Mule Peak Long-Term Risk Assessment

3 August 2005

Objectives

1. Provide information on short- and long-term weather outlooks.
2. Evaluate the growth potential for Mule Peak Fire based on historical weather analysis and forecasted weather.
    a. Identify probable season end dates,
    b. Identify conditions and probabilities of large fire growth events and fire slowing events,
    c. Identify probabilities of fire reaching Minam River via Elk Creek to the northeast and Jim Creek Saddle to the northwest.

Current Situation

Lightning started the Mule Peak Fire on July 28, 2005. Initial attack was unsuccessful and the combination of fire behavior and forecasted weather resulted in an order for a Type II incident management team. On July 30, the fire made significant movement both uphill towards Granite Peak and Mule Peak and downhill towards Catherine Creek after sunset. Low relative humidities allowed the fire to remain active well into the night. The Type II incident management team assumed responsibility for the fire on July 31 and requested a 2-person long-term assessment team to evaluate the fire's potential within the Eagle Cap Wilderness. The Forest Supervisor identified the Minam River corridor as a particular point of concern. The incident management team expects to use the results of the long-term assessment to guide strategies and tactics within the wilderness relative to the threat to the Minam River corridor.

The primary weather data used in this analysis are from Point Prominence (station 351408) and Point Prominence II (station 351419); data from Harl Butte (station 351502) were also used as supporting data. Additional weather and climate data sources include the Western Regional Climate Center, Climate Prediction Center, US Geological Survey, Natural Resources Conservation Service, and the National Climate Data Center. Data analysis tools include Fire Family Plus 3.0.5, Rare Event Risk Assessment Process (RERAP) 6.02, ArcMap 8.3, and Microsoft Office Excel 2003.

Short-term Weather Outlook

High pressure will build over the area for the next few days, bringing very warm and dry weather. The August 2 7-day outlook for Predictive Services Area (PSA) E4, which includes northeastern Oregon, indicates normal seasonal dryness through Saturday, August 6, with very dry conditions on Sunday August 7, and a return to seasonal dryness on Monday, August 8. Forecast highs at Harl Butte are in the upper 80s from Thursday August 4 through Tuesday August 9; minimum relative humidities should drop into the teens and single digits through next Thursday, August 11.

The monthly outlook indicates a normal August for most of the Pacific Northwest, including PSA E4. August is the month known for large fires. The geographic area typically experiences two lightning episodes in August, centered around the 6th and 16th of the month, that result in several large fires. Predictive Services Area E4 averages 265 fires in August, of which 3%, or 8, grow to be 100 acres or larger.

Long-term Weather and Drought Prognosis

The winter of 2004-2005 was a low snowpack year, leading to concerns about severe drought through the summer. However, beginning in April, heavy rains began that continued through spring and into early summer, resulting in considerable greening of vegetation and much greater production of grasses and forbs than were expected based on snowpack. Even though the scant snowpack melted early as well, the heavier than average rain counteracted to some degree the lack of snowpack and early snowmelt.

Thus far, the 2005 fire season as been average to slightly below average based on Energy Release Component for G model at Point Prominence remote access weather station (RAWS) (stations 351408 and 351419) and departure from average greenness maps of vegetation. Until late July, the season largely trended at or below season averages, jumping above seasonal averages just after July 25. This year's pattern was compared to 1996 as well, a dry year with two escaped wildland fire use events (then called prescribed natural fires) (fig. 1). The 1996 fire season started off considerably drier than the 2005 fire season, setting several of the extreme values in the record in the early part of the season.

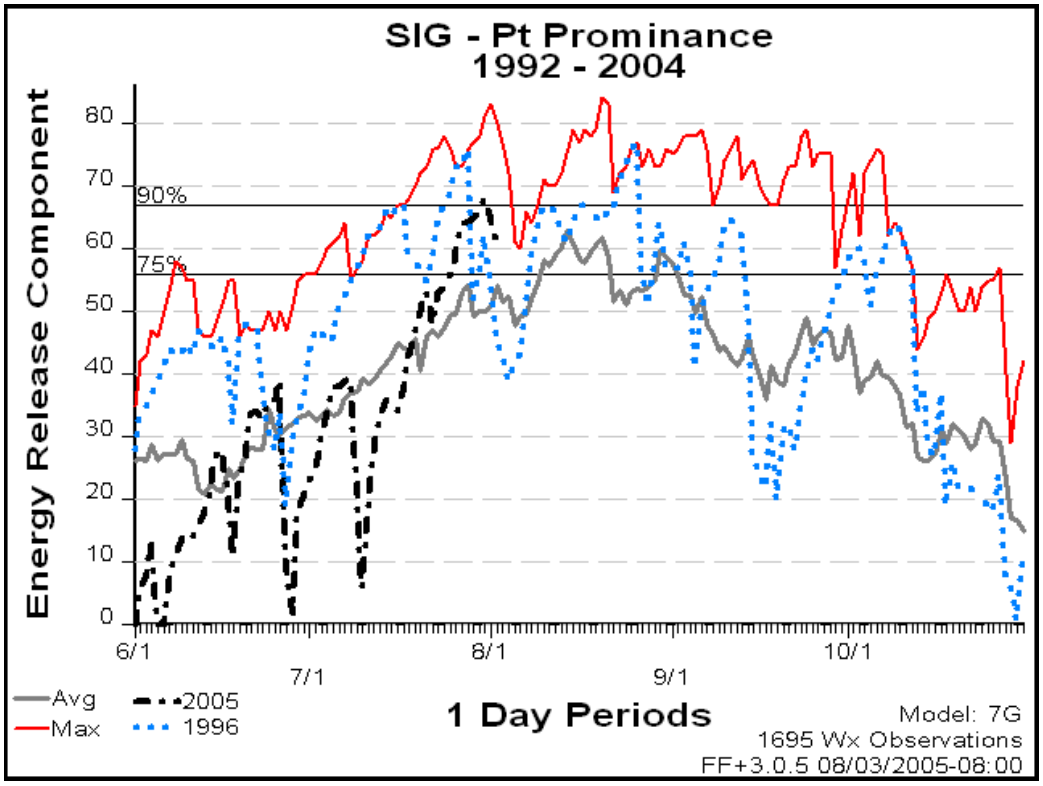

Figure 1. Based on the ERC curve for fuel model G, the District is experiencing average to slightly below average fuel dryness for the season to date.

Harl Butte shows similar trends, but remains at or below seasonal averages through July 31. The departure from average greenness maps for the week ending July 26 also depict the Eagle Cap wilderness and surrounding forest as largely greener than average for this time of year. Other evidence of milder conditions includes the continued greenness of grass fuels in the vicinity of the fire and the fire's failure so far to carry in areas without very heavy loadings of dead fuels. Calculated live woody and 1000-hour fuel moistures were above seasonal averages until July 24, live herbaceous fuel moisture remains above seasonal averages although approaching them, and the more volatile 100-hour fuel moistures are running below seasonal averages and were down near the 3rd percentile in late July. At Harl Butte, live woody, herbaceous, and 1000-hour fuel moistures are running above seasonal averages, sometimes well above, while 100-hour fuel moistures are at seasonal averages.

Despite these positive indicators, the Blue Mountains in general are rated as in moderate to severe drought conditions (fig. 2). The standardized precipitation index indicates June was near normal in precipitation, but longer-term deficits remain. For the water year to date the Blue Mountains are in the -5 to -2 inches category and the deficits continue as far back as 5 years. Streamflow data for the Minam River shows below average flows for the past month (fig 3). Lastly, accumulated precipitation at two Sno-tel sites, Moss Springs and Taylor Green, indicate precipitation levels as of August 1 are 80% and 79.1% of average, respectively.

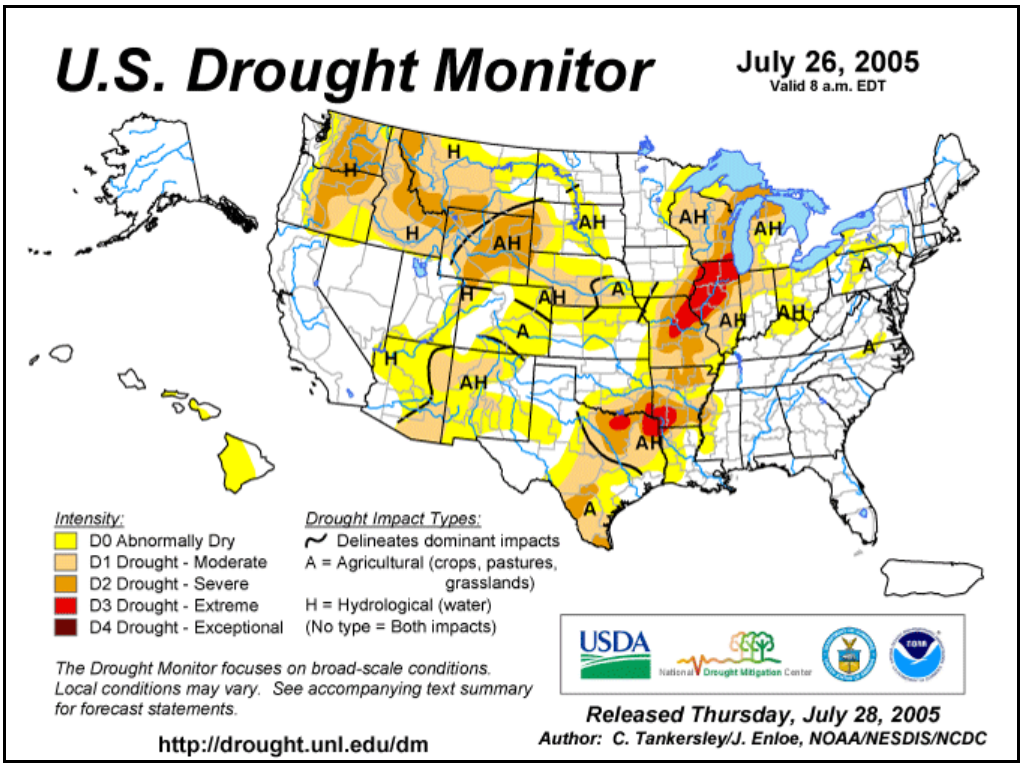

Figure 2. The Blue Mountains remain in moderate to severe drought status for hydrologic purposes, indicating low streamflows, among other impacts.

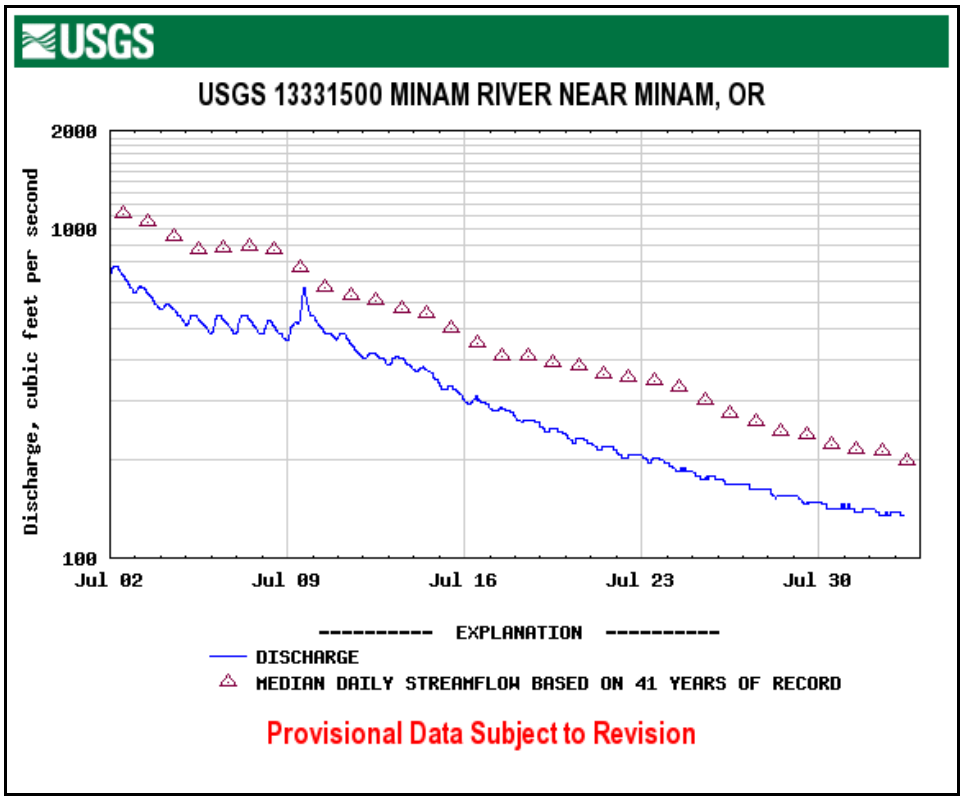

Figure 3. The Minam River has been running below average, an indicator of the lack of snowpack over the winter.

Over the next 30-90 days the Pacific Northwest in general is expected to have temperatures above seasonal averages (fig 4). However, there are equal chances for above average, average, and below average precipitation through October in northeastern Oregon. The existing drought conditions are not expected to improve (fig 5). Even average precipitation is quite low for August and September such that higher than average temperatures can place significant evapo-transpirational demands on soil moisture, which is already below seasonal averages, lowering live fuel moistures. It also dries dead fuels relatively quickly and hastens curing in herbaceous fuels.

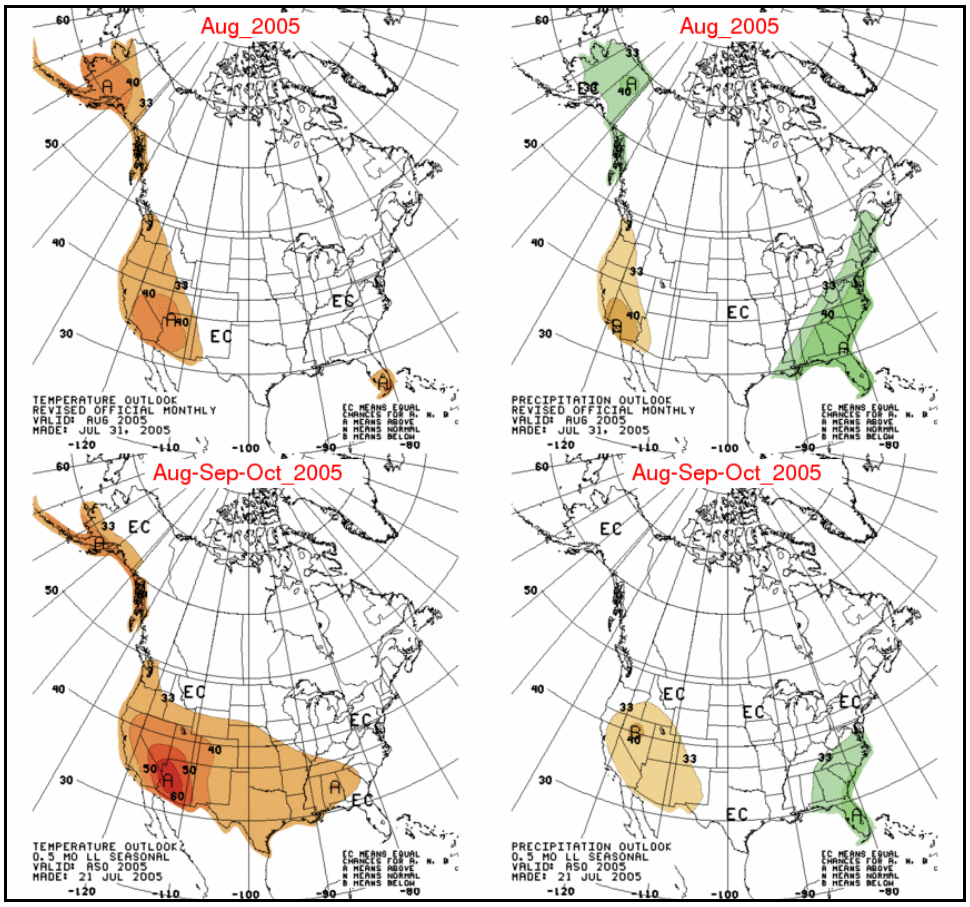

Figure 4. Temperatures should be above average through October, but there is no clear indication of what to expect for precipitation.

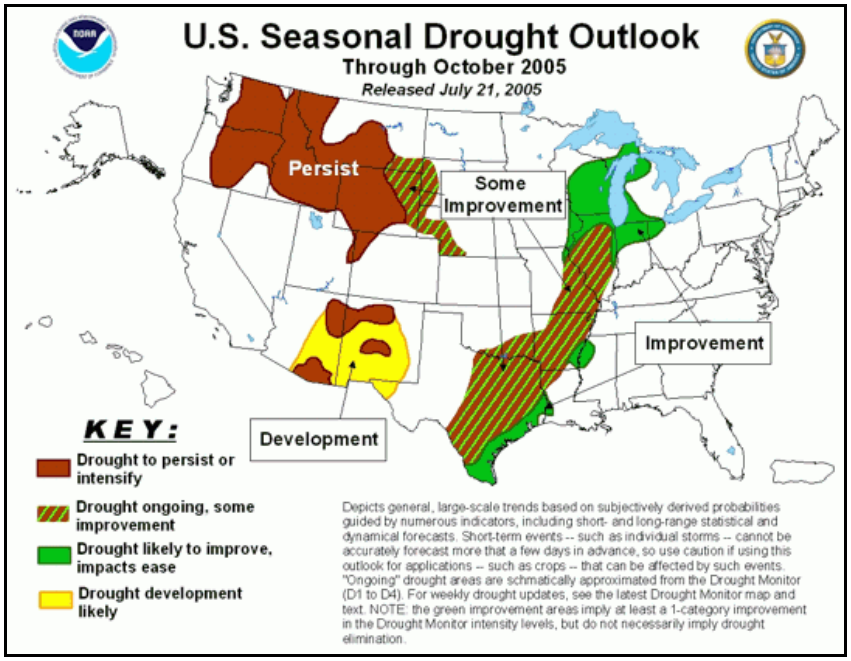

Figure 5. The existing drought conditions are not expected to improve over the next 90 days.

The upshot is that indicators of potential seasonal severity offer contradictory indicators. The area is shown as being in severe drought, but several key fuel moisture indicators and fire behavior itself is more in keeping with average conditions. Drought conditions are expected to persist and temperatures to be above average through the remainder of the summer and into at least early fall. Even then, the trend in both seasonal averages and extreme values for ERC begin falling in early August. These data suggest the greatest risk for this season is likely to be mid-August to mid-September.

Given the conditions present as of August 1, it would still require several days to a couple of weeks to dry fuels to the point where spread could occur in lighter-fueled areas and areas where herbaceous fuels are a primary carrier, and perhaps still later to reduce fuel moistures in other conifer needles to promote crowning in the lighter-fueled areas. Beginning in about mid-September, day length and sun angle will begin to affect the length of the burning period greatly. North and east aspects in particular typically see much shorter burn periods than south and west aspects. Any precipitation begins to have a greater effect and north aspects on the bottom third of slopes may not dry out sufficiently to carry fire readily.

Long-Term Risk Assessment

The long-term risk assessment examines the probabilities of several types of events, such as season end, large fire growth, fire slowing, and the likelihood of the fire reaching certain points of concern before the season ends. The following sections document the type of analysis and results.

Season End

The Forest identified season ending events in the Fire Management Plan (FMP) as a single day of at least 0.75 inches of precipitation or 3 consecutive days of precipitation of at least 0.25 inches each. Data to build a term file were included in the FMP. According to these data, 80% of the time, the season-ending event has occurred by September 28 (fig 6). Ninety percent of the time it has occurred by October 7. These results suggest the Forest and Districts may expect fire activity on Mule Peak Fire to continue for approximately two months.

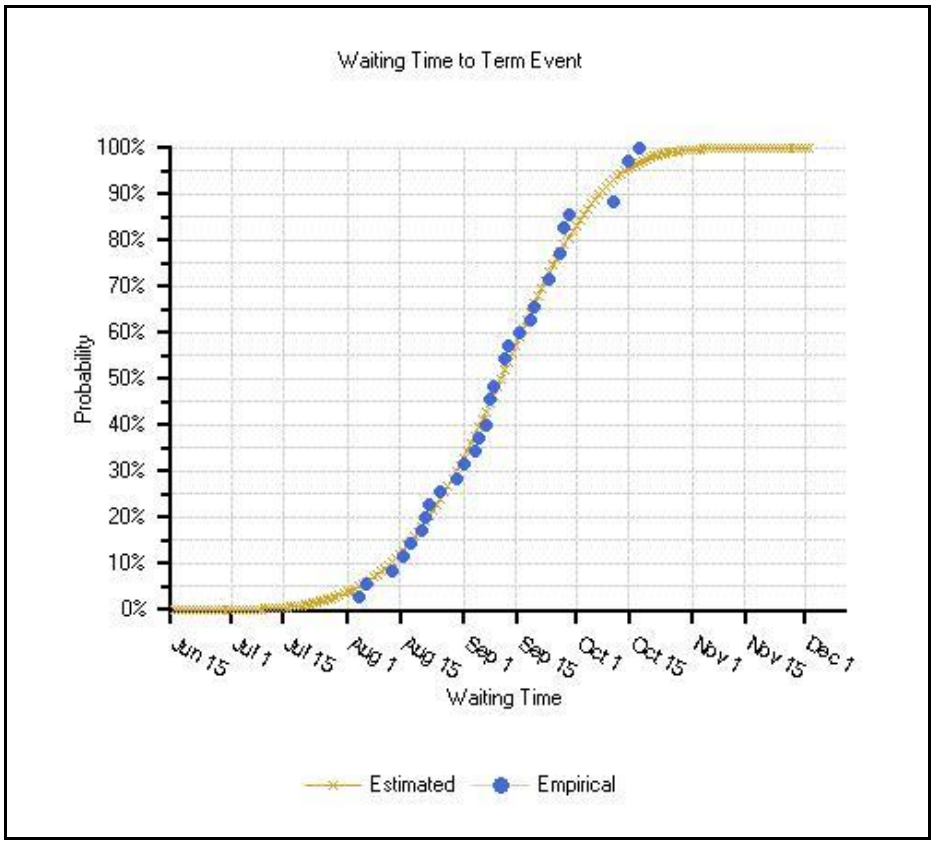

Figure 6. Using the Forest's definition of season end, 80 percent of the time, the season is over by September 28 and 90 percent of the time it is over by October 7.

Large Fire Growth Events

Large fire growth events are driven by a combination of dry fuels and a weather event, usually one involving high winds. Energy Release Component integrates all dead and live fuel classes and provides a good measure of how dry the entire fuel complex is at a given point in time. In particular, the large fuels and live fuels are both prominent in calculating ERC and in driving large fire growth events. High winds can arise from two weather events – thunderstorm downdrafts and frontal passage. The wind event in August is typically a thunderstorm downdraft, while in September and October it is frontal passage. The combination of a high ERC and high winds in fall usually indicates a dry cold front.

We analyzed the relationship between large fires on the entire Wallowa-Whitman and ERC for August 1 through October 31. We attempted to use just those fires associated with La Grande and Eagle Cap Ranger Districts, but there were not enough fires within the useable weather time frame (1992-2004) to draw sound conclusions. Approximately 84% of fires 500 acres and larger occurred when ERC was equal to or greater than the 75th percentile, or 56 (as calculated for the season of June 1 to October 31). Therefore, ERC 56 was selected as the dry fuel indicator.

Identifying high wind events is difficult using weather station data since there is only one observation used in connection with calculating fire danger indices and the wind speed recorded is a 10-minute average. An observation only once a day can easily miss a thunderstorm downdraft or frontal passage. The 10-minute average can 'hide' much higher gusts that are important to driving large fire growth events (Crosby and Chandler 2004). For example, a 10-minute average wind speed can include gusts up to 26 mph (Crosby and Chandler 2004). An examination of the wind records for Point Prominence showed no winds

above 18 mph. Using the event locator tool in Fire Family Plus yielded very few days with ERC $\geq$ 53 and wind speed $\geq$ 10 mph. Therefore, we elected to use an 8 mph wind speed as the indicator; 8 mph wind speed can include gusts of 19-23 mph (Crosby and Chandler 2004).

The Forest also identified relative humidity as a critical factor; fires become active when relative humidity drops to 20% or less. As a result, we also examined when ERC was greater than 56 and minimum relative humidity was 20% or less as an indication of an active fire day. Figure 7 depicts the probability of an active fire day, using ERC in combination with minimum relative humidity, and a large fire day, using ERC in combination with wind. The large fire day probabilities roughly translate to 3-4 major growth events possible in August, 1-2 events in September, and 1 event in October. We also examined the probability by time period of each weather element separately (fig 8). The probability of a single factor being present is much greater than the probability of any two or of all three factors occurring in combination.

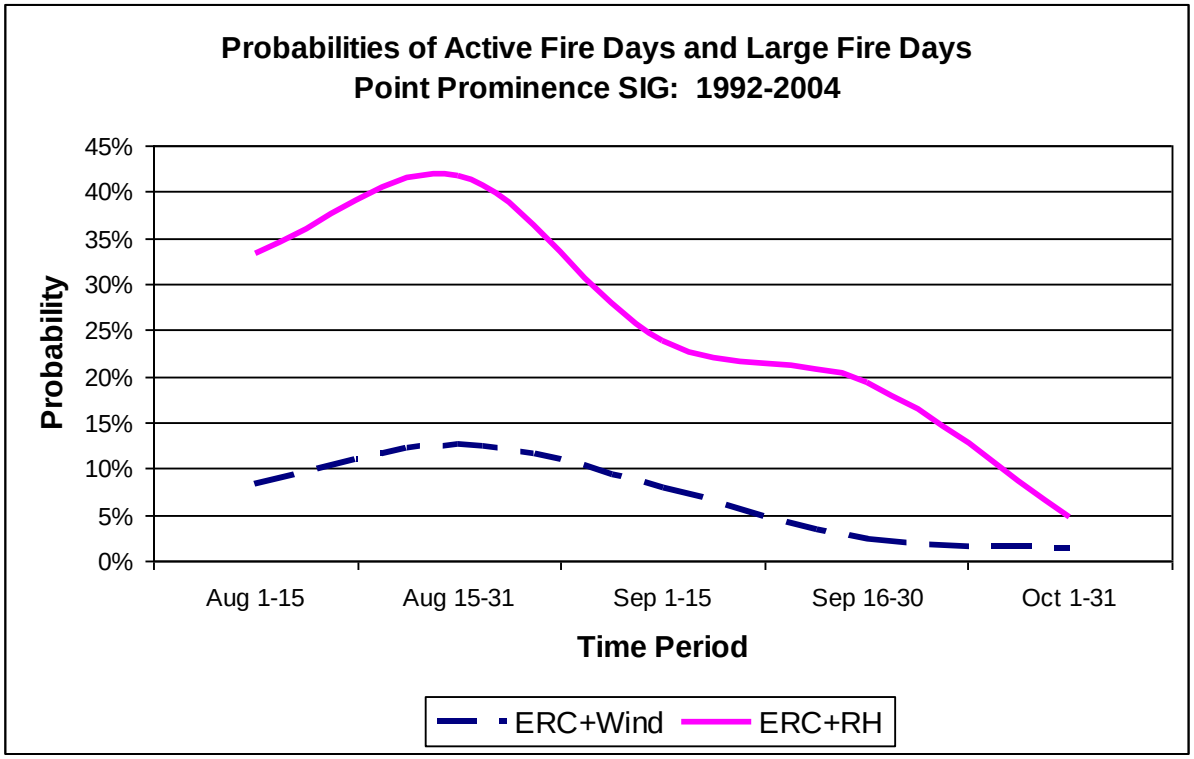

Figure 7. The probability of both an active fire day (ERC+RH) and a large fire day (ERC+Wind) peaks in the second half of August and rapidly declines through September.

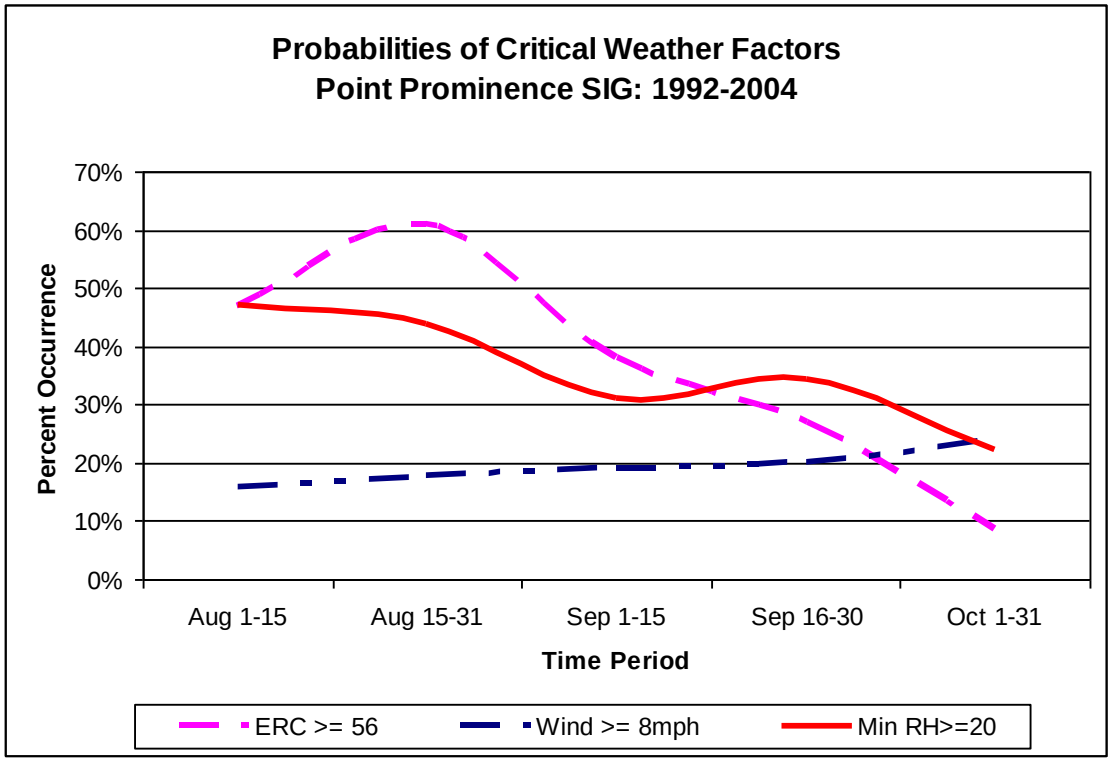

Figure 8. The most likely factor to be present is a high ERC, while high winds are least likely to be present. Point Prominence has recognized problems with wind speeds, however such that the probability of high winds may be underestimated.

Fire Slowing Events

Small rain events that are not enough to extinguish the fire still serve to slow the fire down through a combination of precipitation and changes in temperature and relative humidity. Fuels that receive even a little moisture require some time to evaporate that moisture. Generally, the later in the year such precipitation events occur, the more effective they are at slowing the rate of fire growth as changing day lengths and sun angles reduce the heating effectiveness of even clear, warm days.

After discussions with Larry Aragon, La Grande District Fire Management Officer, we identified 0.10 inches of precipitation as capable of slowing fire spread for approximately two days and 0.25 inches as capable of slowing fire spread for up to four days. Using the event locator tool in Fire Family Plus, we located events of 0.10-0.24 inches and of 0.25-0.49 inches for the period 1992-2004 and in the months of August, September, and October. The results are:

Month	2-Day Slowing	4-Day Slowing
August	1-2 events	1 event
September	1-2 events	1-2 events
October	2-3 events	1-2 events

Not surprisingly, any fire slowing event is most probable in October and least probable in August. However, it is possible to experience up to 3 such events even in August.

Precipitation probability analysis for Cove, Oregon indicates that early August is the seasonal minimum for precipitation. The probability of reaching either 0.10 or 0.25 inches of precipitation over a 1-, 3-, or 5-day period increases fairly steadily through mid- and late September and on through October (fig 9).

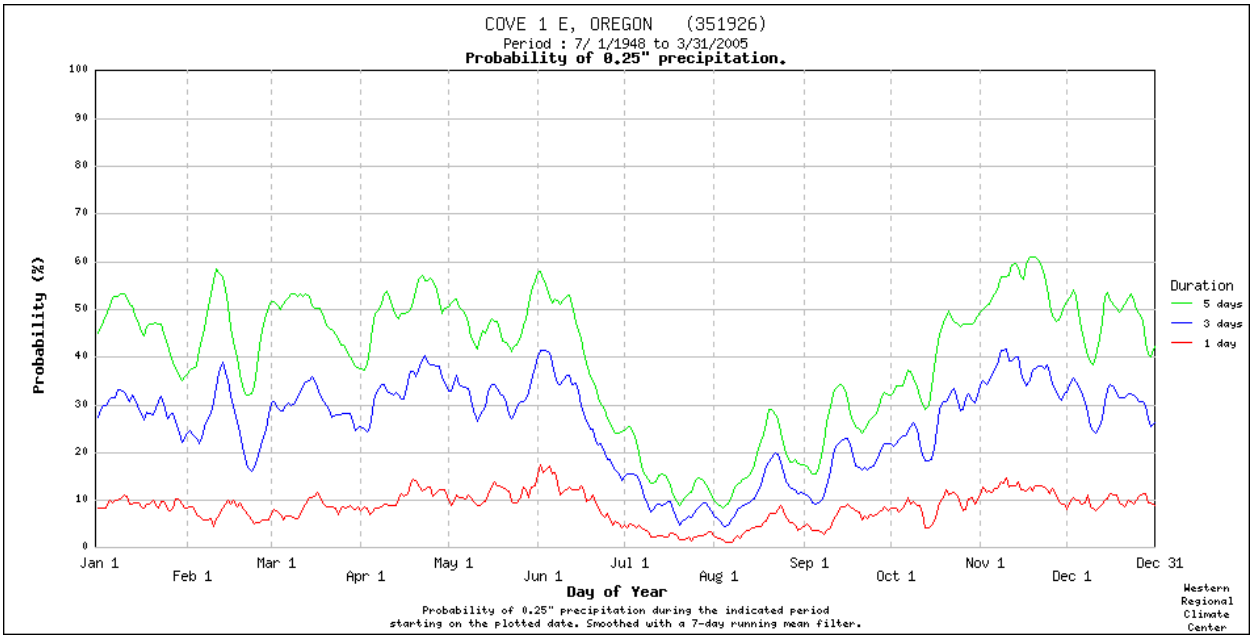

Figure 9. The pattern for the probability of 0.10 inches of precipitation follows a similar pattern with greater probabilities for the lower amount. The jump in about the third week of August suggests this area can experience the so-called August Singularity considered typical of the Bitterroot Valley in Montana and northern Idaho.

RERAP

The Rare Event Risk Assessment Process (RERAP) uses statistical analysis to determine the chances that a fire will reach a specified point of concern before the season end. Weather data are extracted for specified time periods from a station considered representative of the weather on the fire using the percentile weather tool in Fire Family Plus. The potential path of the fire is described using fuel model, slope steepness, aspect, sheltering from the wind, shading from the sun, and so forth – the same environmental parameters used to adjust fuel moistures for use in calculating flame length and rate-of-spread. The same fire spread mathematical model used in BEHAVE is also used in RERAP to model surface fire spread. Crowning spread rates are based on surface rate of spread for a fuel model 10 given the fuel moistures and other environmental parameters, regardless of the fuel model specified in the segment description. Spread by spotting is accounted for through use of crowning spread and adjusting the hours of spread in each time period.

The RERAP model was used to determine the probability of the fire reaching the Minam River or Jim Creek Saddle prior to the season end. Two RERAP lines were analyzed (fig 10):

Line 1 -- head of Elk Creek to the Minam River – 280 chains

Line 2 -- fire edge northeast to the saddle between Jim Creek and Rock Creek – 252 chains

Fuel model information came from La Grande GIS coverages. Weather data used for Line 1 was all from Point Prominence weather station with a usable period of record from 1992-1999. Point Prominence wind data was judged to best represent Line 1 because Elk Creek is largely sheltered from ridgetop winds. Five time periods were used: August 1-15, August 16-31, September 1-15, September 16-30, and October 1-15. The last time period includes the 90th percentile date for season end (October 7).

We used two weather scenarios for Line 2 analysis. In Scenario 1, we used all Point Prominence data. For the Scenario 2, we used fuel moisture data from Point Prominence

and the wind data from Harl Butte weather station. Line 2 is aligned with southeast wind and is exposed to the wind. Point Prominence appears somewhat sheltered from wind and there were too few observations in the data set in the east, southeast, and south directions for statistically sound analysis using two-week time periods. As a result, we used three month-long time periods: August 1-31, September 1-30, and October 1-30.

The term file used was from the Wallowa-Whitman NF Fire Management Plan, and included season-ending data from 1970 through 2004 from Harl Butte weather station. We identified the rare event as a thunderstorm downdraft in August and dry cold front passage in September and October. The goal of the process is to 'push' the fire towards the points of concern in an attempt to estimate the highest probability of a particular event.

RERAP results are based on the following base assumptions:

- The fuels and weather data used are representative of the area,
- No management actions are taken on the fire to slow or halt fire spread.

Line 1 – Elk Creek to Minam River. We assumed fire would become established at the head of Elk Creek in continuous fuels on three different dates: August 4, August 16, and September 1. We used fuel model 10 for the entire area. Crowning fire spread was used during high and extreme conditions on the steeper terrain segments, since the weather was not significantly different in August and September between high and extreme conditions. Extreme conditions in August were classified as thunderstorm winds for 1 hour, in September as frontal winds for 3 hours, and in October as frontal winds for 2 hours. Spread of more than 40 chains was classified as a rare event.

Using this approach, the fire has a 22% probability of reaching the Minam River at the mouth of Elk Creek before the season-ending event, if it were to establish by August 4. It would take a rare event to do so and this event is most likely in September (8% chance). Common daily spread would not be sufficient to carry the fire to the Minam River.

The common spread mechanism would be from material rolling downhill, and then fire running back up hill. It would be very uncommon for a south wind to reach the surface in Elk Creek to over-power the diurnal up canyon winds. More likely, a significant spread event would occur with a combination of low RH, a down-canyon wind, and torching trees that loft embers, causing spot fires further downhill. These spot fires would tend to run uphill and start the process over again.

In talking with Tom Jones, Fire Behavior Analyst for the Northwest Oregon Type II incident management team, we believe there might be enough energy from an uphill fire run north of Catherine Creek to cause spotting of sufficient distance to establish fire in upper Elk Creek. However, the later this occurs in the season, the lower the probability of fire reaching the Minam River. The chart below illustrates how the probability changes if the fire becomes established later in the season.

Date	Total Risk
August 4	22%
August 16	11%
September 1	4%

Line 2 – NW Corner of fire to Jim Creek saddle. We assumed the fire would not be contained by August 4 on the upper part of the ridge north of the fire, to assess the chances the fire could get to the next logical place to the north where it could cross and become established in the head of Rock Creek. We used fuel models 2 and 10 on a roughly 34/66 percent split respectively.

In Scenario 1 (light wind) crowning fire spread was used during high and extreme conditions in fuel model 10. Spread of more than 40 chains was classified a rare event.

Under this scenario, the fire has a 10% probability of reaching the Jim Creek Saddle before the season-ending event. It would take a rare event to do so and this event is most likely in September (8% chance). Common daily spread would not be sufficient to carry the fire to the saddle.

In Scenario 2 (Harl Butte wind) crowning fire spread was used during only extreme conditions in fuel model 10. Spread of 60 chains or more was considered a rare event. Under this scenario, the fire has a 69% probability of reaching the Jim Creek Saddle before the season-ending event. Common daily spread alone has a 54% chance of reaching the saddle before season end. The highest risk for rare event spread is in August.

We think the answer is somewhere between the two scenarios, approximately an even chance the fire makes it to the saddle if no action is taken. The common spread mechanism would likely be from fire backing downhill, then running and spotting back uphill to the ridge. Even though we did not assess it using RERAP, given the results from Line 1, we think the fire would have a poor chance of making it to the Minam River by this route. Another possible route over the ridge is at the head of China Cap Creek.

We also examined how the risk to Jim Creek Saddle would change over time using the Harl Butte winds. However, the probability of the fire reaching the saddle drops to 27% and 11% if the fire stays parked where it is until August 16 or September 1, respectively. In the August 16 scenario, the fire could still reach the saddle through common daily spread, but the chance of that outcome drops to 7%. Also, the highest rare event risk shifts to September. If the fire does not move until September 1, then common daily spread cannot carry it to the saddle before season end. A rare event has a higher probability of reaching the saddle in September.

If there is concern about the fire moving north toward Jim Creek saddle, consider placing a portable RAWS station somewhere on the ridge to better assess wind conditions.

It appears there is a low risk of fire reaching the Minam River. The fire would have to either spot across the ridge into Elk Creek or travel north to spot across the ridge. Then the fire would have to essentially back down to the Minam River on aspects generally sheltered from the prevailing winds.

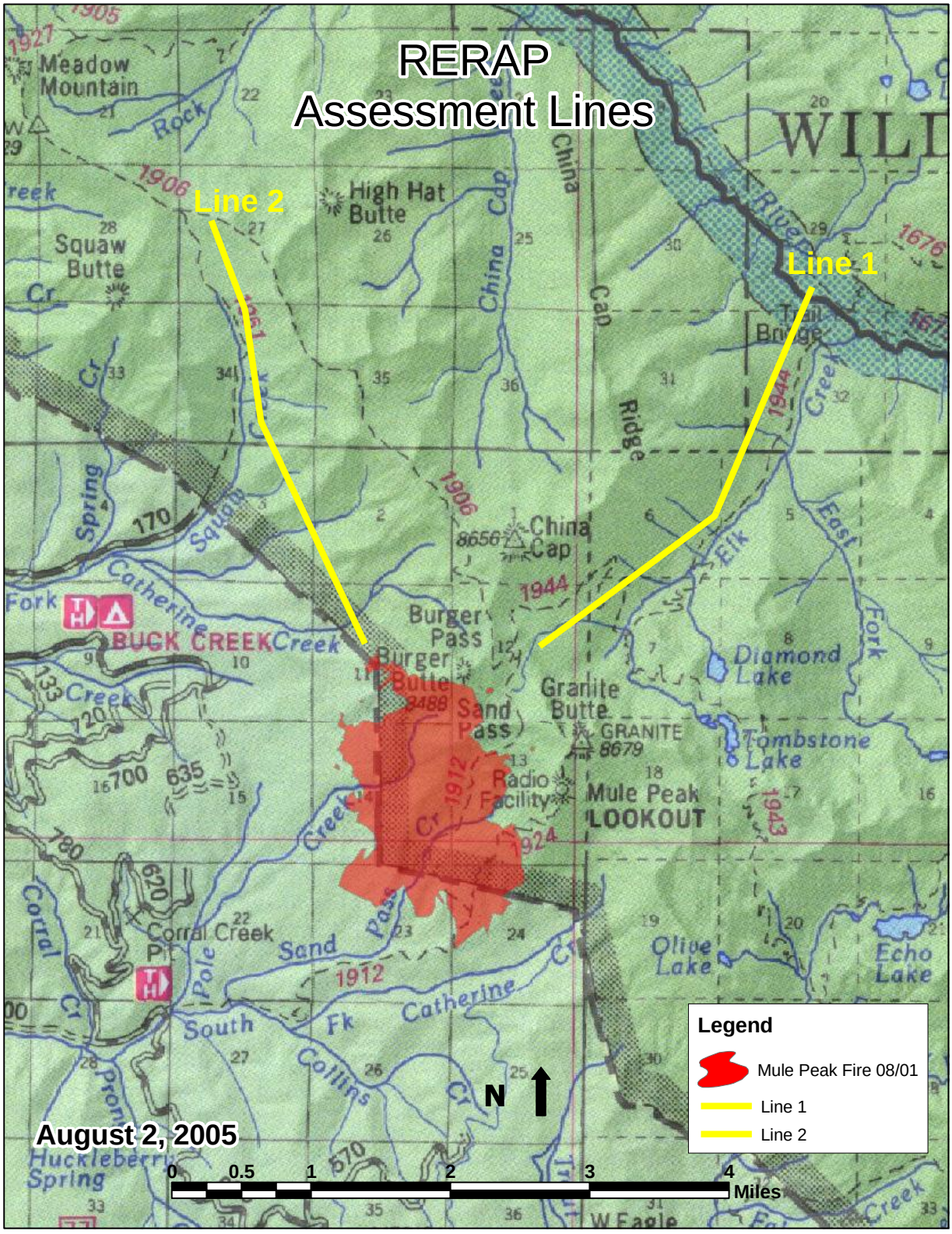

Figure 10. Two RERAP assessment lines were constructed, but more than one analysis conducted on Line 1 to estimate how probabilities change over time.

Summary

- Northeastern Oregon is expected to be hotter and drier than average.
- The Blue Mountains are rated as being in severe drought, Hydrologically, as evidenced by accumulated precipitation amounts for the water year at nearby Sno-tel sites and streamflow levels for the Minam River.
- Much of northeastern Oregon has a 5-year precipitation deficit, although spring and early summer precipitation was average to above average.
- Fire danger and key fuel moisture indices at Point Prominence and Harl Butte have largely been below or at seasonal averages.
- Vegetation is rated as greener than average for this time of year.
- Fire behavior to date on Mule Peak is consistent with an average season in the subalpine fuel type.
- Temperatures are expected to be above average through October, but precipitation is unclear.
- Drought conditions are expected to persist.
- Season end should occur by September 28 80% of the time and by October 7 90% of the time using the definition and data in the Wallowa-Whitman Fire Management Plan.
- Based on Point Prominence data, 3-4 large fire growth events could occur in August, 1-2 events in September, and 1 event in October.
- Based on Point Prominence data, 1-2 fire slowing events that lasts for about 2 days could occur in August, the same number in September, and 2-3 such events in October.
- Based on Point Prominence data, 1 fire slow event that lasts for up to 4 days could occur in August, and 1-2 such events each in September and October.
- Should the fire establish in the head of Elk Creek by August 4, August 16, or September 1 it has a 22%, 11%, or 4% probability, respectively, of reaching the Minam River before the season end.
- Should the fire actively move toward Jim Creek Saddle beginning August 4, August 16, or September 1 it has a 69%, 27%, or 11% probability, respectively, of reaching the saddle before season end.
- Common daily spread is not sufficient to carry the fire to the Minam River regardless of where it crosses the divide.
- Based on current fire activity and fuels, the probability of the fire crossing the divide into Minam River drainage is very low.

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Crosby, J.S.; Chandler, C.C. 2004. Get the most from your windspeed observation. Fire Management Today 64(1): 53-55.