Appendix B Elkhorn 2 Fire Behavior Analysis

Summary: The Elkhorn 2 Prescribed Fire was ignited on June 12, 2008. The purpose of the project was to improve wildlife habitat through the burning of old-growth pinyon-juniper (PJ). The objective was to remove 30-80% of the PJ canopy through the use of uphill fire runs using a helitorch as an ignition source. The total project size was 10,490 acres.

The fire burned more active than anticipated, and burned outside of the project area. On June 14th the fire was declared escaped. A Type 3 Incident management team was brought in and the fire was contained two weeks later at 6,200 acres.

Fuels: The primary fuel types were pinyon-juniper with some small pockets of sagebrush on the slopes and larger stands of sagebrush in the flats. No live fuel moistures were taken prior to the project. The project was delayed two weeks due to a four inch snow in late May.

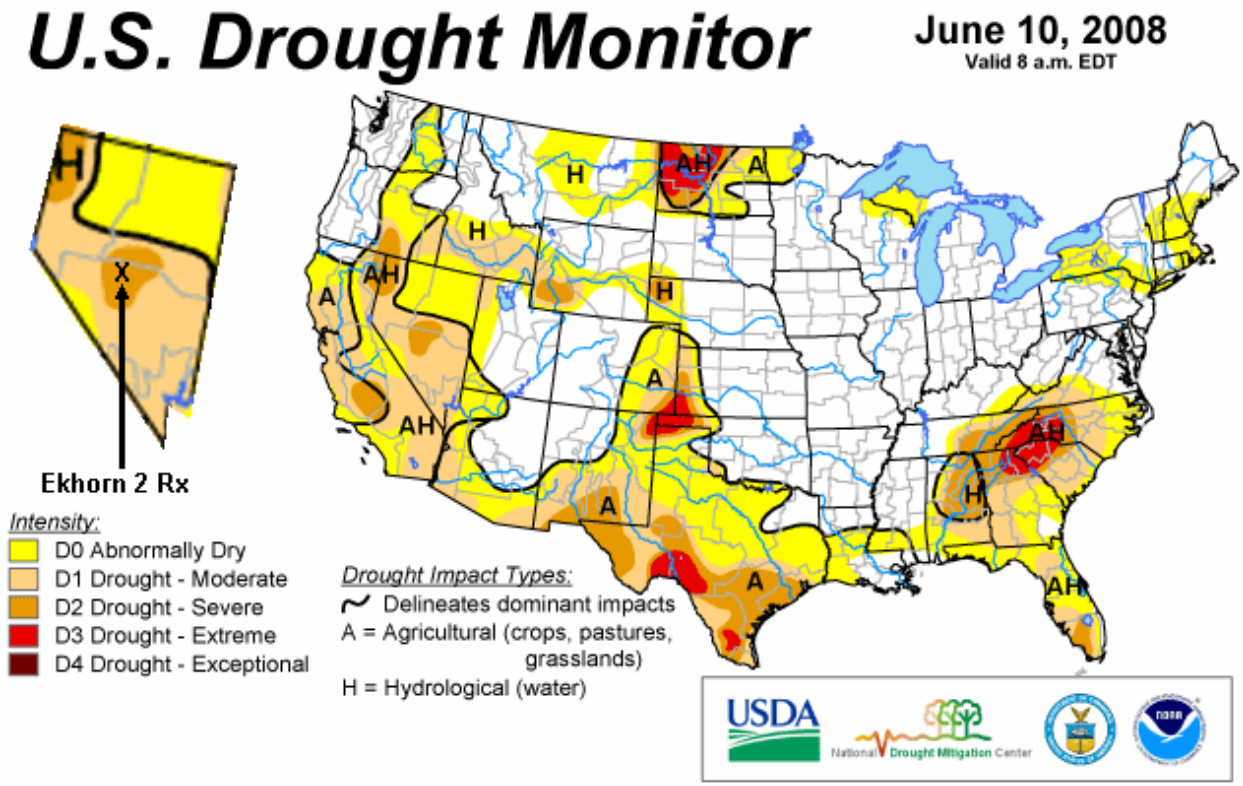
The cooler than normal spring resulted in a delayed growth of the PJ. Estimates range from a two to four week delay in green-up and initiation of plant growth. The late May snow would have contributed to the delay of the trees coming out of dormancy. This would cause decreased foliar moisture from what would be expected for that time of year. There were a number of pitch-outs observed on some of the pinion trees. This type of pitch-out is normally associated with a bark beetle attack on the tree and tends to weaken the tree, decreasing foliar moisture content. These scattered trees would result in pockets of higher fire intensities.

Pitchouts observed on the boles of the pinion trees at Elkhorn 2

Sub-drainages with a north or northeast aspect contained the highest fuel loadings in the unit. This increased surface fuel loading allowed for surface fire spread in some areas.

Weather: The weather patterns were not unusual for the time of year. Weather was warm and dry with an unstable atmosphere, common for central Nevada in mid-June. During the prescribed fire and Type 3 wildfire the weather was dominated by a strong ridge of high pressure which kept temperatures warm, humidities high, the atmosphere unstable, and winds light. There were no significant or unusual winds observed between

the time of initial ignition and the project being declared escaped. Winds measured at the Pancake RAWS were lighter than average during that time.
Central Nevada has been in a prolonged drought for the past five to seven years. The precipitation during the 2007/8 winter was close to normal, but not enough to off-set the effects of the prior years' drought. The live fuels were still drought stressed coming into the 2008 growth season.



Topography: The project is located in the Monitor mountain range, which runs north to south. The project is on the east side of the crest, and has an east aspect. This aspect allows for an increase in vegetation and, in the case of Elkhorn 2, an increase in available fuels. Elevations range from 9,200' to 7,000' and slopes range from flat to 80%. Aspects include north, northeast, east, and southeast.

Monitor Range topography

<u>Anticipated vs. Observed Fire Behavior</u>: The desired and anticipated fire behavior was for short duration, high intensity crown fires that would be five to five hundred acres in size. The following fire behavior characteristics for PJ fires were a part of the thought process, project design, and implementation for the Elkhorn 2 prescribed fire.

1. The ignitions would not last through the night and would require ignitions each day during the fire spread portion of the project.
2. That fire spread would only be uphill.
3. The factor that would have the greatest influence on fire spread would be the wind.
4. The fire activity would be limited to daylight hours and there would be no spread after dark.
5. Because the fire would only spread uphill with the wind, there could only be one head on the fire.
6. Pinyon-Juniper fires are wind driven and not convection dominated.
7. Flanking and backing spread should not be anticipated.

While these general rules concerning fire behavior in pinyon-juniper are valid, they are not absolute. Above average fire indices can negate any and all of these assumptions and in the case of Elkhorn 2 none of the above assumptions were correct.

1. There was only one day of ignition. The fire held through for two weeks.
2. The fire spread was uphill, downhill, and cross-slope.
3. There were no significant winds, yet fire spread was active.
4. The fire was documented to have spread both day and night; with most of the spread occurring late afternoon, evening, and early night time.
5. Multiple heads were reported on several days.
6. The columns observed were primarily convection driven (plume dominated) as opposed to wind driven.
7. Flanking and backing fire was observed and contributed significantly to the overall fire spread.

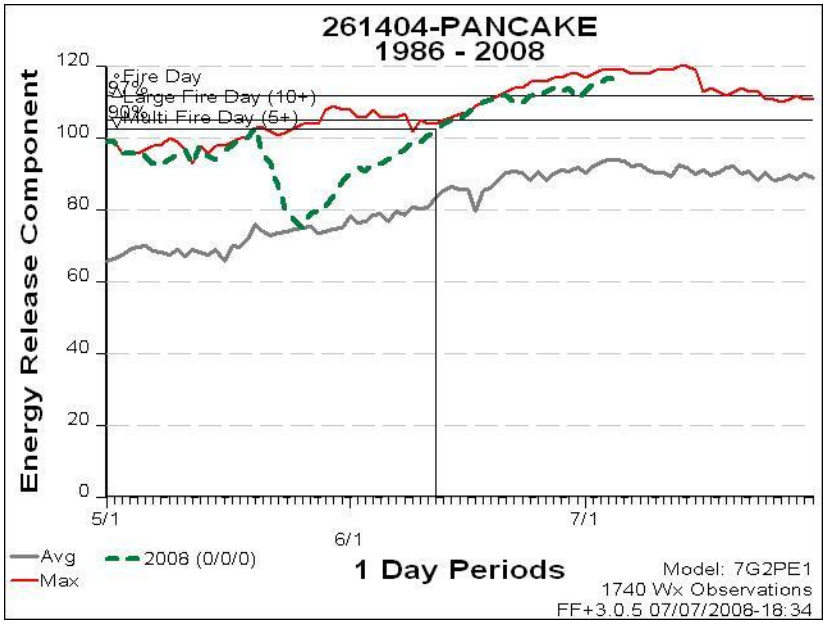
These conditions have been observed and documented on other Pinyon-Juniper fires in Nevada and other Great Basin states.

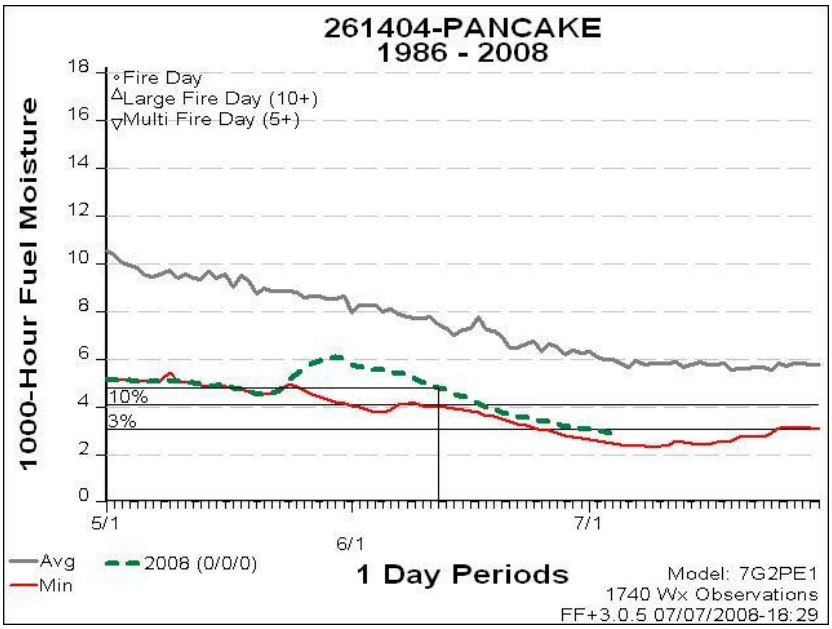
Note the well developed convection columns and lack of wind influence

<u>Contributing Factors to the Extreme Fire Behavior</u>: The closest Remote Automated Weather Station (RAWS) to the Elkhorn 2 project is Pancake. Data from the Pancake RAWS, thirty miles south of the project, was used to analyze weather data from 1986 to the present. The Pancake RAWS is lower than the project site, but is the best RAWS for trend analysis available. This data, when combined with on-site observations, give an indication of why the extreme fire behavior occurred.

Energy Release Component (ERC): The ERC is a measure of overall moisture content in a fuel complex and how much energy is available for release by combustion. ERC is a good trend indicator for how the fire potential is progressing. It does not take into account wind, so it is not a good indicator on fire severity on a day to day basis.

The ERC was 103 on the day of ignition. It was trending upward and soon went on to set all-time highs around the time the project was declared escaped.

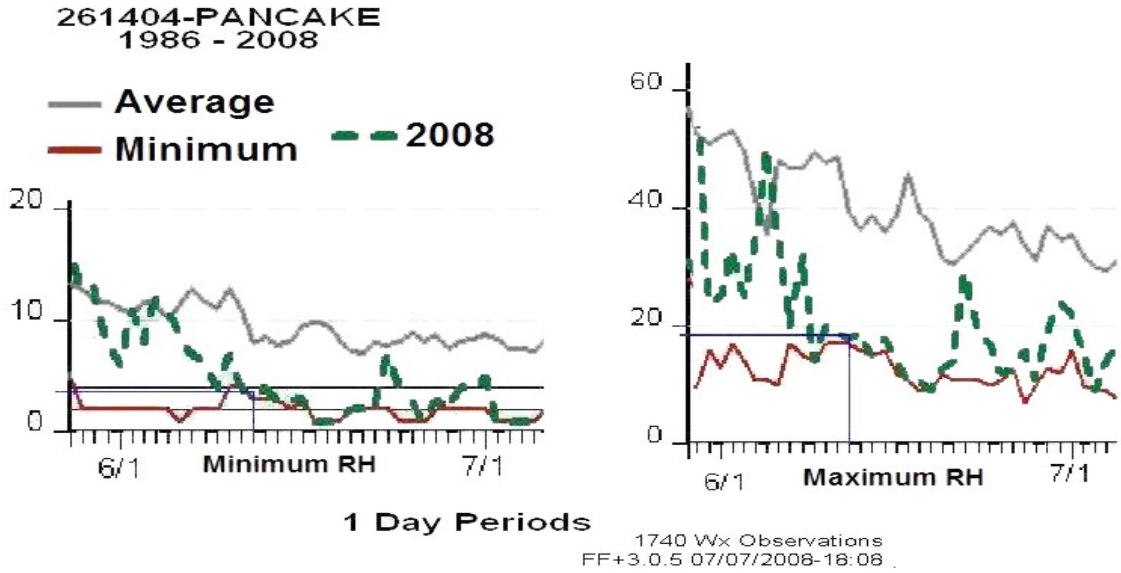




1,000 Hour Fuel Moistures (1,000 HR): 1,000 HRs are also a good indicator of long-term fire danger.

1,000 Hrs had been setting all-time lows prior to the May snow event. There was a slight recovery but the fuel moisture was still well below average. The 1,000 HR was in a downward trend and was at 4.5% at the time of ignition.

Relative Humidity: RH has a major impact on the intensity of burning in the smaller dead fuels. Line crews often measure RH on an hourly basis in order to anticipate changes in fire activity.



Minimum RHs at the Pancake RAWS were down below 5% for the duration of the project. Humidities never recovered to over 20% during the duration of the Prescribed and Type 3 fire. An onsite RAWS indicated a higher RH trend onsite than the Pancake RAWS, but lacks the historical data to use as an analysis.

Onsite RAWS	June 12	June 13	June 14	June 15
Minimum RH	7%	5%	5%	3%
Maximum RH	29%	24%	18%	23%

Fuel Loadings: The moister aspects allowed for better plant growth and a heavier fuel accumulation. This fuel profile allowed for surface spread and residual heat holding overnight, both of which are unusual in pinyon-juniper stands.

Conclusion: The combination of drought stress live fuels, a two to four week delay in the growing season flush, decreased foliar fuel moisture in trees with pitchouts, high ERCs, low large size class dead fuel moisture contents, unstable atmospheres, dry days, poor humidity recovery during nights, and concentrations of down dead fuels on east, northeast, and north aspects combined to allow for dynamic fire behavior. These factors combined develop a fuel driven fire which had intensities beyond direct control capabilities of the resources on hand.

There was not a single critical factor that caused the surprising fire behavior. The lesson to be learned here is that fire behavior in Pinyon-Juniper is very difficult to predict. Modeling has not emphasized this fuel type and the existing fire behavior prediction systems do not address the "all or nothing" spread and fire intensity that is associated with PJ.

The assumptions made for the Elkhorn 2 Prescribed Fire were not unreasonable based on past history and experience in this fuel type.