Overlook Prescribed Fire, Heil Valley Ranch

FEMO Report
Co-BLX-966
October 28, 2015

Summary

The Overlook project was implemented on October 28, 2015. The project was located at Heil Valley Ranch in the central portion of the property. The project was implemented as part of a Forest Restoration treatment that was over 500 acres. The ultimate goal of a Forest Restoration treatment is to reintroduce the natural disturbance processes that have been suppressed for over 100 years.

The burn unit is 22 acres in size and had been previously thinned to a basal area of ~40 ft^2/acre. This thinning resulted in a very open ponderosa pine (*Pinus ponderosa*) forest that can be characterized as having groups of trees within a matrix of mostly native grasses and forbs. The purposes for the project were to reduce the surface fuel loadings, have fire spread across most of the unit and create conditions to support natural ponderosa pine regeneration.

The project was successful in that it was implemented safely and stayed within the predetermined perimeter but all objectives were not met.

Background

Objectives

Objective #1: Reduce surface fuel loading by up to 75%. Pre-fire estimates of 1-2 tons/acre should be reduced to less than 1 ton/acre.

Objective #2: Reintroduce fire to at least 75% of the unit, in a mosaic pattern. At least 16 acres should have fire move across the surface in as natural a pattern as safety allows.

Objective #3: Create conditions to support the establishment of natural ponderosa pine regeneration. Up to 25% of the unit should have intensities sufficient enough to remove all vegetation down to mineral soil.

Fuels

Beginning in 2009 the burn unit was thinned mechanically by the Boulder County Sheriff's Office Fire Crew. All felled bole wood was removed from the unit and all slash was piled and burned. Prior to mechanical thinning the basal area for the burn unit was estimated to be at ~100 ft^2/acre. This was reduced to ~40 ft^2/acre over the 18 months needed to mechanically treat the area.

Fuel loading prior to the application of fire was measured at 3 plots during the growing season leading up to the project. The burn unit is fairly flat with little elevation change across its entirety. The previous thinning resulted in a heterogeneous forest in terms of species composition, diameters, ages and spatial composition at the stand scale but as the unit is only 22 acres in size, it is homogenous in terms of structure and density at a larger scale. The mean fuel loading of dead fuels was 2.5 tons/acre at a mean height of 1.13 ft. The mean depth of duff, a fuel component that is important for determining severity, at the plots was 0.45 inches. Loadings were measured using the Photoload Sampling Technique-estimating surface fuels from downward looking photographs of synthetic fuel beds (Keane, 2007).

Live fuel moistures were measured every two weeks. Old needles, these tend to be more reactive and are more likely to influence tree torching, were measured for 6 months leading up to the project. They peaked at 113% moisture of oven dry weight in mid-August and slowly decreased to 104% one week prior to implementation. New needles, less reactive but used to determine dormancy for measured trees, were measured in the two months leading up to implementation. Moisture content in these fuels peaked in mid-September at 141% moisture of oven dry weight and had dropped to 123% one week prior to implementation.

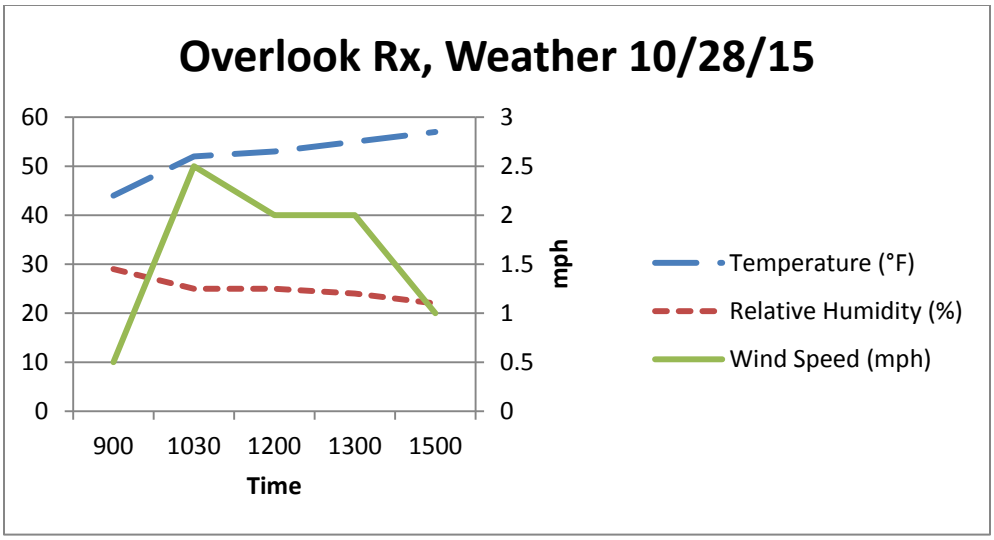
The fuel-size class of 1000 hour fuels and their moisture content can be an indicator for fire intensity and severity. Unlike live fuels which are often the same size, this size class is for dead fuels and its moisture content is a function of atmospheric conditions. This fuel component was measured on the same intervals as the weather for 6 months leading up to the project. As was expected, these fuels peaked in the spring with 40% moisture of oven dry weight. As the summer progressed, these fuels continued to dry out and were nearly stable for the two months leading up to implementation at 10% moisture of oven dry weight.

Daily Summary

The Overlook prescribed fire was completed in one day on Oct. 28. The test fire was ignited at 1200 just to the east of DP 1 in an open area comprised of grass and litter. Ignitions continued using a strip pattern with 10 foot spacing oriented east-west from DP1 north for 600 ft. As interior lighters moved north the flanks of both sides of the unit were ignited to box in the active fire. After approximately a half-hour the orientation of the pattern changed to take advantage of a more favorable wind direction and additional lighters were added to help build and maintain intensity. Strips were oriented southwest to northeast with 15 feet of spacing. This pattern was consistent until the ignitions were ceased at 1400 along the north end of the unit.

Weather

On the day of ignitions the weather was typical for the end of October. The night before ignitions, a frost developed in the unit and waiting for the moisture to evaporate was one reason for delaying the test fire until 1200. Winds were consistent and light from the north-northwest. The SPOT forecast submitted the night before predicted winds in the 5-6mph range (higher than observed) from the west. Temperature and humidity were observed to be different from the SPOT forecast. Temperatures were only forecasted to reach the low 50s yet they were measured at near 60° F in the afternoon. Humidity was forecasted to be between 40% and 25% yet were measured at 30% in the morning and dropped to 22% by the afternoon.



Fire behavior

The pattern used to conduct the test fire resulted in both head and flanking fire with low (<2 ft.) flame lengths and low (6 chains/hour for head fire and 1 chain/hour for flanking) rates of spread. The change in orientation of the firing pattern resulted in increased fire behavior dominated by head fire. The mean flame lengths for the rest of the project were 6 ft. with some of the shrub fuels putting off 12 ft. flame lengths. Rates of spread also increased after the change in the pattern. In areas where the fuels, mainly continuous grass aligned with the wind direction and its velocity increased which resulted in rates of spread as high as 60 chains/hour.

Fire behavior was moderated in the shaded areas, probably a result of the frost the previous night. Where the sun could not reach the ground, evaporation of this moisture was suppressed and the fire did not spread. Shrub fuels, mainly common juniper (*Juniperus communis* L. var. *depressa* Pursh) were at the other end of the behavior spectrum. These fuels took some time to ignite; one strip of fuel in the shrub took 3-5 minutes to become fully involved and an additional 1-2 minutes to consume completely. These fuels produced white ash during combustion but did not alter the soil underneath the vegetation. They also produced a noticeable hissing sound, from the moisture being driven off before combustion.

Smoke

During the test fire, smoke was dark in color and had poor lift (80ft. – 300 ft.). Once ignitions moved passed this phase, lift improved significantly with observed heights of 3000 ft. toward the end of ignitions. Winds were fairly consistent from the observation point on Red Hill out of the north at speeds less than 7mph. This transported the smoke slowly to the south with good mixing and dispersing quickly. No impacts were observed to North Foothills Hwy to the east or the town of Lyons to the north.

Fire Effects

Overstory

Overstory mortality was predicted if >50% of the canopy was scorched. Scorch is measured in the canopy only, as a percentage of the canopy that shows impacts from the fire and as a height in feet above the lowest living branch. Char is measured on the tree bole as a height in feet of discoloration.

Plot	Scorch (%)	Scorch Ht (feet)	Char Ht (feet)	Predicted Mortality (%)
2 Southern	0.00	0.00	0.00	0.00
3 Middle	1.67	3.33	1.33	0.00
5 North	0.00	0.00	0.00	0.00

The plot level did not capture much impact to the overstory with little scorch and no predicted mortality. Several trees did torch during operations, mainly due to tree specific canopy base height and proximity to reactive fuels.

Surface Fuel Consumption

Surface fuel consumption was calculated by comparing pre-fire fuel loading to post-fire fuel loading.

	1-hr (tons/acre)	10-hr (tons/acre)	100-hr (tons/acre)	1000-hr S/R (tons/acre)	Total (tons/acre)	Duff Depth (inches)	Fuelbed Depth (inches)
Before	0.3	0.2	0.3	1.7	2.5	0.45	1.13
After	0.0	0.6	0.5	0.3	1.5	0.3	0.7
Change	0.2	-0.4	-0.3	1.4	1.0	0.1	0.4

Total fuel loadings were reduced by 40% as a result of the project. Duff depth was reduced by 22% and fuel bed depth was reduced by 35%.

Surface Fuel Severity

Severity was assessed using the National Parks Service Fire Monitoring Handbook (2003). A matrix of observed characteristics provides a scale of 1-5 for both substrate and vegetation. 1 is most severely burned and 5 is unburned (unburnable material, i.e. rock = 0).

	Avg.	SD
Burnable substrate area (%)	95%	6%
Burnable vegetation area (%)	94%	5%
% Substrate severity 1	1%	2%
% Substrate severity 2	0%	1%
% Substrate severity 3	1%	1%
% Substrate severity 4	48%	26%
% Substrate severity 5	50%	27%
Avg. Substrate severity	4.44	0.30
% Substrate w/ black	50%	
% Veg severity 1	1%	2%
% Veg severity 2	1%	1%
% Veg severity 3	2%	3%
% Veg severity 4	61%	31%
% Veg severity 5	35%	36%
Avg. Veg severity	4.28	0.5
% Veg w/ black	65%	

Vegetation was completely removed down to bare mineral soil on 1% of the area or <1/4 acre. Fire spread across 65% of the unit or 14.3 acres.

Objective #1: Reduce surface fuel loading by up to 75%. Pre-fire estimates of 1-2 tons/acre should be reduced to less than 1 ton/acre. – This objective was met. Surface fuels were reduced by 40% (1 ton/acre) across the unit.

Objective #2: Reintroduce fire to at least 75% of the unit, in a mosaic pattern. At least 16 acres should have fire move across the surface in as natural a pattern as safety allows. – This objective was not met as fire spread across only 65% (14.3 acres) of the unit.

Objective #3: Create conditions to support the establishment of natural ponderosa pine regeneration. Up to 25% of the unit should have intensities sufficient enough to remove all vegetation down to mineral soil. – This objective was met, barely. Only 1 % (<1/4 acre) of the unit had fire intensities high enough to remove all vegetation down to bare mineral soil.

Discussion

Initial visual assessment of the project was not encouraging for meeting the objectives. Despite sufficient flame lengths and rates of spread it did not appear that the fire had much of an impact on the vegetation. While it was not the intention to turn everything black from edge to edge, the initial opinion of staff was that this project did not fully reach objectives. This report covers the immediate and first order fire effects and once the data was analyzed it is evident that this project did have an impact.

Surface fuels are woody fuels that are dead and not attached to the ground. They are classified by the amount of time for 2/3 of the fuel to reach moisture equilibrium with the atmosphere, i.e. 1-hr, 10-hr, 100-hr and 1000-hr. They are measured and reported as a mass per unit area (tons/acre). Also included in surface fuels is the height above the ground where they lay and the amount of accumulated duff (measured in inches of depth). These fuels take time to accumulate, unlike vegetation which may establish and spread within one growing season of a disturbance. The Overlook project reduced these surface fuels by 40% (1 ton/acre) with 22% (.1 inches) of the duff consumed and the overall height

of the surface fuels reduced by 35% (.4 inches). If it is assumed that the bulk density for duff is 7 tons/acre per inch then an additional 0.7 tons/acre were consumed in the fire.

The various fuel components contribute to fire behavior in differing ways and accumulate at different rates. Their arrangement and relative composition affect intensity and spread. Grass and shrub vegetation will produce a litter layer from their annual growth, but these are always present and except in wet periods will always be available as fuel. Grasses and fine fuels in particular do not contribute much to the intensity of a fire but they are critical to the spread of the fire. The time-lag surface fuels, fallen branches, twigs and needles/ leaves, are from the forest canopy and accumulate slowly over time. (While they are live and attached to the tree they are not necessarily available fuel in a fire.) 1-hr, 10-hr, 100-hr, 1000-hr woody fuels and duff contribute some to fire spread but are more important to fire intensity (the amount of heat released per unit of time) because they continue to burn after the flaming front has passed.

Attempting to consume all of these surface fuels in one application of fire can have negative effects on the existing vegetation and may inhibit new vegetation from establishing. By removing some of the fuel over several applications of fire, outcomes can be controlled more and negative effects may be mitigated. The reduction in these accumulated fuels provides a longer temporal scale benefit for suppression opportunities and potential resiliency of the forest. This application of fire will allow for future prescribed fires to be implemented under conditions where increased fire behavior can occur with decreased opportunity for escape and increased firefighter safety. With the reduction in surface fuels from this project there is less surface fuel and thus less energy available for release as heat from combustion. Since the amount of heat released is lower for the next application of fire then there is less risk to fire fighter safety and potential for escape. Thus the next application of fire can be done under drier, windier or warmer conditions because the risks will be lower.

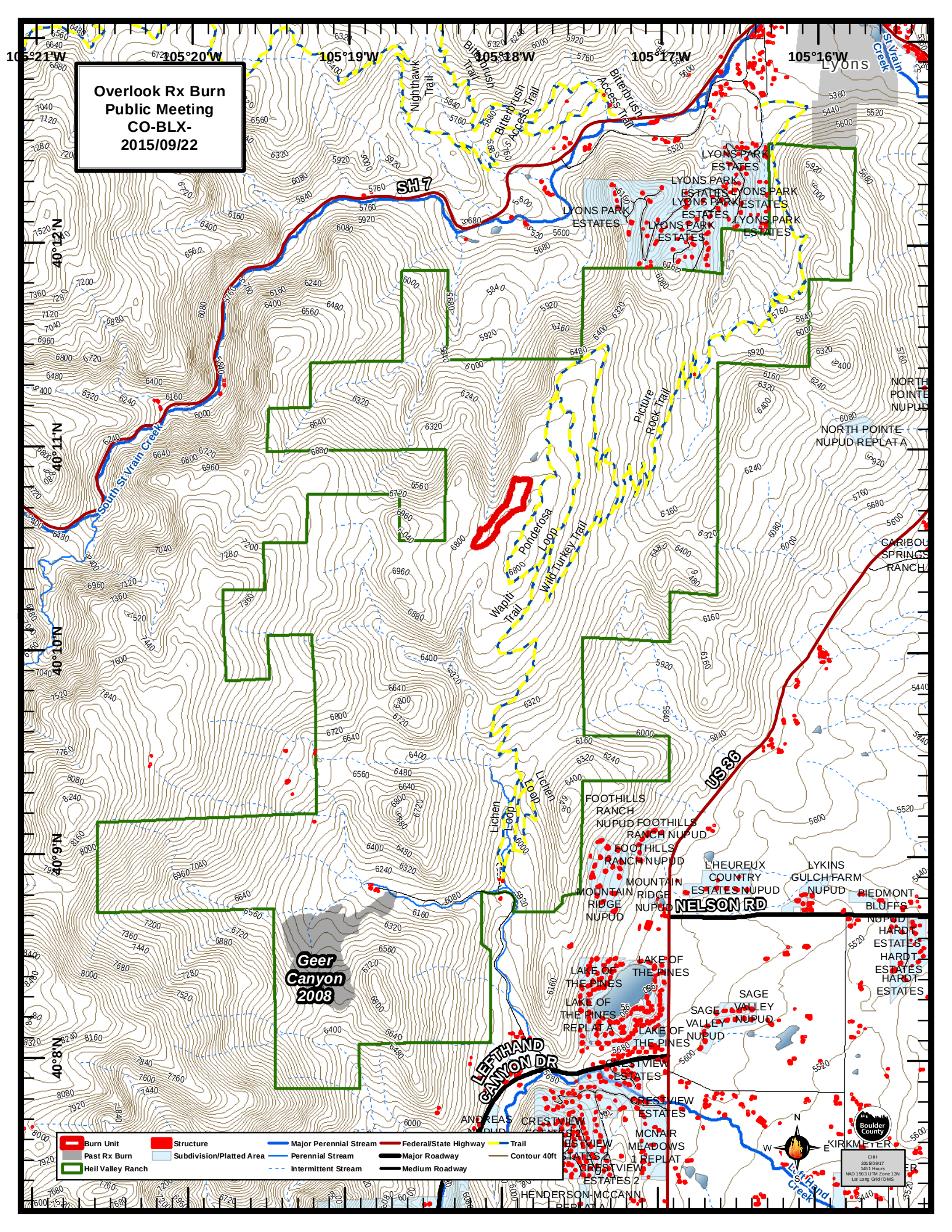
The project also provides a sizeable buffer for the burn units across the road. Any spot fires that start within this burn unit as a result of future adjacent projects can be easily identified and put out. If a wildland fire were to occur in this area in the near future, the open nature of the forest structure and discontinuity of the remaining fuels will allow for aggressive suppression efforts to be undertaken before the wildland fire has an opportunity to spread to areas where suppression will be more complicated.

It is the opinion of the Forestry and Fire staff that this project was a success. If in the future it is determined that different fire effects are desired then it is recommended that the project be implemented under different conditions. Primarily a constant wind direction and a speed of at least 5 mph would help the fire spread over more of the area. This will also reduce the need for more staffing

of the Ignitions crew. In addition, drier fuels will allow for more consumption in all the fuel classes. This is a fine line as fuels that are too dry will result in more impacts to both the overstory and the soil.

Future monitoring

One year post-fire the overstory will be monitored for mortality. Monitoring of conifer regeneration, weeds, native grasses and forbs will continue in 2016 and as necessary.


Overlook Rx Burn
Public Meeting
CO-BLX-
2015/09/22
105°21'W
105°20'W
105°19'W
105°18'W
105°17'W
105°16'W
40°12'N
40°11'N
40°10'N
40°9'N
40°8'N
SH 7
Lyons
St Vrain Creek
Nighthawk Trail
Bitterbrush Trail
Bitterbrush Access Trail
LYONS PARK ESTATES
South St Vrain Creek
Picture Rock Trail
Ponderosa Loop
Wild Turkey Trail
Wapiti Trail
NORTH POINTE NUPUD
NORTH POINTE NUPUD REPLAT A
CARIBOU SPRINGS RANCH
US 36
NELSON RD
FOOTHILLS RANCH NUPUD
L'HEUREUX COUNTRY ESTATES NUPUD
LYKINS GULCH FARM NUPUD
PIEDMONT BLUFFS
HARDT ESTATES
LAKE OF THE PINES
LAKE OF THE PINES REPLAT A
SAGE VALLEY NUPUD
CRESTVIEW ESTATES
LEFTHAND CANYON DR
ANDREAS CRESTVIEW
MCNAIR MEADOWS 1 REPLAT
HENDERSON-MCCANN
Lichen Loop
Geer Canyon 2008
Lefthand Creek
KIRKMEYER
Boulder County
Burn Unit
Past Rx Burn
Heil Valley Ranch
Structure
Subdivision/Platted Area
Major Perennial Stream
Perennial Stream
Intermittent Stream
Federal/State Highway
Major Roadway
Medium Roadway
Trail
Contour 40ft

Overlook Rx Burn
IAP
CO-BLX-
2015/09/28 Day

Boulder County

- Burn Unit
- Escape Zone
- Trail
- Access Road
- Roadway
- Stream
- Contour 40ft
- Drop Point
- Restricted Water Source
- Division

N
W E
S

0 330 660
Feet

EHH
2015/09/17
1419 Hours
NAD 1983 UTM Zone 13N
Lat Long Grid / DMS