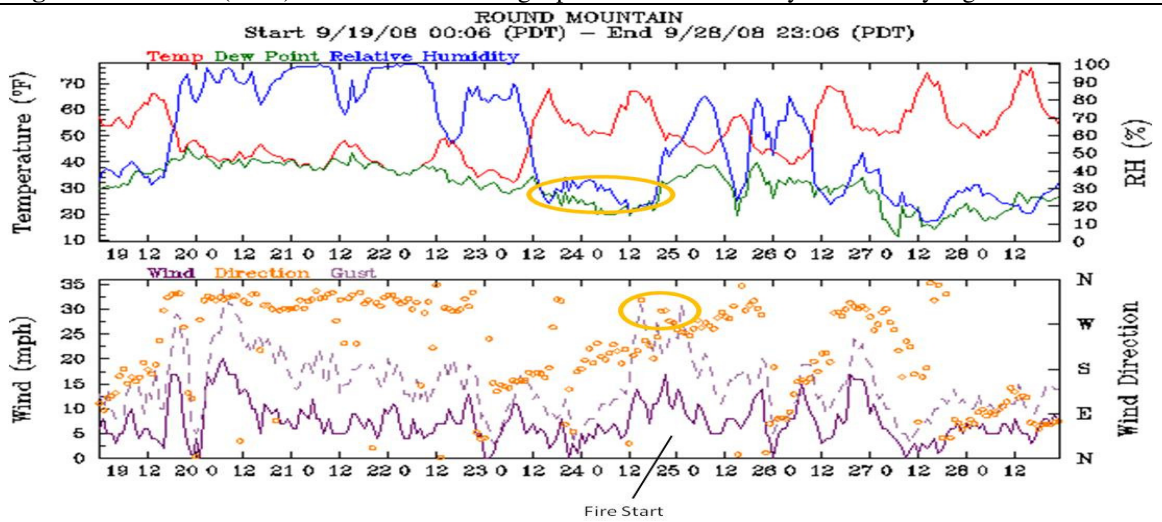


Figure 3: Wizard Fire (2008) trace RAWS late season fire growth showing similar WX pattern inductive to large fire growth.

The above figures show temperature and relative humidity traces for the Round Mountain RAWS site during periods of fire growth for three evaluation fires of interest, note that nighttime relative humidity recovery was poor immediately prior to and during the periods of fire growth. Low overnight humidity recovery indicates a warm, dry airmass over the area resulting in decreases in live and dead fuel moistures. When coupled with high winds, the likelihood of rapid fire progression as a result of crown fire initiation and spotting is increased – a fire behavior phenomenon that was observed on the fire growth days for all B&B, GW, and Wizard fires.

High wind events, particularly east wind events, are of concern as associated with the Shadow Lake Fire. The below windroses show filtered wind directions and speed for relevant RAWS stations (16 years of data) both east and west side. Readings from this wind data were used to develop probabilities of fire spread under conditions of concern.

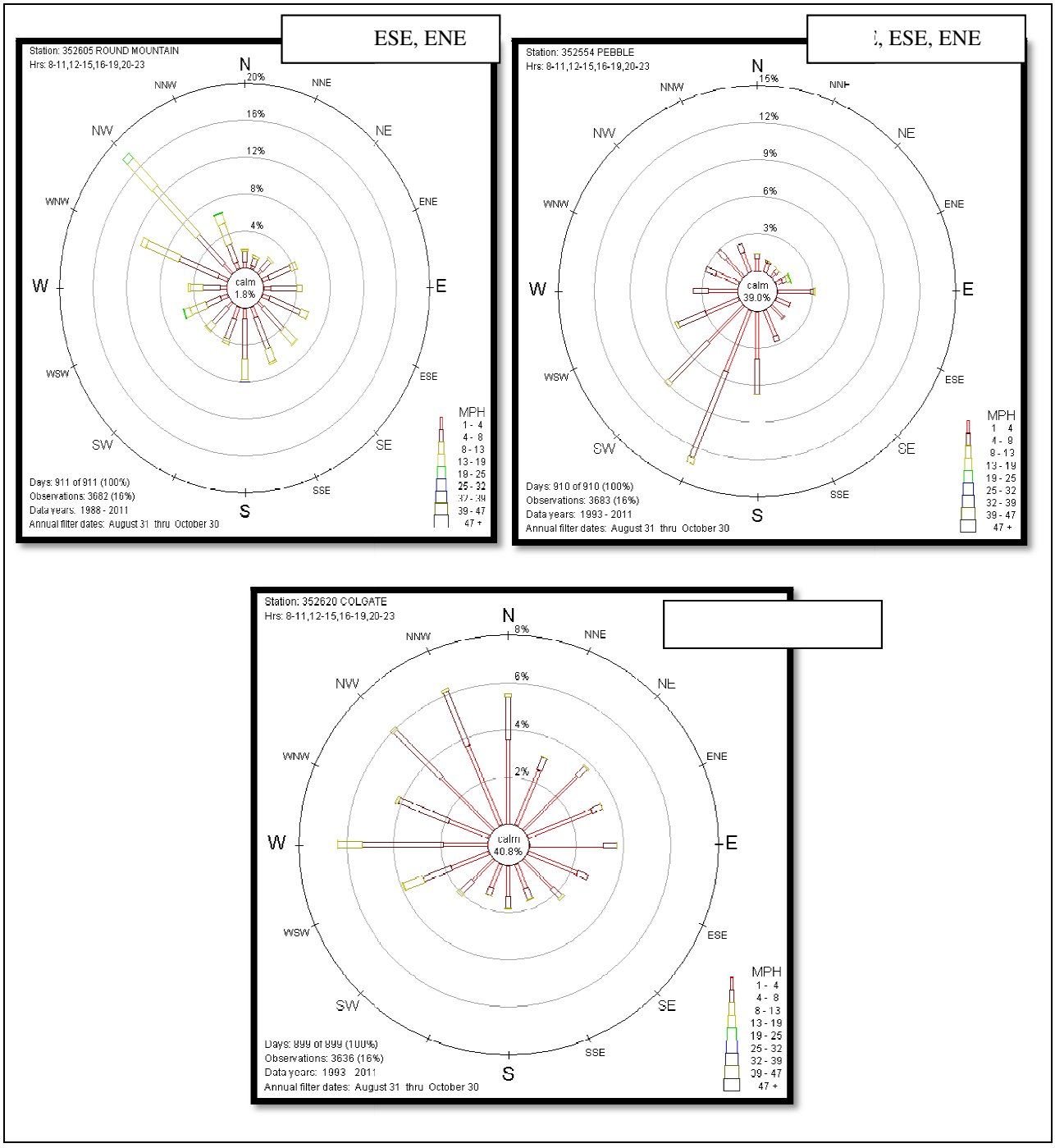


Figure 4: Windrose data showing dominating winds on both East and West sides of the crest for the late August-October daytime burn periods.

Using indicator criteria of nighttime humidity recovery below 40%, local ERC values greater than the 60th percentile (as measured by Round Mountain RAWS), and particularly a combination of the two, local fire managers can monitor and anticipate significant growth days in the future – we recommend managers monitor said indices and shift tactical and resource allocation decisions as appropriate.

Table 2 shows percentage probability of such events occurring before season end.

Measure	2 Day Period	1 Day Period
ERC >=60%	13.5%	25%
MaxRH <= 40	2%	8%
Combined (ERC, MaxRH)	2%	7%
1000FM<11 w/ ERC >= 60%	.7%	5%

Table 2: Showing percentage chance of combinations of large fire growth indices from Aug 31 to 90th percentile season end date of Oct 17.

Long Term Outlook

- The 2011 season started with significant late spring precipitation and snowfall that delayed the seasonal green-up phase 3-4 weeks.
- Long range forecasts released 8/31/2011 indicate the current warming and drying trend will persist through the month of September, transitioning into cooling wet conditions in early October.
- The season ending events for this fire area begin to increase in potential starting with 50% by September 28th, jumping to 90% by October 17th, and 99% by Oct 30.
- Fire growth in this area is usually associated with hot, dry, unstable atmosphere paired with moderate wind (7-10 mph). Fire growth events are often accompanied by 2 nights of poor humidity recovery (<40%) paired with ERCs above the 60th percentile. These weather events can serve as indicators for large fire growth potential.
- The Round Mountain Remote Automated Weather Station (RAWS) was determined to be the most representative weather site for High Cascade conditions. Using 16 years of data, the above indicator events occur only 13.5% throughout the fire season, and 2% from September 1st to the season ending date.
- A risk assessment for 3 points of concern (Big Lake, Wagon Road wilderness boundary, and Cache Cr private lands) indicates that the fire has the greatest potential to reach Wagon Road wilderness boundary by the season ending event. The potential for the fire to reach the Big Lake area is largely dependent on the timing the fire spread reaches the Cascade crest/forest boundary.
- A pattern of previous wildfire events, timber harvest activities, and road boundaries, have modified the available fuel profile from heavy litter timber to light litter timber and regenerating shrubs.
- It is recommended that local fire managers monitor forecasted weather and fire danger forecasts, and prepare for increased fire behavior when the forecast includes Haines Index 5-6 days, low overnight humidity recovery (<40%), ERCs above the 60% percentile and east winds.

Risk Assessment

Fire Growth Projections

The Rare Event Risk Assessment Process (RERAP) and Fire Spread Probability (FSPro) models were both used to evaluate fire spread potential. RERAP evaluates the probability that a free-burning fire will reach a particular point of concern before a season-ending weather event, creating essentially a "race" between a spreading fire and fall rains. FSPro, on the other hand, 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. Both RERAP and FSPro can be used to identify the probability that areas of concern could see fire. The outputs are helpful for developing priorities and analyzing values at risk.

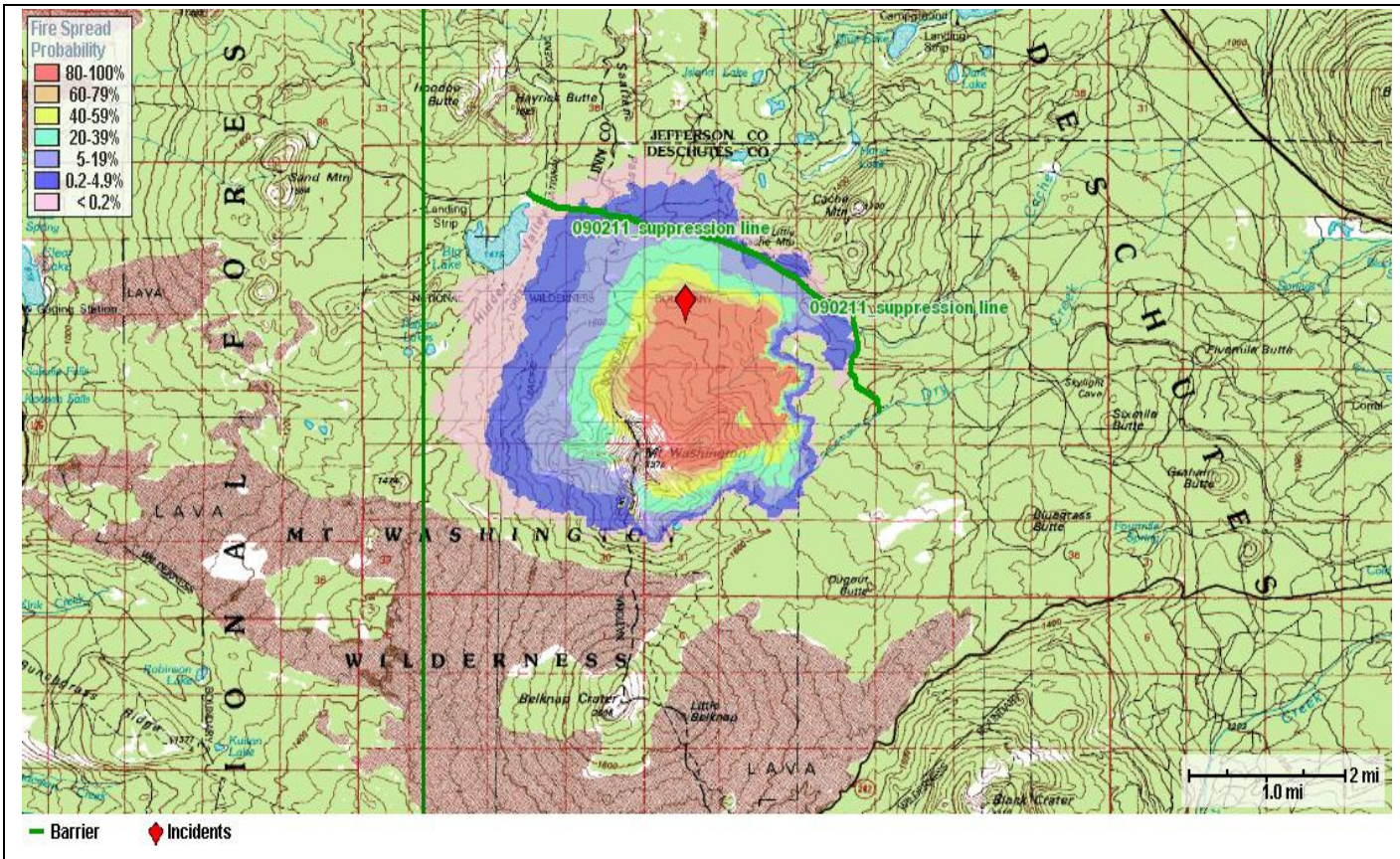


Figure 5: Fire Spread Probability (FSPro) analysis for the Shadow Lake fire, Deschutes National Forest, Sept 1-September 14, 2011 with existing suppression line.

FSPro evaluates the likelihood that a free-burning fire reaches any given piece of ground during the assessment period. The team conducted two FSPro analyses: one for 14 days with suppression measures, and one for 14 days with free burning potential. There were three points of concern that the local unit identified – Big Lake recreation area, Wagon Road wilderness boundary, and private lands to the east. The FSPro analysis indicates <0.2% threat to Big Lake recreation area, a 40% probability of reaching the wilderness boundary along the Wagon Road and no probability of spread reaching the private lands to the east of current fire perimeter where recent wildfire footprints and a matrix of roads interrupts and slows fire spread potential.

FSPro also provides a histogram of fire sizes from the 1056 simulations. The average fire size was 3,543 acres for the 14 day run, with 90% of the simulations resulting in a fire size of 5,937 acres or less.

Appendix A provides the details of the RERAP analysis. A multi-risk assessment was conducted to evaluate the various risk of fire spreading from several identified points to the points of concern throughout the remaining time frames of the season. The first set of risk by distance uses the current fire perimeter identified by aerial IR on 9/2/11. The second set of risk by distance uses "decision points" identified by stakeholders and agency administrators to assist in providing decision makers the ability to evaluate risk.

Assessment Dates	Risk From Current Perimeter to Big Lake	Risk From to Current Perimeter Wagon Road Wilderness Bdy	Risk From Current Fire to Cache Cr Private Lands
9/1-9/15	6%	85%	2%
9/16-9/28	<1%	17%	<1%
9/29-10/08	<1%	<1%	<1%
10/09-10/28	<1%	<1%	<1%
Assessment Dates	**Risk From Cascade Crest to Big Lake**	**Risk From Segment D to Wagon Road Wilderness Bdy**	**Risk From Dozerline to Cache Cr Private Lands**
9/1-9/15	63%	94%	3%
9/16-9/28	3%	76%	<1%
9/29-10/08	<1%	29%	<1%
10/09-10/28	<1%	13%	<1%

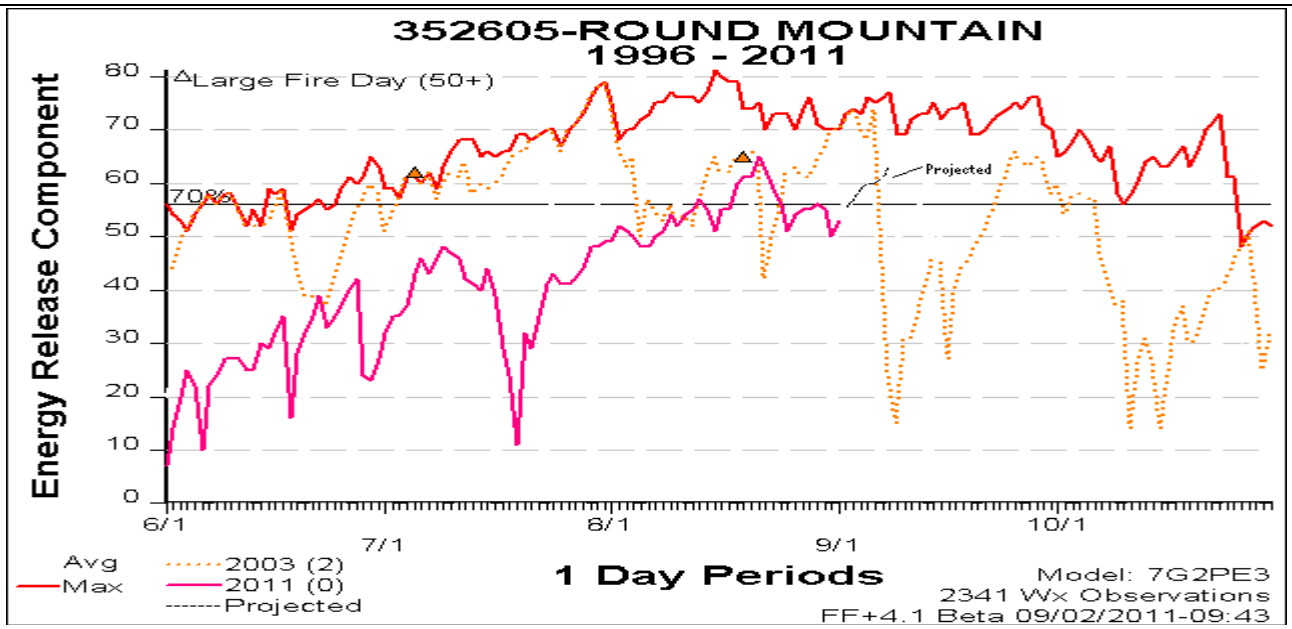
Table 3: Summary of RERAP analysis for likelihood a fire reaches the three points of concern, based on the date that fire crosses the identified segment.

The utility of this analysis is that it is clear that after September 16, the risk to reach Big Lake drops significantly, risk of fire spread reaching Wagon Road wilderness boundary is highest of all points of interest, and risk of fire spread to Cache Cr private lands is low from both spread points.

Seasonal Severity Indicators

Energy Release Component

Energy Release Component (ERC, using Fuel Model G) is a measure of the longer term large fuel dryness, and is a good indicator of fire season severity. Local ERC values tend to approach the seasonal maximum around the middle of August, tailing off gradually into early September. While there have been years when mid-October ERCs were near the 90th percentile, in most years the ERC drops as a result of cooler conditions, precipitation, lower sun angle, and shorter day length. Both Pebble and Round Mtn were used in analysis to best compare east and west side conditions conducive to fire growth. This year (2011) showed below seasonal norms until mid August where it reached averages. Projected values are expected to increase over the next few days as an extended thermal trough develops over the area.



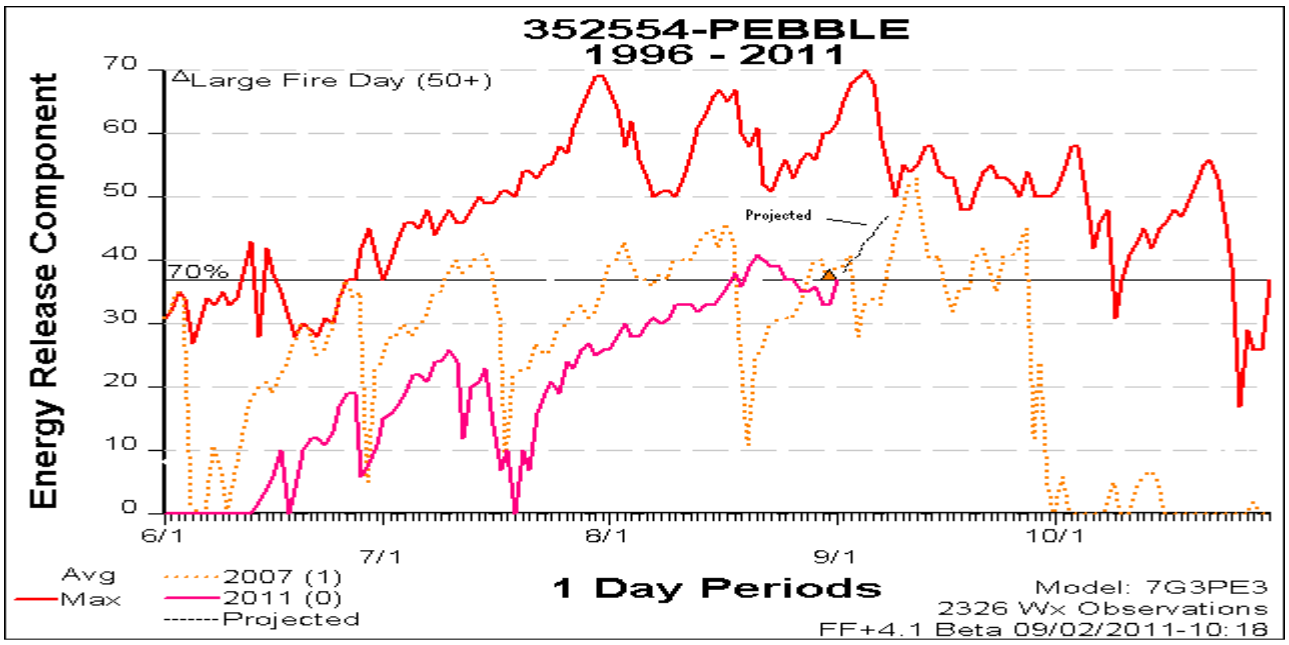


Figure 5 - ERC graph for the representative RAWS (east and west side) **with ERC projected from** date to date based on Predictive Services forecasts.

Figure 5 shows the ERC trace for a group of two RAWS sites near the fire area, Pebble and Round Mountain. The ERC is projected to raise above near term averages as a thermal trough develops. Also included in this chart is the data from 2003 and 2007 respectively, when the B&B and GW fires burned adjacent to the current fire area.

Large Fuel Moisture

Another measure of seasonal dryness and potential fire behavior is the calculated thousand (1000) hour fuel moistures (large dead woody fuels). Up through early August, 1000hr fuels were trending at or above seasonal averages. 1000hr fuels remain above values associated with large fire events analyzed and are projected to remain within that range through the forecast period. Figure 6 shows 1000 hour fuel moisture for the Round Mountain and Pebble RAWS, with actual observations through August 31, 2011 and then projected another 7 days based on Predictive Services forecasts.

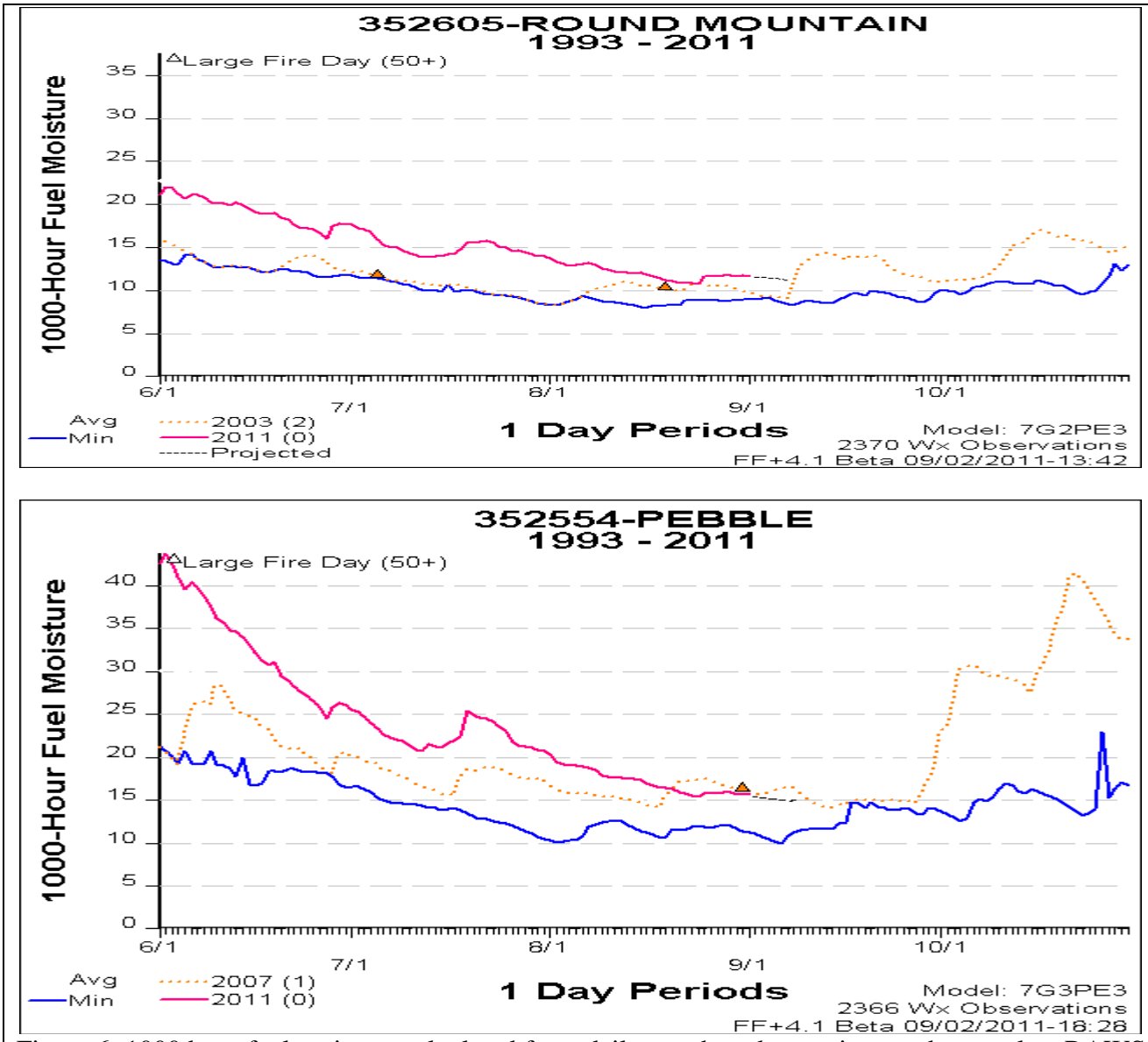


Figure 6: 1000 hour fuel moisture calculated from daily weather observations at the template RAWS, high lighting data to date, and **projecting 1000hr fuel moisture** from date to date.

Long Range Forecast

The 2011 long range forecast is for a drier September, with above normal temperatures in eastern Oregon (figures 7). However, October through December (Figure 8) values showing a return to normal or slightly below normal values. Considering the later start to the fire season with persistent snowpack and moisture at higher elevations, fire specific conditions may remain depressed or on average through the fall.

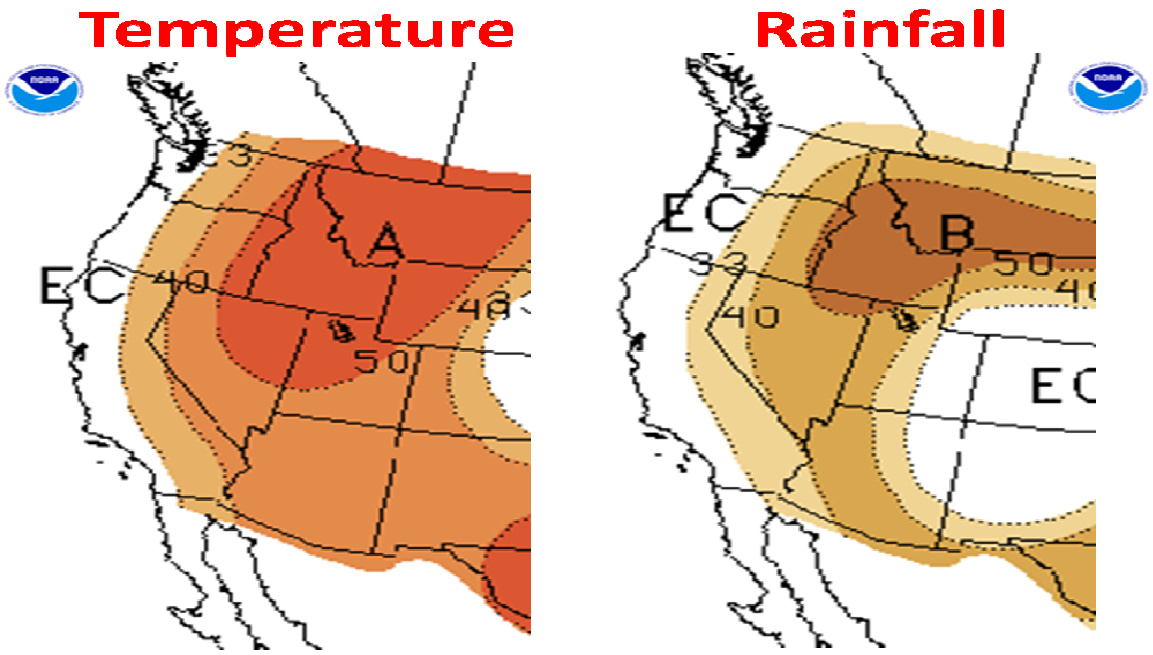


Figure 7 – September predicted values of temperature and precipitation for the Pacific Northwest showing above average temperatures and below normal precipitation as likely

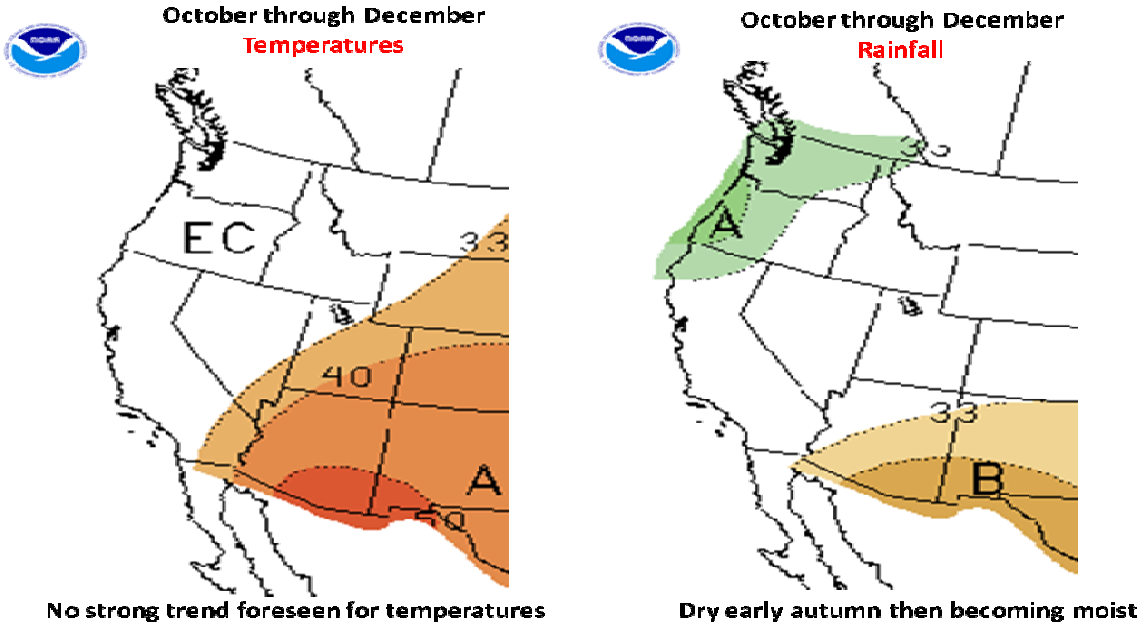


Figure 8 – Late autumn predicted values of temperature and precipitation for the Pacific Northwest showing near average temperatures and near to above average normal precipitation as likely

Season Slowing Events

Typical summers include periods of little to no fire growth, often as a result of precipitation that temporarily slows fires. As we move later into the fire season within Central Oregon, season slowing events are related to shorter burn periods, higher RH recoveries, reduced solar radiation, and reduced temperatures. Many of the events typically examined earlier in the fire season are inherent to the fall months.

Season Ending Events

The potential length of the fire season is important to operational and other management decisions, as the number of burn days left in the season have a direct effect on the likelihood that a free-burning fire will reach any point of concern. Local observations on the Deschutes National Forest indicate that active fire behavior and large fire growth are uncommon starting around the middle of September.

Season ending dates were developed from the past 16 years of RAWS data collected at the Round Mountain RAWS station. A season ending event was defined as a precipitation event of >.25in of rain over any three day period after August 1, accompanied by a depression in the ERC to below the 60th percentile, and for which the ERC never again rose above the 60th percentile before the end of the year.

Figure 8 displays the result of this analysis. September 30 is the midpoint date; by this date, 50% of fire seasons in the 16 years' records had ended. By October 17, there is a 90% chance that the season will be over. This assessment compares well with some other available estimates of season-ending dates. The Northwest Interagency Coordination Center Predictive Services group calculates season ending dates differently, emphasizing fire occurrence data, across the entire PSA (Predictive Services Area C2, encompassing Central Oregon). This measure lines up well with the analysis based on rainfall and ERC; September 28th is the 50th percentile date for season ending, with October 4 the 90th percentile date.

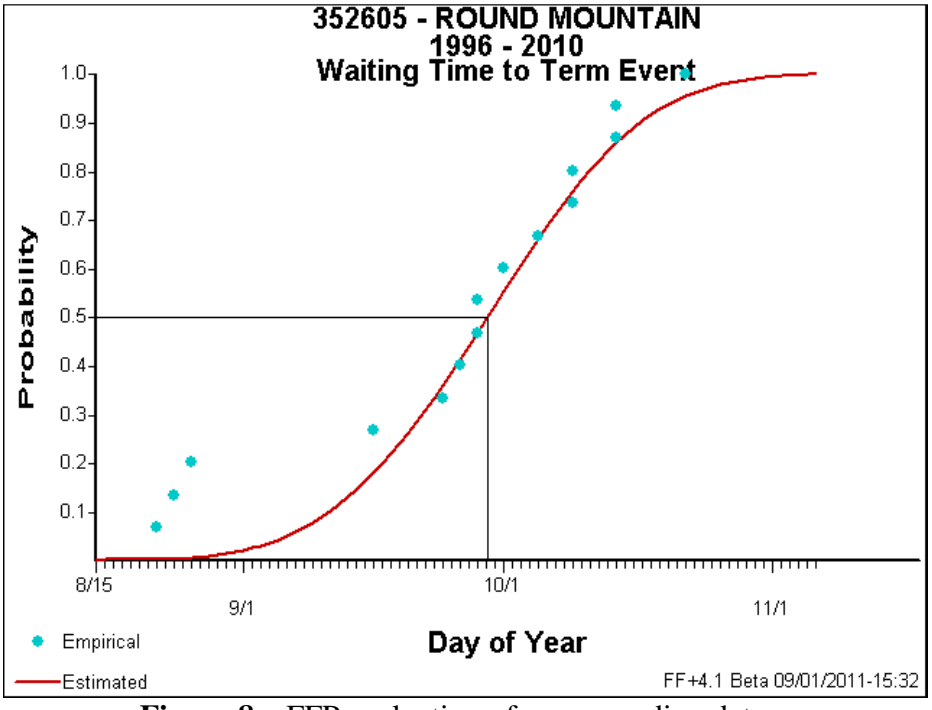


Figure 8 – FFP evaluation of season ending dates.

Smoke Management

The local unit is particularly interested in smoke impacts to local communities for the duration of this fire. Residents and visitors to Sisters, Camp Sherman, and Black Butte Ranch will see smoke the remainder of the summer, and at times haze will settle into these lower lying areas, creating a visual nuisance impacting Central Oregon's famous scenery, and (at high concentrations) potential health risks. Currently, smoke in the area has been drifting in from the north (the Cascade Complex on the Warm Springs Reservation), but as these fires are contained, the smoke impacts locally will be less. Because the Shadow Lake fire will be a longer term event, smoke impacts are possible until the end of the season. Our analysis of historical wind patterns indicates that smoke from the Shadow Lake Fire will move towards the Black Butte and Sisters area about 50% of the time for the remainder of the fire season.

The weather conditions that will set up these communities for impacts include: an increasing difference between daytime and nighttime temperatures, stable air masses creating inversions, and sustained high pressure systems contributing to stagnant air mass with poor ventilation. A sustained high pressure is anticipated over the first two weeks of September, and several of these episodes should be expected in any typical late summer and early fall in central Oregon.
To predict these episodes, several tools are available. The Forest Service in the Pacific Northwest has developed and is supporting the Blue Sky Framework web-based application (www.airfire.org/bluesky), and this system will allow a user to predict up to 72 hours into the future smoke impacts to a selected landscape.

Smoke sensitive receptor areas (SSRA) have been identified by the State of Oregon. These areas are provided the highest level of protection under the smoke management plan because of their past history of smoke incidents, density of population or other special legal status related to visibility. Bend and Redmond are both listed as SSRAs, but smoke impacts are also monitored in Sisters by a nephelometer located at the Forest Service office. Real time air quality monitoring data is available on the web at http://www.deq.state.or.us/lab/aqm/airMonitoring.htm.

Recommended Monitoring Actions:

The following monitoring actions are recommended for the duration of this season.

- Photo points and webcams are already in place, and as time permits should be monitored over the life of the fire (see monitoring appendix).
- Continue to monitor air quality, and establish the weather conditions that predicate smoke impacts in Sisters, Camp Sherman, Black Butte Ranch, Bend, and Redmond.

Education/Interpretation Opportunities

The Long Term Assessment team has identified several opportunities for public education coming from this LTA:

1) Photo points – we have established several photo points that provide quality distant views of the fire area, which are useful for documenting fire spread and smoke impacts over the life of the incident. (See monitoring appendix for photos and GPS coordinates). Black Butte Ranch (Blackbutteranch.com/webcam) also has a publically-available web cam trained on Mt. Washington and the fire.

2) Fuels and fire effects plots – we have also established photo points and geo-referenced transects along the fire edge to measure and monitor daily spread rates and fire effects (see monitoring appendix (for locations, data, and photos).

3) The decisions made by line officers and fire managers are informed by sound decision support tools, including this long term assessment. The models used in long term assessments are of interest to a segment of the public, and the key messages are about how science and experience are combined to base these decisions. Several of the model outputs (e.g. FS-Pro) are visually attractive as well.

4) Smoke impacts – the public information messages should include discussions and short term forecasts of smoke impacts to both the central Oregon communities and to the Big Lake recreation areas. Blue Sky is one of the tools that can be used to forecast smoke impacts, but should also be monitored over time for accuracy.

Conclusions and Recommendations:

Consider assigning an incident meteorologist to help with forecasting smoke events, fire growth events, etc. The IMET would help anticipate those events that are of public interest or impact, and help build credibility and trust by accurately forecasting and broadcasting these events.

The Shadow Lake Fire is a wilderness fire, but is not particularly remote or distant from wilderness boundaries. There is a high likelihood that the fire will reach the boundary of the Wilderness before the end of the 2011 fire season. We recommend continued implementation of the indirect attack option to protect the values at risk, with the first value at risk likely to be the Big Lake recreation area. The high loading of dead standing and downed trees in the fire area makes direct attack a risky proposition. The risks to firefighters are not related to fire behavior as much as the falling of standing dead trees. Therefore, the direct attack on the current fire perimeter is not recommended.

Expect at least another month of fire season in central Oregon, although most days should exhibit relatively benign fire growth. Fire managers and the public will see some active periods of fire growth and smoke from the Shadow Lake fire until the end of the season. These periods can be anticipated by the forecast for poor overnight humidity recovery and easterly air flow. The team recommends a sharing these forecasts with the public, allowing them to anticipate these days of active fire growth. Similarly, smoke impacts will be greatest during periods of stable air masses and cool nights – anticipate, predict, and communicate these events.

There are many opportunities for public information, education, and monitoring presented by this incident. Our team has established monitoring transects and photopoints on the fire, the information is included in the monitoring appendix, and we recommend using these as the starting point for continued monitoring of fire effects, fire growth, and fire behavior.

Appendix A – Details of the RERAP Analysis:

Multiple Assessment Date Report

Assessment Name:	Cascade Crest to Big Lake
Total Distance (ch):	101

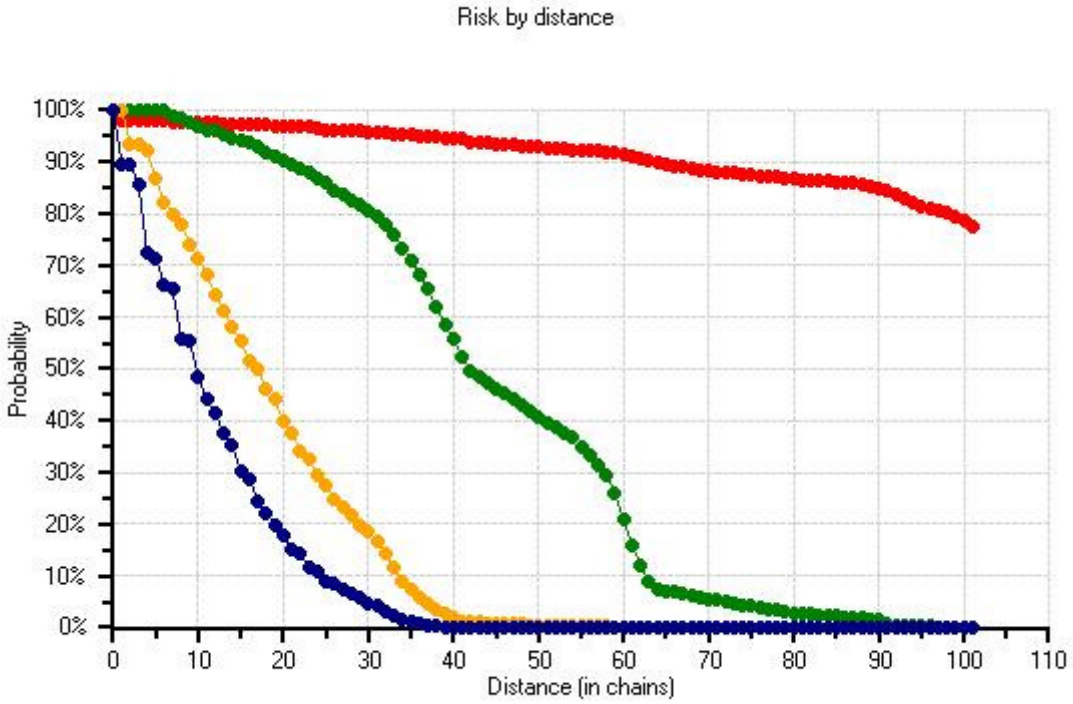
Description

Assessing the risk of fire spread potential assuming the active fire edge has reached the cascade crest, moving towards Big Lake under current seasonal conditions.

Term File Information	
Season Start Date:	4/1/2011
Alpha Value:	12.3
Beta Value:	0.0054
File name:	shadow_season_term.trm

Summary of Fire Movement Risk Estimates for Multiple Assessment Dates

Assessment Date	Total Risk
9/2/2011	63%
9/15/2011	3%
9/28/2011	<1%
10/8/2011	<1%



Assessment Name:	Cache Cr Private
Total Distance (ch):	90

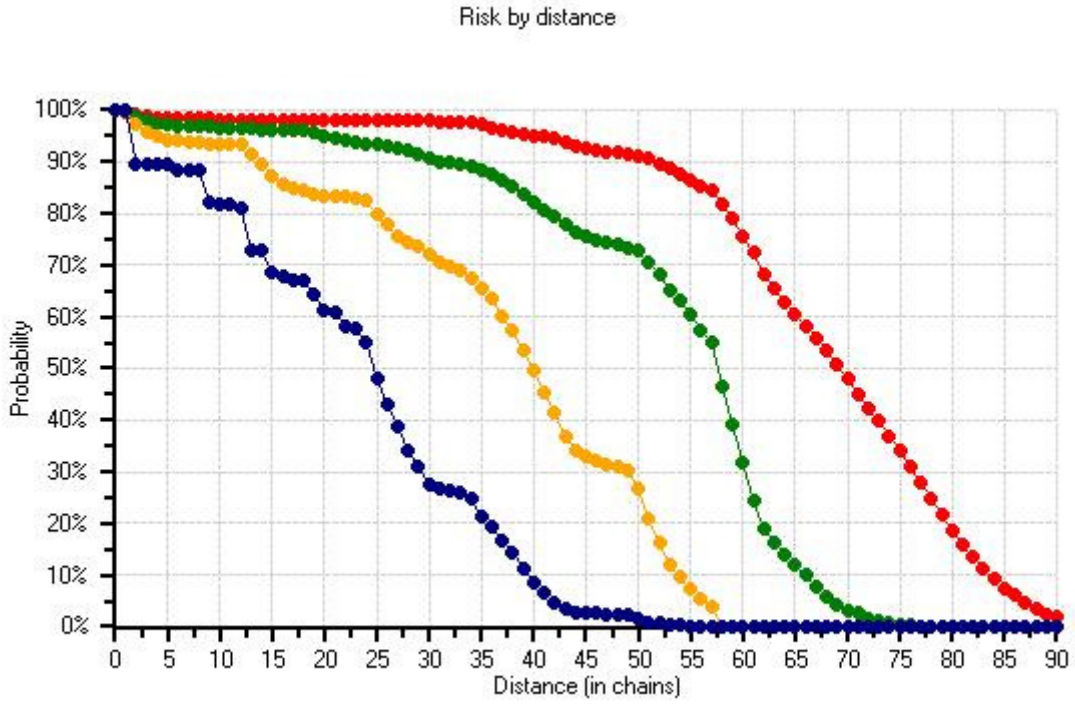
Description

Assessing the potential for fire spread from the current perimeter to the Cache Cr Private lands under current conditions.

Term File Information	
Season Start Date:	4/1/2011
Alpha Value:	12.3
Beta Value:	0.0054
File name:	shadow_season_term.trm

Summary of Fire Movement Risk Estimates for Multiple Assessment Dates

Assessment Date	Total Risk
9/2/2011	2%
9/15/2011	<1%
9/28/2011	<1%
10/8/2011	<1%



Multiple Assessment Date Report

Assessment Name:	Across Dozerline to Cache Cr Private
Total Distance (ch):	61

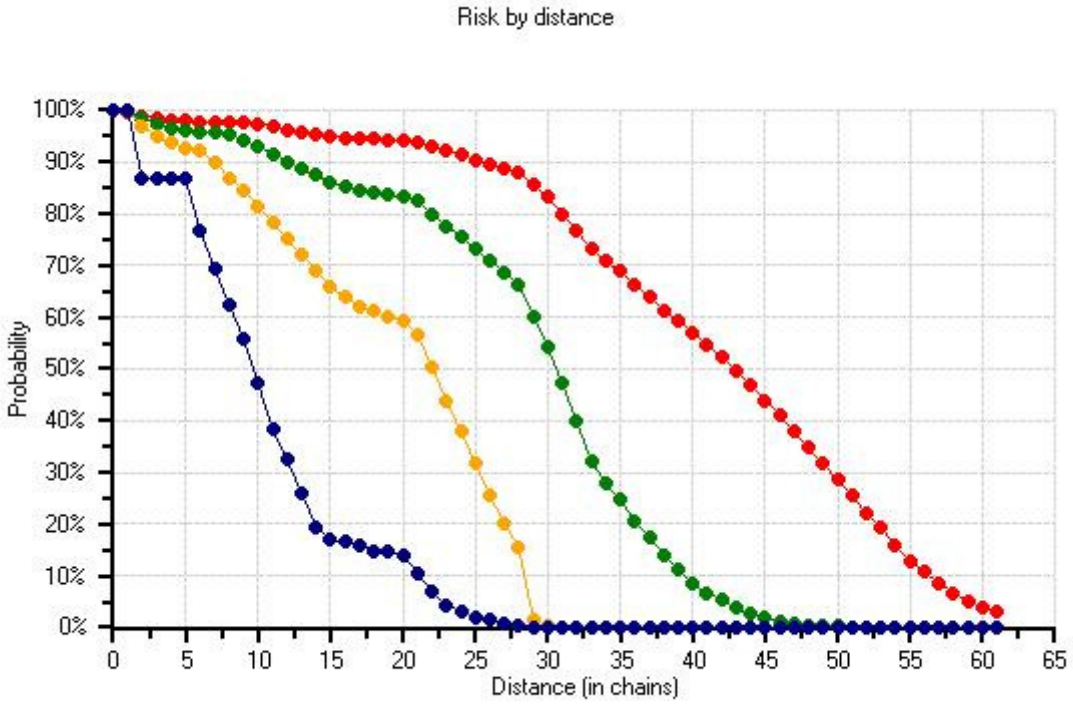
Description

Assessing the potential for fire spread from the dozerline to the Cache Cr Private lands under current conditions.

Term File Information	
Season Start Date:	4/1/2011
Alpha Value:	12.3
Beta Value:	0.0054
File name:	shadow_season_term.trm

Summary of Fire Movement Risk Estimates for Multiple Assessment Dates

Assessment Date	Total Risk
9/2/2011	3%
9/15/2011	<1%
9/28/2011	<1%
10/8/2011	<1%



Multiple Assessment Date Report

Assessment Name:	Wagon Road
Total Distance (ch):	87

Description

Assessing fire spread potential from the current fire perimeter 9/2/2011 to the historical Wagon Road and wilderness boundary.

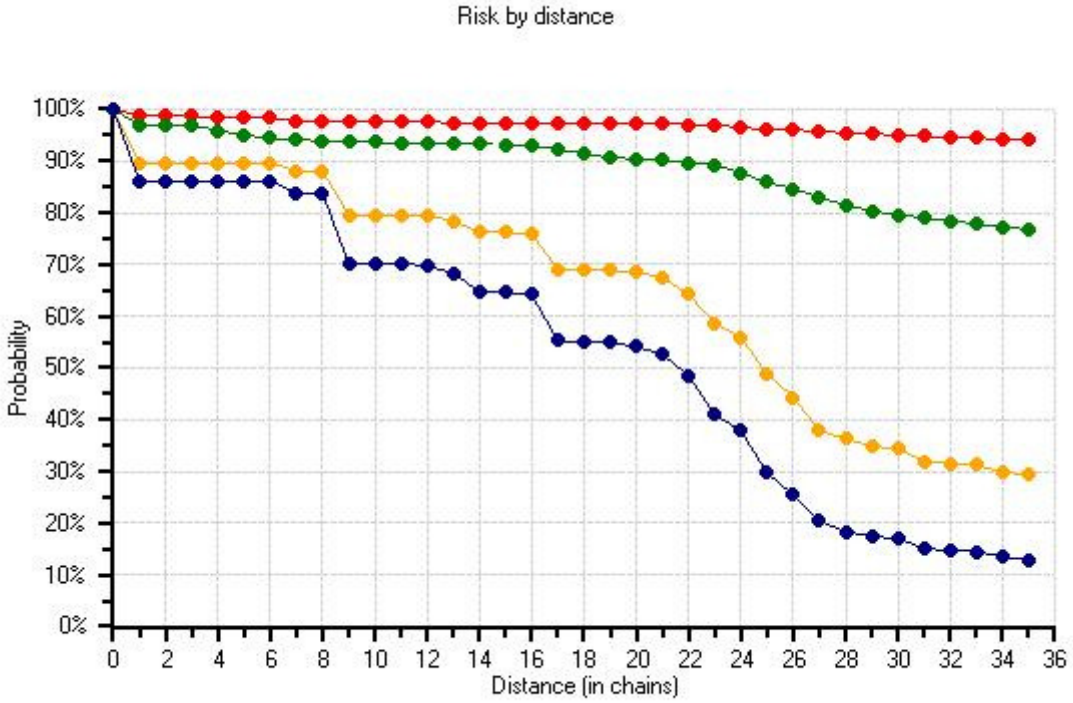
Term File Information	
Season Start Date:	4/1/2011
Alpha Value:	12.3
Beta Value:	0.0054
File name:	shadow_season_term.trm

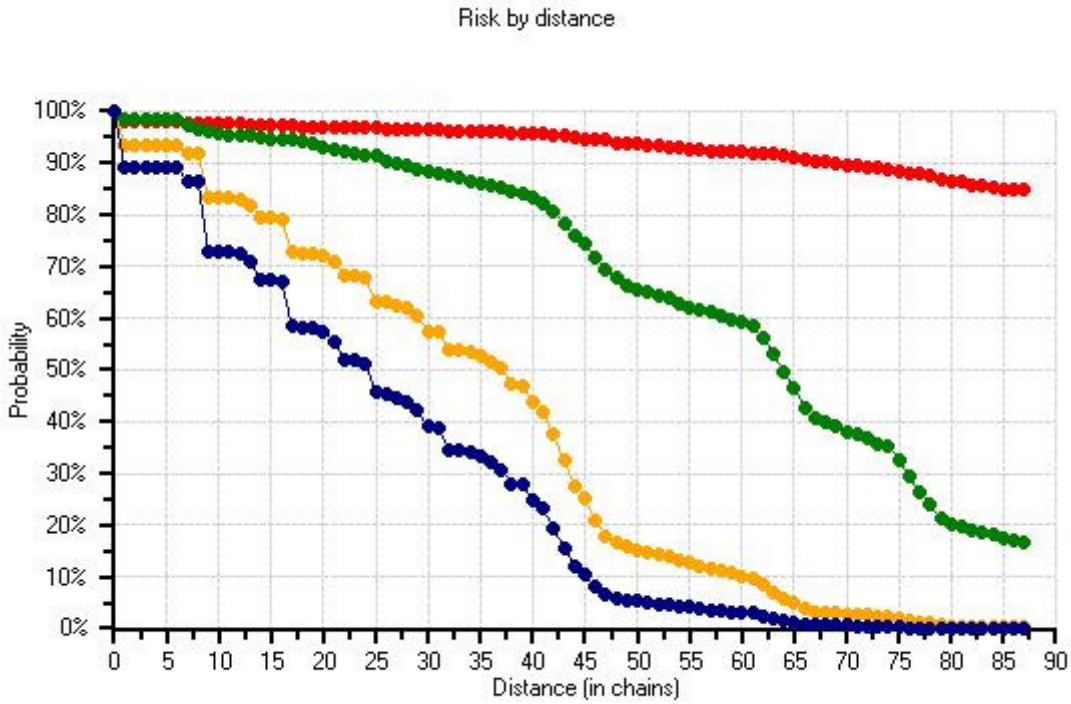
Summary of Fire Movement Risk Estimates for Multiple Assessment Dates

Assessment Date	Total Risk
9/2/2011	85%
9/15/2011	17%
9/28/2011	<1%
10/8/2011	<1%

Multiple Assessment Date Report

Assessment Name: Wagon Road
Total Distance (ch): 35



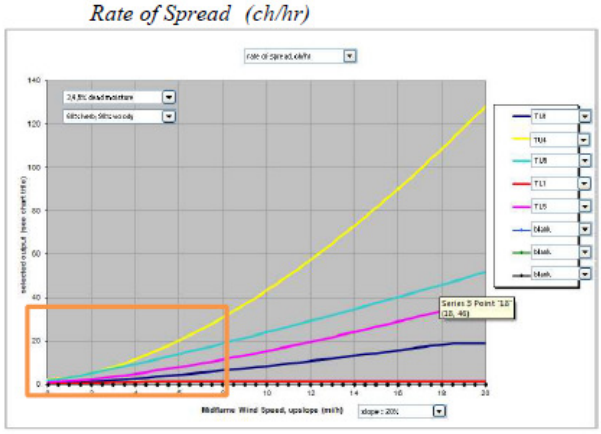

Risk by distance
Probability
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
Distance (in chains)

Appendix B

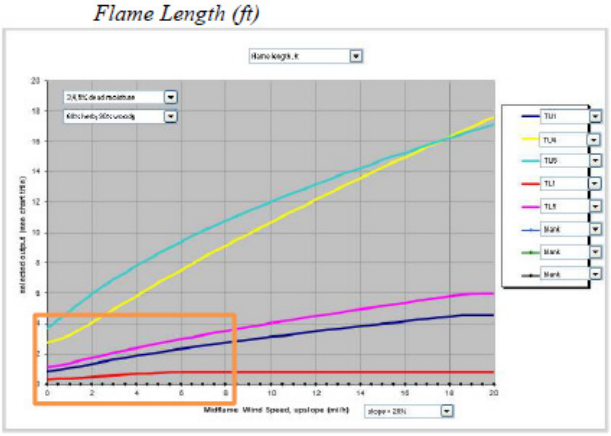
The BehavePlus fire modeling system is a program for personal computers that is a collection of mathematical models that described fire and the fire environment. It is a flexible system that produces tables, graphs, and simple diagrams that display potential fire behavior parameters such as rate of spread and flame length given certain weather and fuel conditions. It can be used for a multitude of fire management applications including projecting fire behavior of an ongoing fire. Primary modeling capabilities include surface fire spread and intensity, size of point source fire, safety zone size, spotting distance, and probability of ignition.

The following graphs use the same mathematical models as BehavePlus along with a set of parameters to quickly compare fire behavior generated by different fuel models. It was used to visualize the potential rate of spread and flame lengths under dry fuel conditions. Mid-flame wind speeds of 8 mph or less is reasonable to consider as the worst case scenario given historic climatology. Thus, this mid-flame wind speed range and resultant outputs are circled below.

Rate of Spread (ch/hr)



Flame Length (ft)



BehavePlus was used to calculate spotting distance base on torching trees. Under general forecasted conditions using a TL5 or TU5 fuel model with 1-3 trees torching, maximum spotting distance was modeled as 0.1 mile. Under worst case scenario using a TU4 fuel model the maximum distance with 5 torching trees is 0.6 miles. This could vary on the number of trees torching, power of the convective column, speed of transport winds, etc. Maximum distance observed in the field was estimated to be less than 0.1 miles so fire during the fire event.

Worse case spotting scenario using 25 mph 20' wind, with Lodgepole pine torching (60' tall, 20" dbh) from a ridgetop location.

Trees Torching	ROS (max) ch/h	Flame Length ft	Torch Tree Spot Dist mi
1	26.1	8.2	0.4
3	26.1	8.2	0.5
5	26.1	8.2	0.6

Appendix C

Monitoring and Field Observation Report

FOBS: Kathleen Russell, Scott McDonald, Amanda Rau (trainee)

Photo Points

Two photo point plots were established on the fire's south perimeter on August 31, located at N 44° 20' 41.5" W 121° 48' 37.5" (see Figure 1) and N 44° 20' 43.9" W 121° 48' 38.6". No fire progression was observed within either of the photo point plots on September 1. Two photo point plots were established on the fire's north perimeter on September 2 at N 44° 21' 35.3" W 121° 48' 30.2" and N 44° 21' 35.7" W 121° 48' 26.5", which have yet to be reevaluated for fire spread and effects.

Figure 1

Figure 2

Observed Fire Progression and Effects

North Perimeter:
Flagging was placed at the intersection of the fire's north perimeter with Dry Creek Trail to evaluate fire spread August 30 at N 44° 21' 22.4" W 121° 48' 31.7". No perimeter growth was observed August 31 and no observations were made on September 1. Perimeter growth was observed on September 2 at N 44° 21' 25.9" W 121° 48' 31.2", with approximately 300 ft. of fire progression toward the north (see Figure 2).

Fire effects were generally mosaic and mixed in severity with individual and group tree torching, coupled with smoldering, creeping, and residual burning in 100 and 1000-hour fuels. Fire was primarily carried into the forest canopy via abundant lichen in both dead and living trees.

South Perimeter:
Flagging was placed on the fire's south perimeter at N 44° 20' 41.5" W 121° 48' 37.5" on August 31. On September 1, fire progression was observed approximately 200 ft. to the southwest at N 44° 20' 42.0" W 121° 48' 35.4".

Observed fire effects resulting from spotting into the GW Fire of 2007 (see Figure 3) included complete consumption of 100 and 1000-hour fuels. Fire effects in unburned areas within and outside the GW Fire were similar to those observed on the north perimeter.

Figure 3

Monitoring Plots

One fuels monitoring plot was established on September 2, 0.9 miles south of the Dry Creek Trailhead from the 500 spur road, approximately 25 ft. west of the trail, to measure fire effects in dead and live fuels, located at N 44° 21' 35.3" W 121° 48' 30.2". A second fuels monitoring plot was begun but abandoned due to encroaching fire spread, located approximately 45 ft. east of the Dry Creek Trail, located at N 44° 21' 35.7" W 121° 48' 26.5". Four cardinal transects measured dead fuels in 1, 10, 100, and 1000-hour size classes; and fuelbed and duff depth. Four ordinal transects were performed measuring live fuels, soil exposure, and grass and vegetation cover.

Summary

Further observation and monitoring is recommended to ensure that data collected can be used to evaluate second order fire effects. Monitoring data has been provided to fuels personnel on the Sisters Ranger District for long-term monitoring purposes.

Hoodoo Photopoint N 44.24.109 x W 121.52.917 NAD83

Tuesday August 30 2011 1500

Thursday September 1 1500

Cache Mountain Photopoint 1 Sept 2011 1500hrs N 44.22.203 x W 121.47.081 NAD83