Mesa Cortina/Summit County Open Space Wildfire Mitigation Plan
Summit County Open Space

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Prepared: December 2018

Executive Summary

At the request of the Summit County Open Space Department, the Colorado State Forest Service has prepared the following wildfire mitigation plan for the entire open space parcel. This analysis was based on observations from field reconnaissance, data collection and analysis, and aerial photo/topographical analysis.

The open space parcel was broken into three stand types based on forest condition, species composition, and road trisections.

Ten forest inventory points were randomly located throughout the parcel to sample fuel loading, trees per acre, basal area, live/dead, and tree species composition data. The data were analyzed using Forest Vegetation Simulator (FVS) and the Fire and Fuels extension (FFE) to determine recommended treatments based on expected fire conditions.

The Colorado Wildfire Risk Assessment Portal (CO-WRAP) Summary Report included in the Appendix also provides a broader area perspective on wildfire risk.

Wildfire in the Wildland Urban Interface

Wildfires in Colorado are a natural part of our ecosystems, and they can help restore and maintain healthy forests. The wildland-urban interface (WUI) can be described as the area where structures and other human development meet or intermingle with wildland vegetative fuels. Where homes and other infrastructure have been built in this WUI, it is generally important to mitigate these built features against the inevitable risk of wildland fire.

The forests in the Summit County area have evolved with fire as an agent of change and renewal, and fire is the most significant factor in shaping the forest landscape we see today. Generally speaking, the return interval, or years between major fire events, increases as altitude increases, but fire remains a significant risk in our wildland-urban interface. When considering fire in these ecosystems, it is crucial to assess the current stand conditions because they will define fire behavior and, consequently, potential fire hazard.

Aspect and slope are two conditions that affect fire intensity and spread. More specifically, aspect affects the fire hazard as a result of climatic differences between slopes. North and east facing slopes are cooler and moister than south and west facing slopes; consequently, fires on west and south slopes are expected to be more severe and move faster. Slope influences fire hazard by affecting rate of fire spread. Fires on steep slopes spread faster than those on moderate or flat slopes because heat rising from fire preheats and dries fuels upslope, thus increasing the rate of ignition and fire spread.

The type of fuels, the quantity of fuels, and the orientation (vertical or horizontal) and location of fuels are important factors in assessing wildland fire risk. Ground fuels consist of the burnable materials on the forest floor. The amount and continuity of ground fuels will influence the direction and rate at which a fire will spread. Ladder fuels are those above the forest floor, such as shrubby vegetation or even tree limbs. These fuels provide a pathway for a fire burning on the ground to move into the crowns of trees.

If fire was to move into the crowns of trees, the amount of canopy closure (extent to which the crowns of the trees are in contact with one another) will determine fire behavior and intensity. If the trees are in close contact, a fire may burn in the treetops without ever touching the ground, resulting in a more difficult fire to suppress.

Finally, weather conditions will be the determining factor in fire hazard and suppression activities. A cool, moist day with high humidity will restrict rate of fire spread in comparison to a hot, dry, windy day. These factors are all directly related to hazard class. The hazard classes in Table 1 are based on expected fire behavior.

These are some of the factors a landowner and/or resource manager needs to be aware of in planning and administering management activities. Fire protection of a residential structure is directly related to the above factors.

Open Space Overview

Legal Description

The Mesa Cortina parcel of land is located in Sections 13 and 14, Township 5 South, Range 78 West, 6th P.M., Summit County, Colorado. The parcel is approximately 71 acres.

Access

The open space parcel is located between Ryan Gulch Rd and Royal Buffalo/Buffalo Mountain Rd. in the Mesa Cortina and Wildernest subdivisions of Silverthorne, CO. 20 Grand Rd. and Buffalo Dr. trisect the open space parcel.

All access roads are asphalt and provide some firebreak. Access to certain areas of the parcel is generally via asphalt or concrete driveways.

Access into the timber stands is difficult, based on steep slopes off roadsides, private property, and riparian areas. Recommendations in this plan take into account these factors for determining treatments methods.

Vegetation

The vegetative cover consists predominately of mixed conifer species, such as lodgepole pine, Engelmann spruce, subalpine fir, and aspen. Fire hazard in these areas is generally moderate due to the species and surrounding site moisture. There are also concentrated areas of willow and riparian species running down the center of the parcel. Grasses and some shrubs are located between the timber and roadways.

The inventory shows 328 trees per acre (TPA), with 115 TPA of those being classified as dead. aspen (40%) and lodgepole Pine (34%) comprised the majority of the species composition, with spruce (16%) and fir (10%) making up a significantly lower percentage.

Aspect & Slope

In general, the open space parcel has an eastern aspect. Slope varies throughout the parcel, with the majority of the slopes between low (< 10 %) to moderate (10 – 20%). The steepest slopes are located in the north-east portions of the parcel and typically are associated with the roadside. Elevations range from 8,800 ft by the east entrance to 9,600 ft in the northwestern corner of the property. See Slope Analysis Map.

Stand Delineation

The parcel has three distinct forest stands based on the species compositions and density. The stands start at stand 1 in the east and run uphill to the west to stand 3. Although stand conditions, species composition and density vary among the stands, the recommendations for each stand are quite similar due to similar objectives. Varying amounts of removal are based on live/dead component and trees per acre.

Recommended Treatments

The three main objectives to be met through the recommend treatments are to reduce and limit: (1) the initiation of crown fire activity, (2) the spread of fire through the canopy, and (3) to establish/maintain forest resiliency. The first two objectives are often accomplished by designing treatments that reduce surface and canopy fuel loading and increase the canopy base height. The forest resiliency and health objective will be met by removing unhealthy trees, increasing tree composition, and by reducing tree densities to allow better growing conditions.

By utilizing a thin from below (removing smaller, ladder fuels) with appropriate slash treatment, the above objectives will be met. These treatments will work in concert to reduce surface fuel loading, increase canopy base height, and to limit the transition from surface to crown fire. In addition, this will also increase the crown spacing to limit the potential for crown fire spread.

Harvesting Recommendation

For all three stands, the recommend treatment for harvesting will be a thin from below to a residual TPA of 175. This TPA will be accomplished by harvesting all dead trees within the stands, removing dying, diseased or poor form live trees (≈ 40 live TPA), and removing ladder fuels under the remaining overstory. This prescription will involve an individual tree marking before project implementation. By marking individual trees, foresters will be able to modify the crown spacing to limit the ability of a crown fire, while also selectively retaining the healthiest and most aesthetically pleasing trees. Actual treatments could be a combination of hand and mechanical felling, with most, if not all, done by hand due to the sensitive nature of the area.

Slash and Log Removal Recommendations

Effective slash treatment and removal of logs are going to be the most challenging aspect of the project. With limited access into the stands, log removal will have to be done via winching. Slash treatment options are pile and burn, lop and scatter, or chipping where limbs come out with logs.

Pile and burn is the most effective way to reduce the post treatment fuel loading. Piling would be done by hand in the most sensitive areas, assuring the least negative effects to remaining vegetation. Piles would then be burned in the winter with seasonal snowpack to ensure effective and safe consumption. The smoke impacts to the surrounding communities could be mitigated by burning when there are ideal conditions for smoke dispersion as well as quick pile consumption.

Lop and scatter would be the most cost effective treatment; however, this changes the fuel arrangement/orientation rather than reducing the fuels. Logs and slash will have ground contact and begin to decay quicker than standing material, but will still pose a risk for the near

future. This treatment may be utilized in conjunction with pile and burn in areas where damage to the riparian area could occur.

A last option for slash treatment is chipping with full removal. This option would be the most costly, and labor intensive but would ensure all fuels are removed from the site.

Aspen Stand Enhancement Optional Treatment

Several areas in all three stands have a component of aspen, specifically in stand 1. These groups of aspen range from declining to vigorous in health. The stands in poor health have several types of canker present (Cytospora, black), with declining crowns. Some of these stands have regeneration already establishing in the understory of the declining mature aspen. Where abundant natural regeneration is occurring, removal of conifers is recommended to expand the aspen clone. The removal of declining aspen overstory trees may also be necessary if reducing the risk of standing trees that are in poor condition is a priority. In areas where natural aspen regeneration is not occurring, a clearcut prescription for the aspen, along with any conifers, will be necessary in order to hormonally stimulate clonal new aspen as well as allow the necessary sunlight to penetrate the ground.

In the all health aspen stands, the removal of encroaching conifer species in and surrounding the aspen will allow increased sunlight to promote growth of new aspen sprouts. The removal of conifers within, will allow the aspen stands to continue un-impended and stimulate growth into any openings caused by the first treatment practice.

Depending on the amount of conifer in the aspen stands, a combination of lop and scatter and pile and burn might be most practical.

Conclusion

Any combination of the treatments outlined above will reduce the risk for fire; however, in severe fire conditions the more fuel removed from the site will ultimately reduce the severity of the fire.

No one treatment and/or slash treatment is going to cover the entire parcel. The project may require a combination of the treatment and slash options listed above to accomplish the objectives for fuels reduction and forest health.

Due to the proximity to local residents, the project will need effective public outreach. This will clearly communicate the objectives of the treatments and how they improve the forest conditions, while reducing wildfire risks.

Stand 3

Stand 2

Stand 1

Appendices

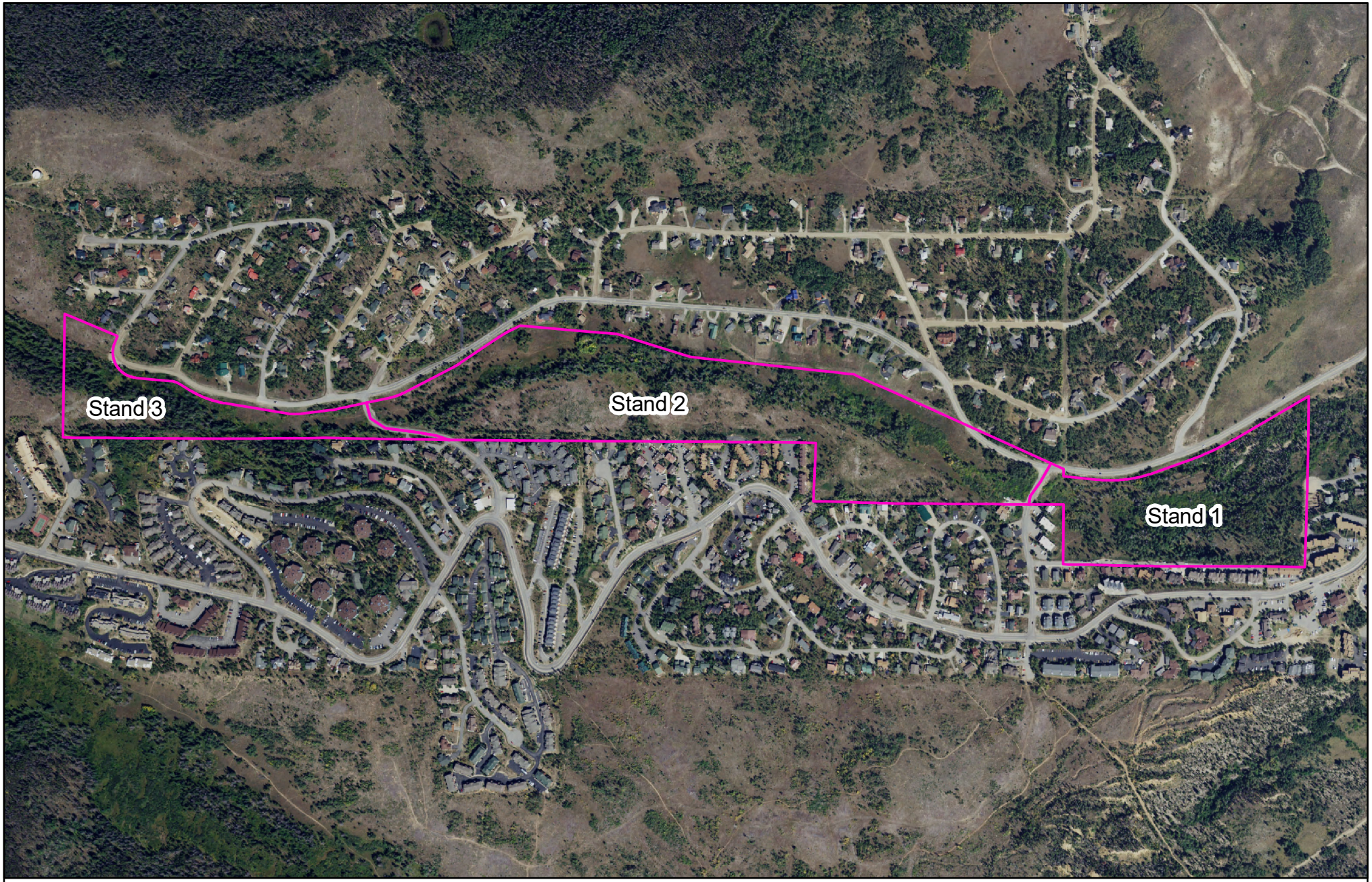
Maps

Stand & Stock Table

CO-WRAP Risk Assessment

Fuelbreaks for Subdivisions & Communities

Mesa Cortina Open Space - Stands



Prepared By:
Colorado State Forest Service
Granby FO, NW Area
December 2018

0 400 800 1,600 2,400 Feet

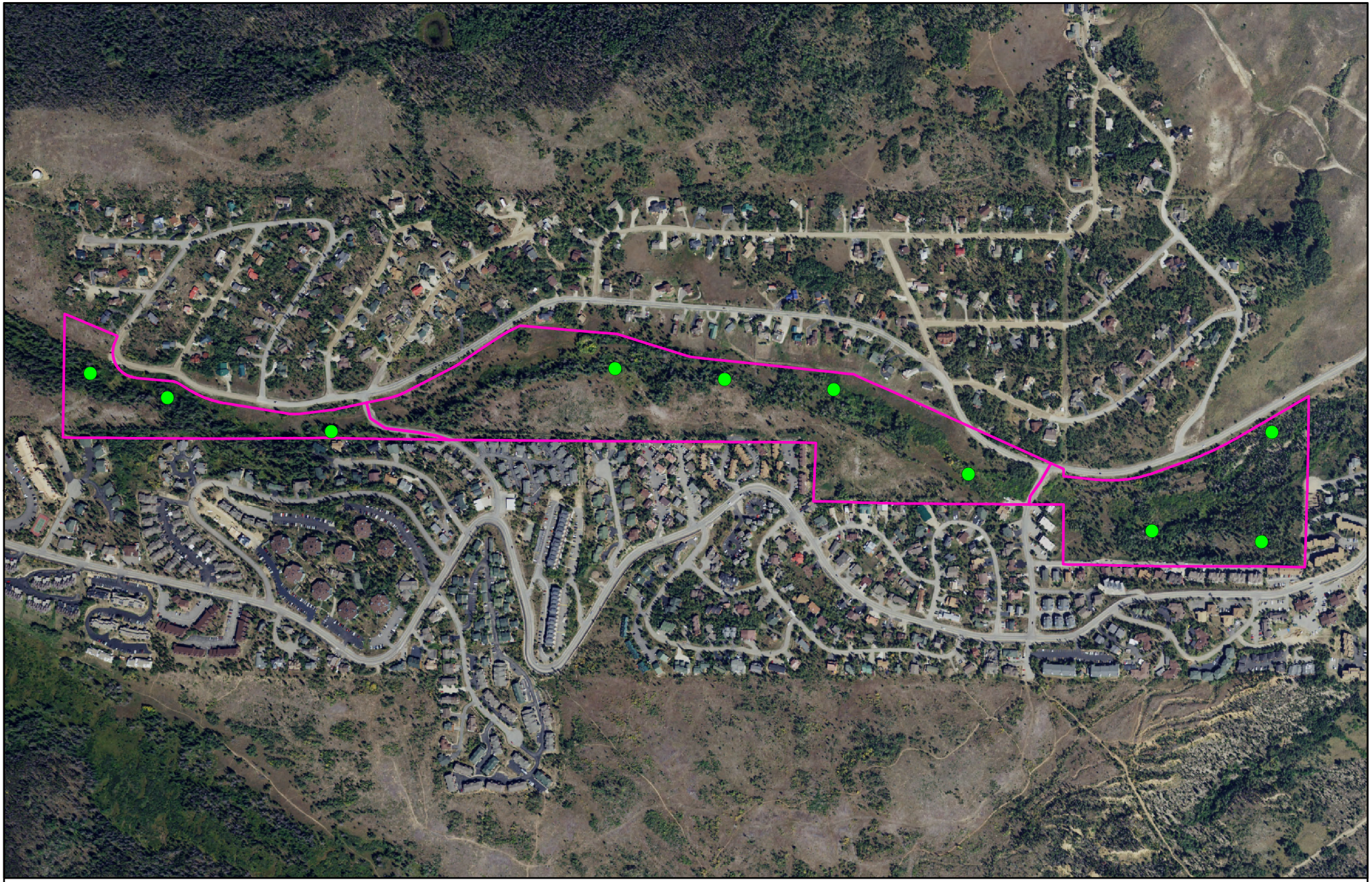
1:8,500

Legend

Stands

COLORADO STATE FOREST SERVICE

Mesa Cortina Open Space - Inventory



Prepared By:
Colorado State Forest Service
Granby FO, NW Area
December 2018

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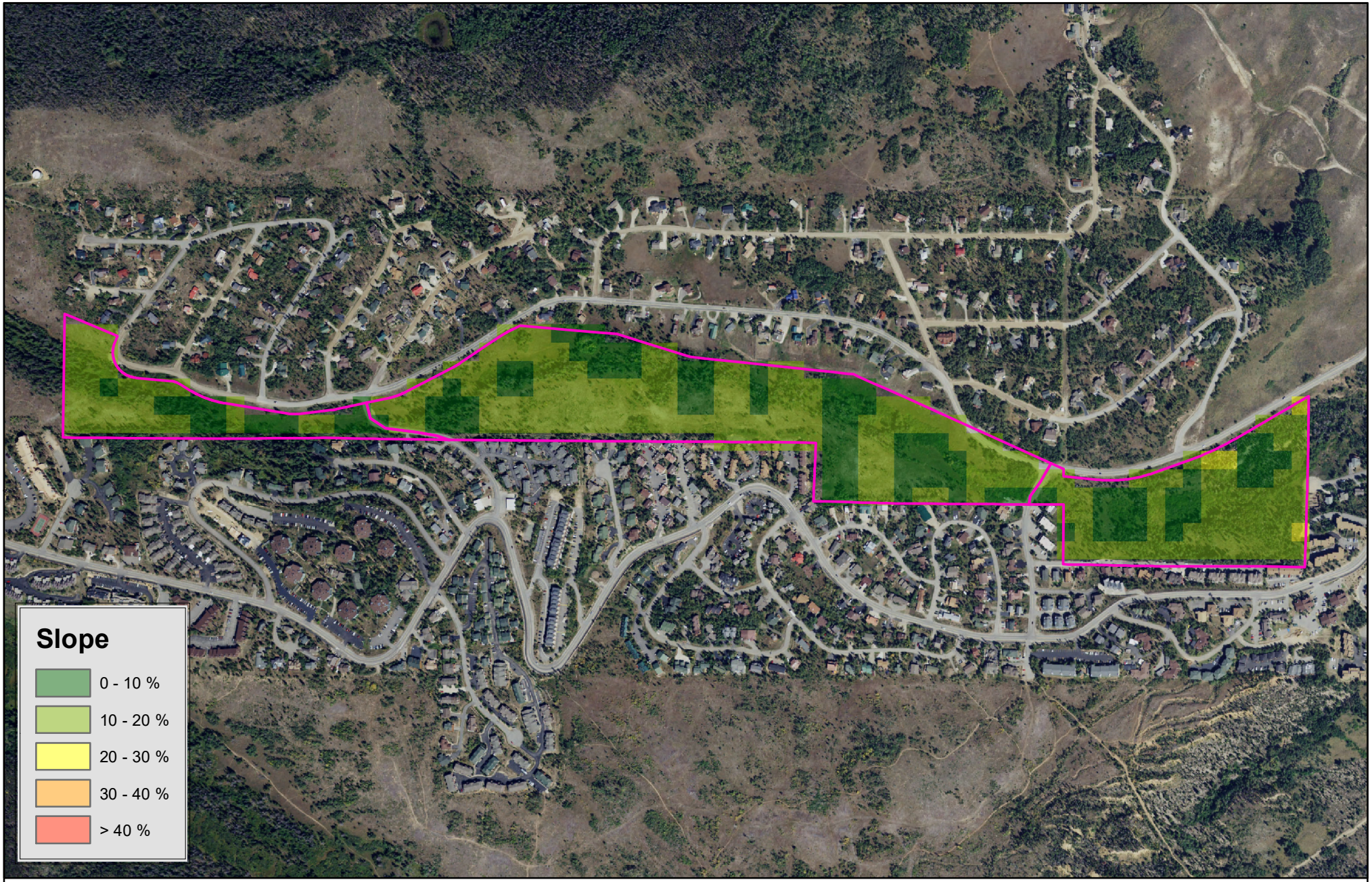
Legend

- Inventory Plots
- Stands

COLORADO STATE FOREST SERVICE
COLORADO STATE UNIVERSITY

Mesa Cortina Open Space - Slope



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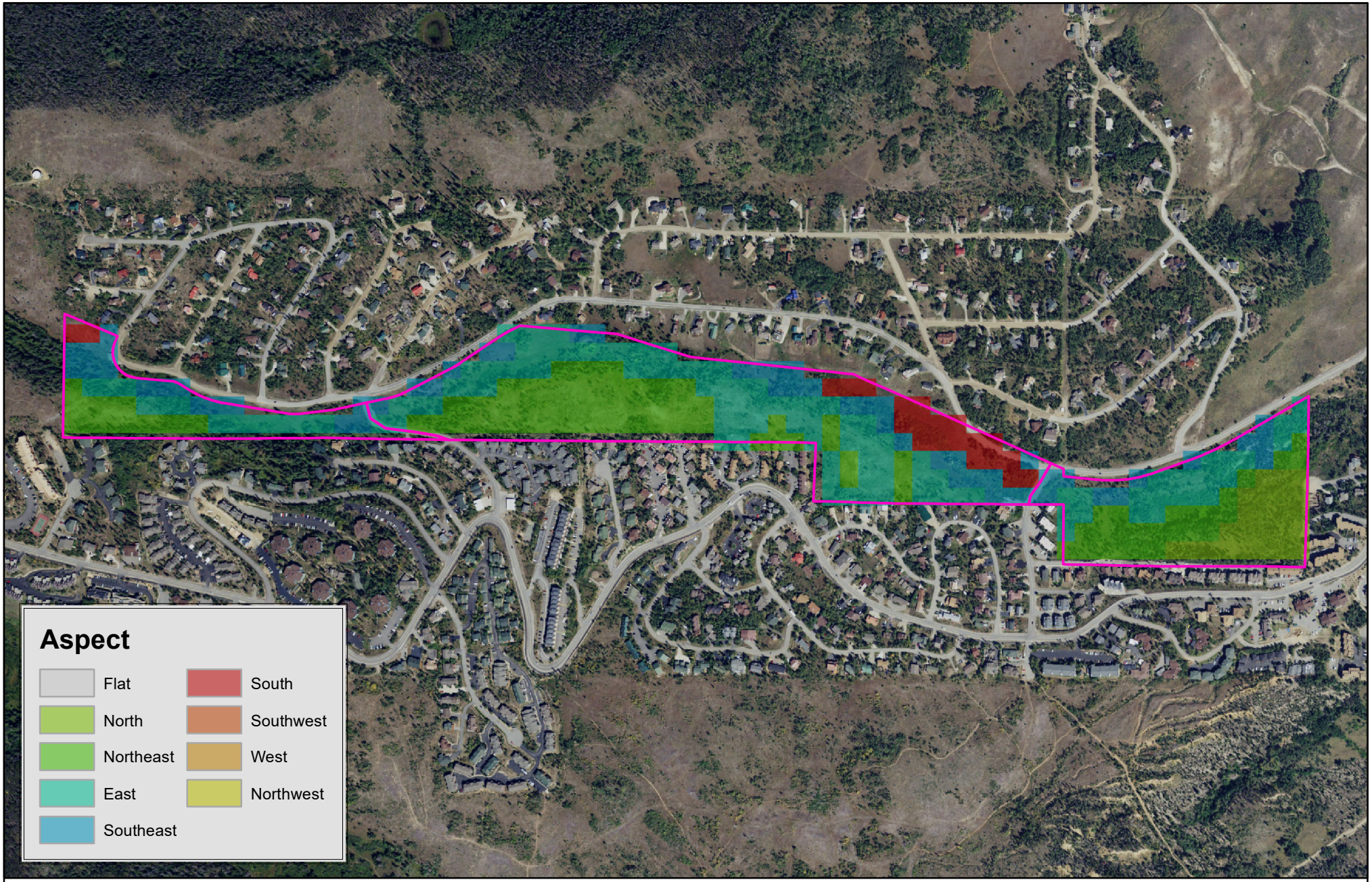
Legend

Stands

COLORADO STATE FOREST SERVICE

Mesa Cortina Open Space - Aspect



Prepared By:
Colorado State Forest Service
Granby FO, NW Area
December 2018

0 400 800 1,600 2,400 Feet

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Legend

Stands

COLORADO STATE FOREST SERVICE

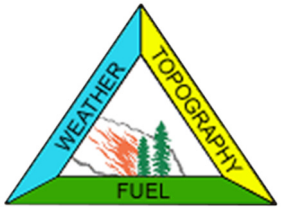
Stand ID	Year	Species	Diam Class	Live TPA	Live Avg Ht	Live BA	Live Total CuFt	Live Merch CuFt	Live Merch BdFt	Mort TPA	Mort Avg Ht	Mort BA	Mort Total CuFt	Mort Merch CuFt	Mort Merch BdFt
Mesa_1	2018	**ALL**	2	0	0	0	0	0	0	0	0	0	0	0	0
			4	10	38	0.7	12	0	0	0	0	0	0	0	0
			6	92.9	39.4	18	301.6	222.3	0	31	39.4	6	100.7	71.7	0
			8	53.1	49.2	18	352.2	302.7	0	58	47.2	18	340.1	287	0
			10	18.3	51.6	10	202.2	182.7	550.3	7.8	55.4	4	75.5	68.6	162.3
			12	20.2	56.3	16	350.7	326.5	1283.9	2.2	49	2	32.6	30	108
			14	10	57.4	10	221.5	206.6	868	7.4	50.3	8	135.2	125.9	494.2
			16	4.2	70.8	6	176.7	169	843.7	5.8	71.5	8	198.2	188.1	819.4
			18	3.5	75.5	6	180.6	172	818	1.1	75	2	48.7	46.5	215.3
			20	1	56	2	36.4	34.3	162.9	2	58	4	75.6	71.3	335.8
			All	**213.3**	**46.6**	**86.7**	**1833.8**	**1616**	**4526.8**	**115.3**	**47.5**	**52**	**1006.7**	**889.1**	**2135**
		AF	2	0	0	0	0	0	0	0	0	0	0	0	0
			4	0	0	0	0	0	0	0	0	0	0	0	0
			6	7.9	36	2	30.1	23.8	0	0	0	0	0	0	0
			8	11.9	42.8	4	69.1	58.3	0	7.5	46	2	38.2	29.9	0
			10	0	0	0	0	0	0	0	0	0	0	0	0
			12	0	0	0	0	0	0	0	0	0	0	0	0
			14	2.1	50	2	40.2	37.3	157.9	0	0	0	0	0	0
			All	**21.9**	**41**	**8**	**139.5**	**119.3**	**157.9**	**7.5**	**46**	**2**	**38.2**	**29.9**	**0**
		LP	2	0	0	0	0	0	0	0	0	0	0	0	0
			4	0	0	0	0	0	0	0	0	0	0	0	0
			6	37.8	34.4	6	83.1	61.7	0	10.2	32	2	25.5	19.4	0
			8	10.8	52.7	4	72.8	64.7	0	17.7	48.6	6	102	88.4	0
			10	3.4	48	2	32.5	29.5	78	7.8	55.4	4	75.5	68.6	162.3
			12	5.2	55.1	4	72.4	67	216.3	2.2	49	2	32.6	30	108
			14	1.9	63	2	41.4	38.9	148.3	7.4	50.3	8	135.2	125.9	494.2
			16	0	0	0	0	0	0	4.5	71.1	6	139.9	132.7	558.3
			18	0	0	0	0	0	0	1.1	75	2	48.7	46.5	215.3
			20	1	56	2	36.4	34.3	162.9	2	58	4	75.6	71.3	335.8
			All	**60.1**	**41.5**	**20**	**338.6**	**296**	**605.5**	**52.9**	**49.5**	**34**	**635**	**582.7**	**1873.9**
		ES	2	0	0	0	0	0	0	0	0	0	0	0	0
			4	0	0	0	0	0	0	0	0	0	0	0	0
			6	9	33	2	28.6	20.6	0	0	0	0	0	0	0
			8	7.3	56	2	46.6	37.1	0	0	0	0	0	0	0
			10	14.9	52.4	8	169.7	153.2	472.3	0	0	0	0	0	0
			12	10.1	58.6	8	187.4	174.2	689.3	0	0	0	0	0	0
			14	6	58.1	6	139.9	130.5	561.8	0	0	0	0	0	0
			16	1.4	80	2	63.9	60.9	284.9	1.3	73	2	58.3	55.5	261.1
			18	3.5	75.5	6	180.6	172	818	0	0	0	0	0	0
			All	**52.2**	**53.7**	**34**	**816.6**	**748.4**	**2826.4**	**1.3**	**73**	**2**	**58.3**	**55.5**	**261.1**
		AS	2	0	0	0	0	0	0	0	0	0	0	0	0
			4	10	38	0.7	12	0	0	0	0	0	0	0	0
			6	38.3	46.5	8	159.7	116.2	0	20.8	43	4	75.3	52.4	0
			8	23.1	48.9	8	163.7	142.6	0	32.8	46.7	10	200	168.6	0
			10	0	0	0	0	0	0	0	0	0	0	0	0
			12	4.9	52.7	4	90.9	85.3	378.3	0	0	0	0	0	0
			14	0	0	0	0	0	0	0	0	0	0	0	0
			16	2.8	66.3	4	112.8	108	558.8	0	0	0	0	0	0
			All	**79.1**	**47.2**	**24.7**	**539.1**	**452.2**	**937.1**	**53.6**	**45.3**	**14**	**275.2**	**221**	**0**

Fire Behavior

Description

Fire behavior is the manner in which a fire reacts to the following environmental influences:

1. **Fuels**
2. **Weather**
3. **Topography**



Fire behavior characteristics are attributes of wildland fire that pertain to its spread, intensity, and growth. Fire behavior characteristics utilized in the Colorado WRA include fire type, rate of spread, flame length and fireline intensity (fire intensity scale). These metrics are used to determine the potential fire behavior under different weather scenarios. Areas that exhibit moderate to high fire behavior potential can be identified for mitigation treatments, especially if these areas are in close proximity to homes, business, or other assets.

Fuels

The Colorado WRA includes composition and characteristics for both surface fuels and canopy fuels. Assessing canopy fire potential and surface fire potential allows identification of areas where significant increases in fire behavior affects the potential of a fire to transition from a surface fire to a canopy fire.

Fuel datasets required to compute both surface and canopy fire potential include:

- **Surface Fuels** are typically categorized into one of four primary fuel types based on the primary carrier of the surface fire: 1) grass, 2) shrub/brush, 3) timber litter, and 4) slash. They are generally referred to as fire behavior fuel models and provide the input parameters needed to compute surface fire behavior. The 2017 assessment uses the latest 2017 calibrated fuels for Colorado.
- **Canopy Cover** is the horizontal percentage of the ground surface that is covered by tree crowns. It is used to compute wind-reduction factors and shading.
- **Canopy Ceiling Height/Stand Height** is the height above the ground of the highest canopy layer where the density of the crown mass within the layer is high enough to support vertical movement of a fire. A good estimate of canopy ceiling height is the average height of the dominant and co-dominant trees in a stand. It is used to compute wind reduction to mid-flame height, and spotting distances from torching trees.

- **Canopy Base Height** is the lowest height above the ground above which sufficient canopy fuel exists to vertically propagate fire (Scott & Reinhardt, 2001). Canopy base height is a property of a plot, stand or group of trees, not an individual tree. For fire modeling, canopy base height is an effective value that incorporates ladder fuels, such as tall shrubs and small trees. Canopy base height is used to determine whether a surface fire will transition to a canopy fire.
- **Canopy Bulk Density** is the mass of available canopy fuel per unit canopy volume (Scott & Reinhardt, 2001). Canopy bulk density is a bulk property of a stand, plot or group of trees, not an individual tree. Canopy bulk density is used to predict whether an active crown fire is possible.

Weather

Environmental weather parameters needed to compute fire behavior characteristics include 1-hour, 10-hour and 100-hour time-lag fuel moistures, herbaceous fuel moisture, woody fuel moisture and the 20-foot, 10-minute average wind speed. To collect this information, Weather data (1988-2017) from NCEP (National Center for Environmental Prediction) was used to analyse potential weather scenarios in which assessing fire behavior and spread. In particular, the North American Regional Reanalysis (NARR) product from NCEP was selected because of it provides high resolution weather data for all of Colorado. The following percentiles (97th, 90th, 50th and 25th) were analysed for each variable in each 30km NARR point to create four weather scenarios to run the fire behavior analysis: “Extreme”, “High”, “Moderate” and “Low”. After computing the weather percentiles of the NARR variables, an IDW algorithm was used to derive 30m resolution data to match the surface fuels dataset.

The four percentile weather categories are intended to represent low, moderate, high and extreme fire weather days. Fire behavior outputs are computed for each percentile weather category to determine fire potential under different weather scenarios.

For a detailed description of the methodology, refer to the 2017 Colorado Wildfire Risk Assessment Final Report at www.ColoradoWildfireRisk.com.

Topography

Topography datasets required to compute fire behavior characteristics are elevation, slope and aspect.

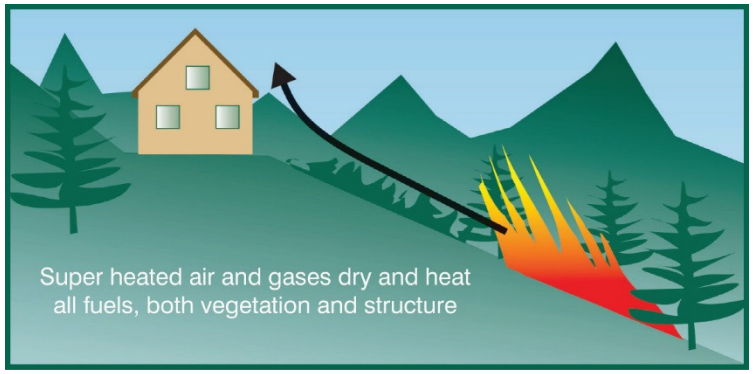
FIRE BEHAVIOR CHARACTERISTICS

Fire behavior characteristics provided in this report include:

- **Characteristic Rate of Spread**
- **Characteristic Flame Length**
- **Fire Intensity Scale**
- **Fire Type – Extreme Weather**

Characteristic Rate of Spread

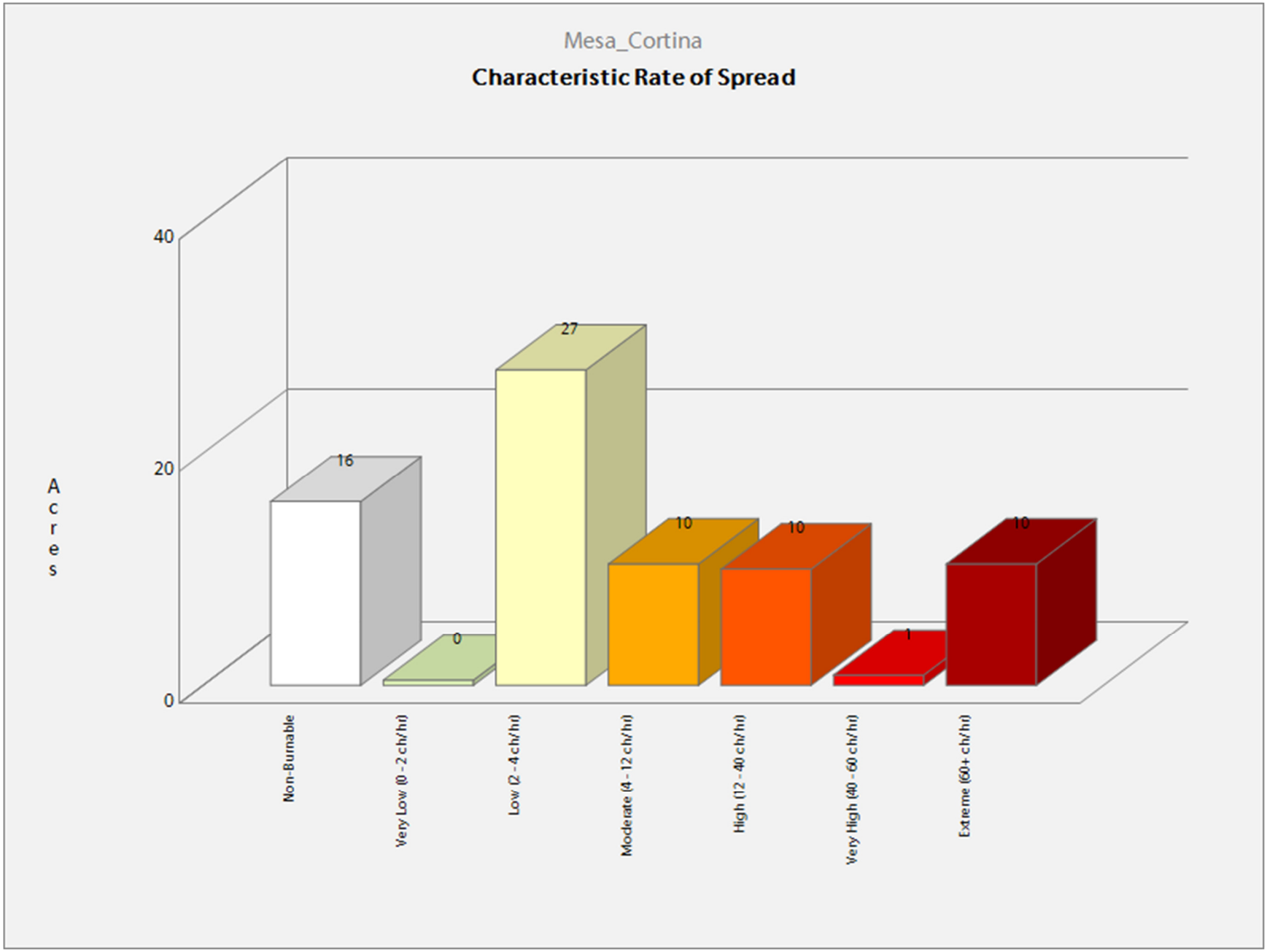
Characteristic Rate of Spread is the typical or representative rate of spread of a potential fire based on a weighted average of four percentile weather categories. Rate of spread is the speed with which a fire moves in a horizontal direction across the landscape, usually expressed in chains per hour (ch/hr) or feet per minute (ft/min). For purposes of the Colorado WRA, this measurement represents the maximum rate of spread of the fire front. Rate of Spread is used in the calculation of Wildfire Threat in the Colorado WRA.

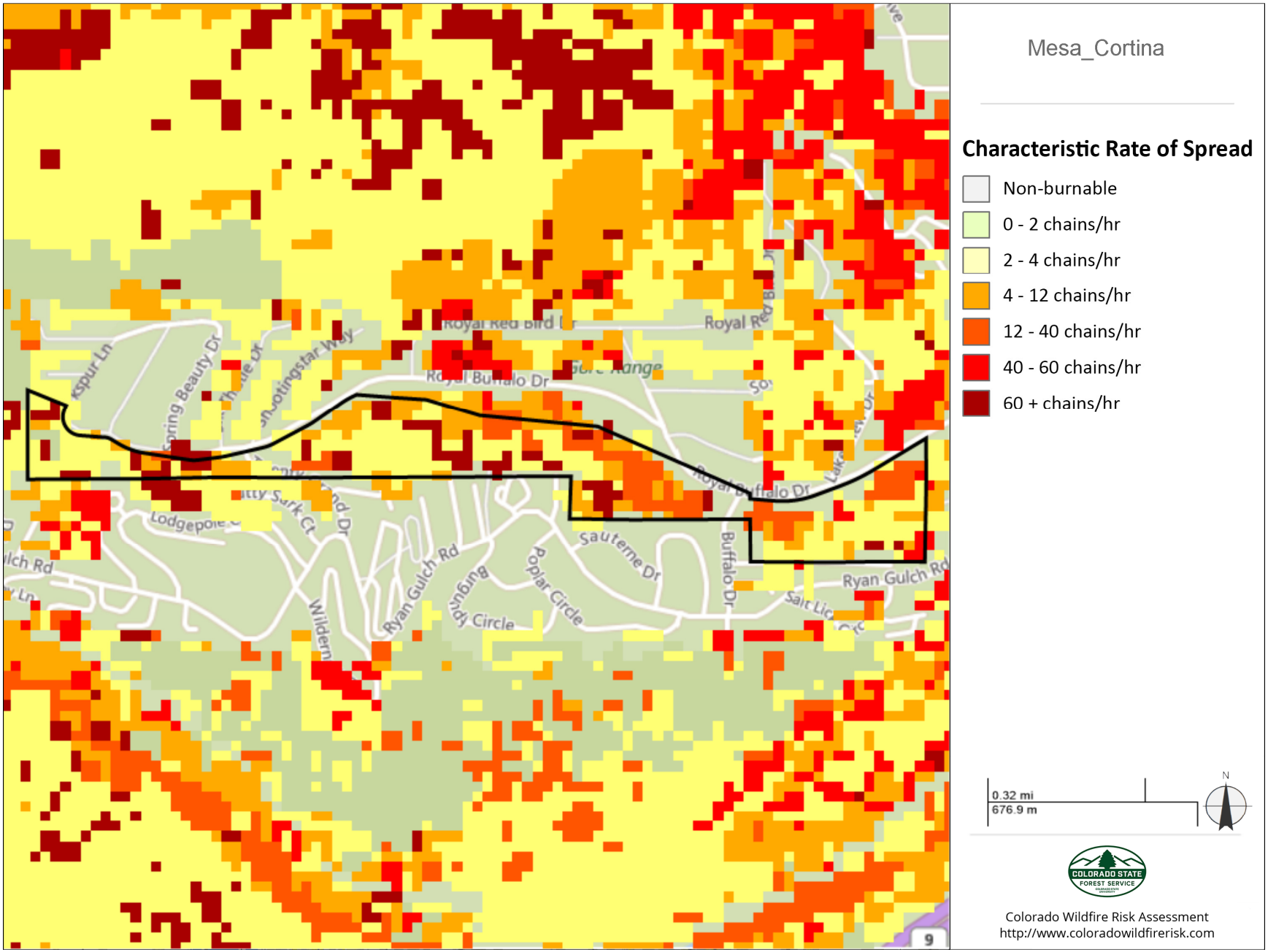


Rate of spread is a fire behavior output, which is influenced by three environmental factors - fuels, weather, and topography. Weather is by far the most dynamic variable as it changes frequently. To account for this variability, four percentile weather categories were created from historical weather observations to represent low, moderate, high, and extreme weather days for each 30-meter cell in Colorado. Thirty (30) meter resolution is the baseline for the Colorado WRA, matching the source surface fuels dataset.

The "characteristic" output represents the weighted average for all four weather percentiles. While not shown in this report, the individual percentile weather ROS outputs are available in the Colorado WRA data.

Rate of Spread	Acres	Percent
Non-Burnable	16	21.0 %
Very Low (0 - 2 ch/hr)	0	0.6 %
Low (2 - 4 ch/hr)	27	36.1 %
Moderate (4 - 12 ch/hr)	10	13.9 %
High (12 - 40 ch/hr)	10	13.3 %
Very High (40 - 60 ch/hr)	1	1.2 %
Extreme (60+ ch/hr)	10	13.9 %
Total	**75**	**100.0 %**


Mesa_Cortina
Characteristic Rate of Spread
Acres
40
20
0
16
0
27
10
10
1
10
Non-Burnable
Very Low (0 - 2 ch/hr)
Low (2 - 4 ch/hr)
Moderate (4 - 12 ch/hr)
High (12 - 40 ch/hr)
Very High (40 - 60 ch/hr)
Extreme (60+ ch/hr)


Mesa_Cortina
Characteristic Rate of Spread
Non-burnable
0 - 2 chains/hr
2 - 4 chains/hr
4 - 12 chains/hr
12 - 40 chains/hr
40 - 60 chains/hr
60 + chains/hr
Royal Buffalo Dr
Sauterne Dr
Ryan Gulch Rd
Poplar Circle
Buffalo Dr
0.32 mi
676.9 m
N
COLORADO STATE FOREST SERVICE
Colorado Wildfire Risk Assessment
http://www.coloradowildfirerisk.com

Fire Intensity Scale

Description

Fire Intensity Scale (FIS) specifically identifies areas where significant fuel hazards and associated dangerous fire behavior potential exist. Similar to the Richter scale for earthquakes, FIS provides a standard scale to measure potential wildfire intensity. FIS consist of five (5) classes where the order of magnitude between classes is ten-fold. The minimum class, Class 1, represents very low wildfire intensities and the maximum class, Class 5, represents very high wildfire intensities.

1. **Class 1, Lowest Intensity:**
   Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment.
2. **Class2, Low:**
   Small flames, usually less than two feet long; small amount of very short-range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools.
3. **Class 3, Moderate:**
   Flames up to 8 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozer and plows are generally effective. Increasing potential for harm or damage to life and property.
4. **Class 4, High:**
   Large Flames, up to 30 feet in length; short-range spotting common; medium range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property.
5. **Class 5, Highest Intensity:**
   Very large flames up to 150 feet in length; profuse short-range spotting, frequent long-range spotting; strong fire-induced winds. Indirect attack marginally effective at the head of the fire. Great potential for harm or damage to life and property.

Burn Probability and Fire Intensity Scale are designed to complement each other. The Fire Intensity Scale does not incorporate historical occurrence information. It only evaluates the potential fire behavior for an area, regardless if any fires have occurred there in the past. This additional information allows mitigation planners to quickly identify areas where dangerous fire behavior potential exists in relationship to nearby homes or other valued assets.

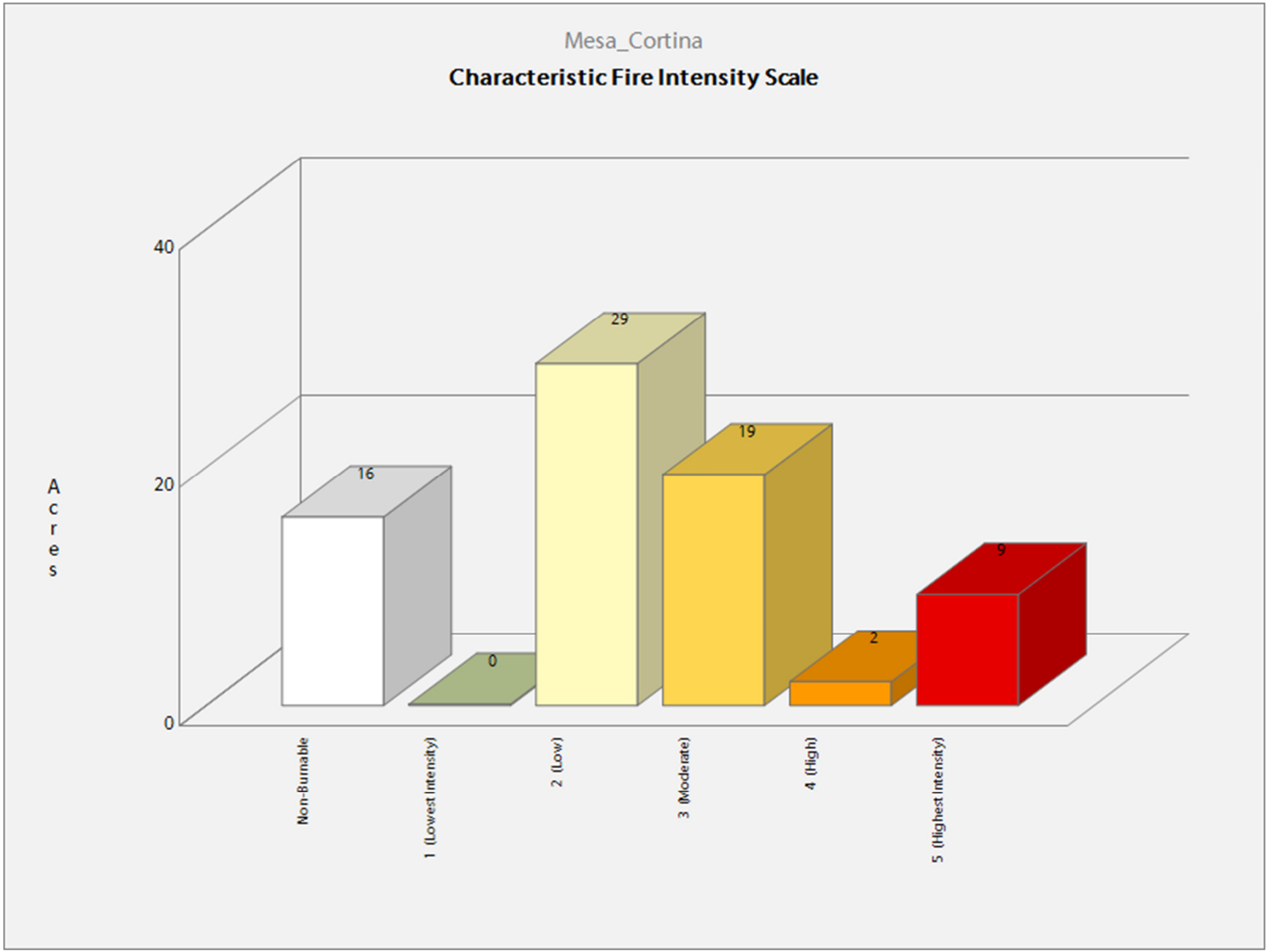
Since all areas in Colorado have fire intensity scale calculated consistently, it allows for comparison and ordination of areas across the entire state. For example, a high fire intensity area in Eastern Colorado is equivalent to a high fire intensity area in Western Colorado.

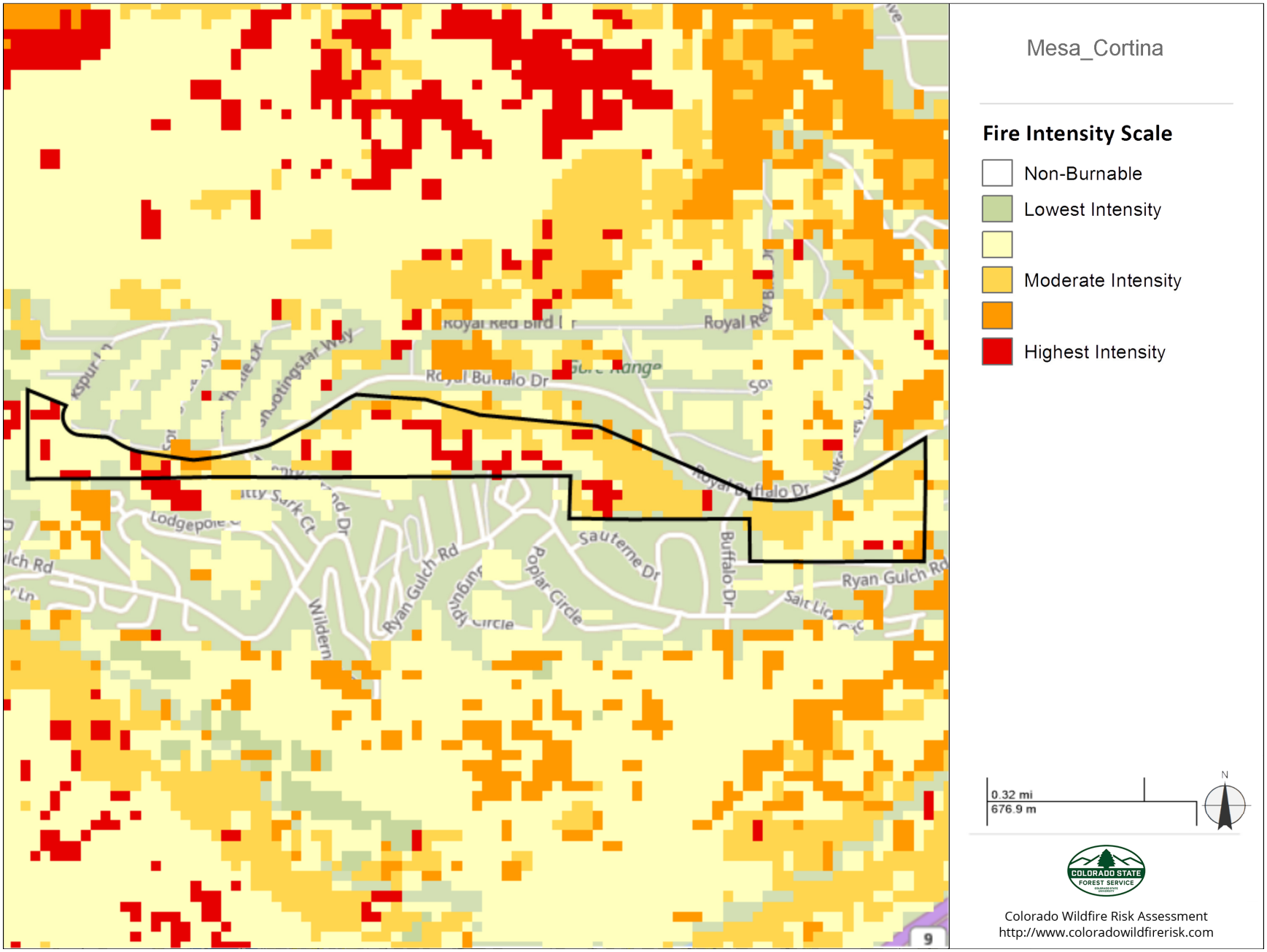
Fire intensity scale is a fire behavior output, which is influenced by three environmental factors - fuels, weather, and topography. Weather is by far the most dynamic variable as it changes frequently.

To account for this variability, four percentile weather categories were created from historical weather observations to represent low, moderate, high, and extreme weather days for each 30-meter cell in Colorado. The FIS represents the weighted average for all four weather percentiles.

The fire intensity scale map is derived at a 30-meter resolution. This scale of data was chosen to be consistent with the accuracy of the primary surface fuels dataset used in the assessment. While not appropriate for site specific analysis, it is appropriate for regional, county or local planning efforts.

FIS Class	Acres	Percent
Non-Burnable	16	21.0 %
1 (Lowest Intensity)	0	0.0 %
2 (Low)	29	38.2 %
3 (Moderate)	19	25.7 %
4 (High)	2	2.7 %
5 (Highest Intensity)	9	12.4 %
Total	**75**	**100.0 %**


Mesa_Cortina
Characteristic Fire Intensity Scale
Acres
40
20
0
16
0
29
19
2
9
Non-Burnable
1 (Lowest Intensity)
2 (Low)
3 (Moderate)
4 (High)
5 (Highest Intensity)


Mesa_Cortina
Fire Intensity Scale
Non-Burnable
Lowest Intensity
Moderate Intensity
Highest Intensity
Royal Red Bird Dr
Royal Buffalo Dr
Sauterne Dr
Buffalo Dr
Ryan Gulch Rd
Poplar Circle
Lodgepole
0.32 mi
676.9 m
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COLORADO STATE FOREST SERVICE
Colorado Wildfire Risk Assessment
http://www.coloradowildfirerisk.com

Fuelbreak Guidelines for Forested Subdivisions & Communities

By

Frank C. Dennis

Colorado State Forest Service

Knowledge to Go Places

This publication was developed for use by foresters, planners, developers, homeowners' associations and others. Implementation of these measures cannot *guarantee* safety from all wildfires, but will greatly increase the probability of containing them at more manageable levels.

Inadequate fire planning can result in loss of life or property and costly suppression activities.

Colorado's forested lands are experiencing severe impacts from continuing population increases and peoples' desire to escape urban pressures. Subdivisions and developments are opening new areas for homesite construction at an alarming rate, especially along the Front Range and around recreational areas such as Dillon, Vail, and Steamboat Springs.

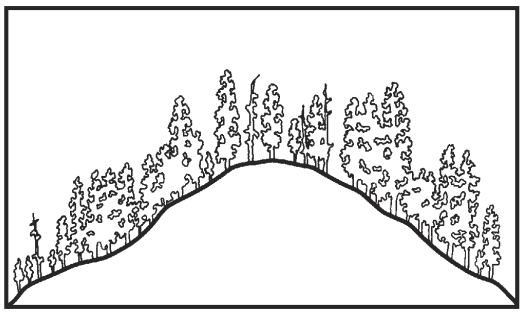
But with development inevitably comes a higher risk of wildfire as well as an ever-increasing potential for loss of life and property. Methods of fire suppression, pre-suppression needs, and homeowner and fire crew safety must all be considered in the planning and review of new developments as well as for the "retrofitting" of existing, older subdivisions.

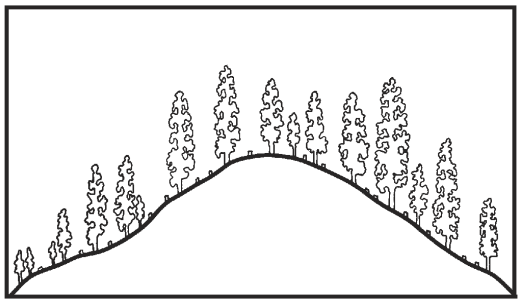
Fuelbreaks should be considered in fire management planning for subdivisions and developments; however, the following are guidelines **only**. They should be customized to local areas by professional foresters experienced in Rocky Mountain wildfire behavior and suppression tactics.

Fuelbreak vs Firebreak

Although the term fuelbreak is widely used in Colorado, it is often confused with firebreak. The two are entirely separate, and aesthetically different, forms of forest fuel modification and treatment.

• A firebreak is strip of land, 20 to 30 feet wide (or more), in which all vegetation is removed down to bare, mineral soil each year prior to fire season.





Above, cross section of mixed conifer stand before fuelbreak modification. Below, after modification.

• A fuelbreak (or shaded fuelbreak) is an easily accessible strip of land of varying width (depending on fuel and terrain), in which fuel density is reduced, thus improving fire control opportunities. The stand is thinned, and remaining trees are pruned to remove ladder fuels. Brush, heavy ground fuels, snags, and dead trees are disposed of and an open, park-like appearance is established.

The following is a discussion of the uses, limitations, and specifications of fuelbreaks in wildfire control and fuels management.

Fuelbreak Limitations

Fuelbreaks provide quick access for wildfire suppression. Control activities can be conducted more safely due to low fuel volumes. Strategically located, they break up large, continuous tracts of dense timber, thus limiting uncontrolled spread of wildfire.

Fuelbreaks can aid firefighters greatly by slowing fire spread under normal burning conditions. However, under extreme conditions, even the best fuelbreaks stand little chance of arresting a large

Before and after photos of a forest stand thinned to reduce fuel loads.

fire, regardless of firefighting efforts. Such fires, in a phenomenon called "spotting," can drop firebrands 1/8-mile or more ahead of the main fire, causing very rapid fire spread. These types of large fires may continue until there is a major change in weather conditions, topography, or fuel type.

It is critical to understand: A fuelbreak is the line of defense. The area (including any homes and developments) between it and the fire may remain vulnerable.

In spite of these somewhat gloomy limitations, fuelbreaks have proven themselves effective in Colorado. During the 1980 Crystal Lakes Subdivision Fire near Fort Collins, crown fires were stopped in areas with fuelbreak thinnings, while other areas of dense lodgepole pine burned completely. A fire at O'Fallon Park in Jefferson County was successfully stopped and controlled at a fuelbreak. The Buffalo Creek Fire in Jefferson County (1996) and the High Meadow Fire in Park and Jefferson Counties (2000) slowed dramatically wherever intense forest thinnings had been completed. During the 2002 Hayman Fire, Denver Water's entire complex of offices, shops and caretakers' homes at Cheesman Reservoir were saved by a fuelbreak with no firefighting intervention by a fuelbreak.

Burned area near Cheesman Reservoir as a result of the Hayman Fire. Note the unburned green trees in the middle right of the photo, a treated fuelbreak.

The Need For A Fuelbreak

Several factors determine the need for fuelbreaks in forested subdivisions, including: (1) potential problem indicators; (2) wildfire hazard areas; (3) slope; (4) topography; (5) crowning potential; and (6) ignition sources.

Potential Problem Indicator

The table below explains potential problem indicators for various hazards and characteristics common to Colorado's forest types. All major forest types, except aspen, indicate a high potential for wildfire hazard.

Fuel Type	Characteristics			Hazards			
	Aesthetics	Wildlife	Soil	**Wildfire**	Avalanche	Flood	Climate
Aspen	2	3	3	**2**	4	3	2
Douglas-fir	2	2	3	**5**	2	2	3
Greasewood-Saltbrush	4	2	2	**2**	1	3	3
Limber-Bristlecone Pine	3	2	4	**3**	4	2	5
Lodgepole Pine	2	2	3	**5**	4	2	4
Meadow	5	4	4	**2**	3	4	3
Mixed Conifer	2	1	1	**5**	3	1	3
Mountain Grassland	5	3	4	**3**	3	2	4
Mountain Shrub	3	5	4	**4**	2	2	3
Piñon-Juniper	2	3	4	**4**	2	3	2
Ponderosa Pine	2	3	1	**5**	2	2	3
Sagebrush	4	4	3	**3**	3	2	3
Spruce-Fir	2	3	3	**4**	5	**3**	4

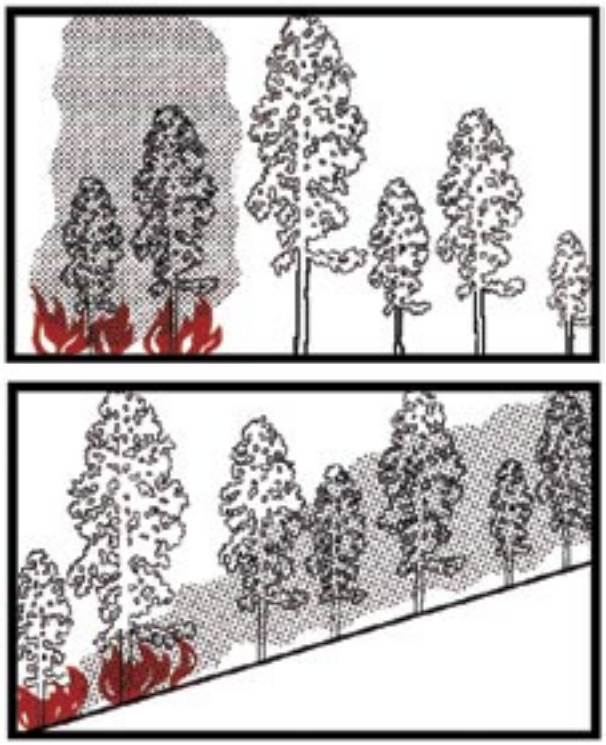
Legend: 5 – Problem may be crucial; 4 – Problem very likely;
3 – Exercise caution; 2 – Problem usually limited;
1 – No rating possible

Wildfire Hazard Maps

The Colorado State Forest Service (CSFS), numerous counties and some National Forests have completed wildfire hazard mapping for many areas within Colorado, particularly along the Front Range. These maps typically consider areas with 30 percent or greater slope; hazardous fuel types; and hazardous topographic features such as fire chimneys. Wildfire Hazard Ratings may be depicted in several ways. Whatever system is used, areas rated moderate or higher should be considered for fuel modification work.

Slope

Rate of fire spread increases as the slope of the land increases. Fuels are preheated by the rising smoke column or they may even come into contact with the flames themselves.



Fire effects, flat vs steep terrain. Note preheating of fuels on steep ground from passage of smoke column.

At 30 percent slope, rate of fire spread doubles compared to rates at level ground, drastically reducing firefighting effectiveness. **Areas near 30 percent or greater slopes are critical and must be reviewed carefully.**

Topography

Certain topographic features influence fire spread and should be evaluated. Included are fire chimneys, saddles, and V-shaped canyons. They are usually recognized by reviewing standard U.S.G.S. quad maps.

• Chimneys are densely vegetated drainages on slopes greater than 30 percent. Wind, as well as air pre-heated by a fire, tends to funnel up these drainages, rapidly spreading fire upslope.

• Saddles are low points along a main ridge or between two high points. Like chimneys, they also funnel winds to create a natural fire path during a fire's uphill run. Saddles act as corridors to spread fire into adjacent valleys or drainages.

Chimney.

Saddle.

• Narrow, V-shaped valleys or canyons can ignite easily due to heat radiating from one side to the other. For example, a fire burning on one side of a narrow valley dries and preheats fuels on the opposite side until the fire "flashes over." The natural effect of slope on fire then takes over and fire spreads rapidly up drainage and uphill along both sides of the valley.

Flashover in V-shaped valley.

Crowning Potential

An on-site visit is required to accurately assess crowning potential. A key, below, helps determine this rating. Fuel modification is usually unnecessary if an area has a rating of 3 or less.

Crowning Potential Key

	Rating
A. Foliage present, trees living or dead — B	
B. Foliage living — C	
C. Leaves deciduous or, if evergreen, usually soft, pliant, and moist; never oily, waxy, or resinous.	0
CC. Leaves evergreen, not as above — D	
D. Foliage resinous, waxy, or oily — E	
E. Foliage dense — F	
F. Ladder fuels plentiful — G	
G. Crown closure > 75 percent	9
GG. Crown closure < 75 percent	7
FF. Ladder fuels sparse or absent — H	
H. Crown closure > 75 percent	7
HH. Crown closure < 75 percent	5
EE. Foliage open — I	
I. Ladder fuel plentiful	4
II. Ladder fuel sparse or absent	2
DD. Foliage not resinous, waxy, or oily — J	
J. Foliage dense — K	
K. Ladder fuels plentiful — L	
L. Crown closure > 75 percent	7
LL. Crown closure < 75 percent	4
KK. Ladder fuels sparse or absent — M	
M. Crown closure > 75 percent	5
MM. Crown closure < 75 percent	3
JJ. Foliage open — N	
N. Ladder fuels plentiful	3
NN. Ladder fuels sparse or absent	1
BB. Foliage dead	0

The majority of dead trees within the fuelbreak should be removed. Occasionally, large, dead trees (14 inches or larger in diameter at 4 1/2 feet above ground level) may be retained as wildlife trees. If retained, all ladder fuels must be cleared from around the tree's trunk.

Ignition Sources

Possible ignition sources, which may threaten planned or existing developments, must be investigated thoroughly. Included are other developments and homes, major roads, recreation sites, railroads, and other possible sources. These might be distant from the proposed development, yet still able to channel fire into the area due to slope, continuous fuels, or other topographic features.

Fuelbreak Locations

In fire suppression, an effective fire line is connected, or "anchored," to natural or artificial fire barriers. Such anchor points might be rivers, creeks, large rock outcrops, wet meadows, or a less flammable timber type such as aspen. Similarly, properly designed and constructed fuelbreaks take advantage of these same barriers to eliminate "fuel bridges." (Fire often escapes control because of fuel bridges that carry the fire across control lines.)

Since fuelbreaks should normally provide quick, safer access to defensive positions, they are necessarily linked with road systems. Connected with county-specified roads within subdivisions, they provide good access and defensive positions for firefighting equipment and support vehicles. Cut-and fill slopes of roads are an integral part of a fuelbreak as they add to the effective width of modified fuels.

Fuelbreaks without an associated road system, such as those located along strategic ridge lines, are still useful in fire suppression. Here, they are often strengthened and held using aerial retardant drops until fire crews can walk in or be ferried in by helicopter.

Preferably, fuelbreaks are located along ridge tops to help arrest fires at the end of their runs. However, due to homesite locations and resource values, they can also be effective when established at the base of slopes. Mid-slope fuelbreaks are least desirable, but under certain circumstances and with modifications, these too, may be valuable.

Fuelbreaks are located so that the area under management is broken into small, manageable units. Thus, when a wildfire reaches modified fuels, defensive action is more easily taken, helping to keep the fire small. For example, a plan for a subdivision might recommend that fuelbreaks break up continuous forest fuels into units of 10 acres or less. This is an excellent plan, especially if defensible space thinnings are completed around homes and structures, and thinning for forest management and forest health are combined with the fuelbreak.

When located along ridge tops, continuous length as well as width are critical elements. Extensive long-range planning is essential in positioning these types of fuelbreaks.

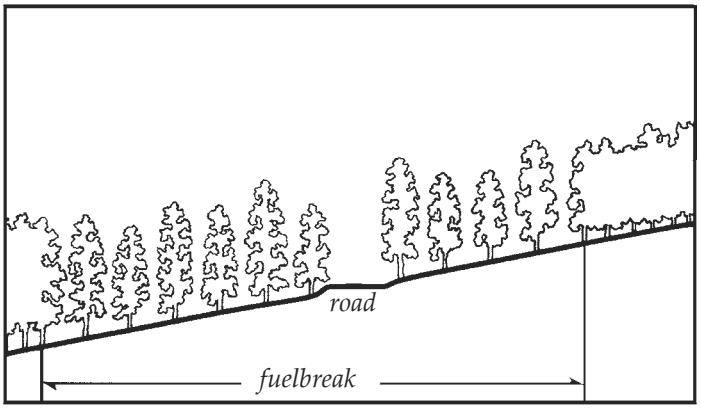
Aesthetics

Improperly planned fuelbreaks can adversely impact an area's aesthetic qualities. Careful construction is necessary when combining mid-slope fuelbreaks with roads involving excessive cut-and-fill.

These photos, far- and near- views of the same site, illustrate that forest can be thinned without impacting aesthetics.

Care must also be taken in areas that are not thinned throughout for fuel hazard reduction. In such cases the fuelbreak visually sticks out like a "sore thumb" due to contrasting thinned and unthinned portions of the forest. (Especially noticeable are those portions of the fuelbreak above road cuts).

These guidelines are designed to minimize aesthetic impacts. However, some situations may require extensive thinning and, thus, result in a major visual change to an area. Additional thinning beyond the fuelbreak may be necessary to create an irregular edge and to "feather," or blend, the fuelbreak thinning into the unthinned portions of the forest. Any thinning beyond the fuelbreak improves its effectiveness and is highly recommended.



Cross-section of a typical fuelbreak built in conjunction with a road.

Constructing the Fuelbreak

Fuelbreak Width and Slope Adjustments

Note: Since road systems are so important to fuelbreak construction, the following measurements are from the toe of the fill for downslope distances, and above the edge of the cut for uphill distances.

The minimum recommended fuelbreak width is approximately 300 feet for level ground. Since fire activity intensifies as slope increases, the overall fuelbreak width must also increase. However, to minimize aesthetic impacts and to maximize fire crew safety, the majority of the increases should be made at the bottom of the fuelbreak, below the road cut.

Widths are also increased when severe topographic conditions are encountered. Guidelines for fuelbreak widths on slopes are given below:

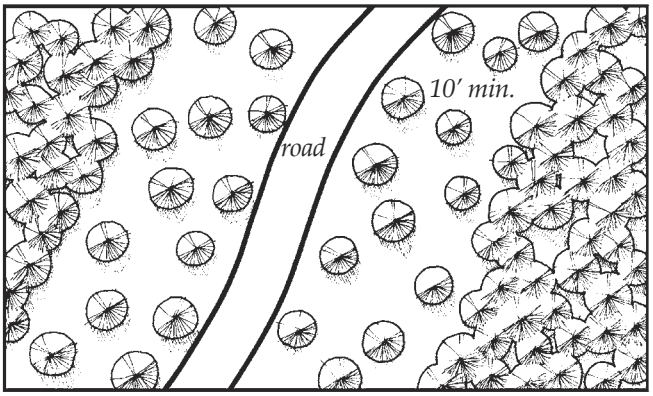
Fuelbreak Width/Slope

Percent Slope (%)	Minimum Uphill Distance (ft)	Minimum Downhill Distance (ft)	Total Width of Modified fuels (ft)*
0	150	150	300
10	140	165	303
20	130	180	310
30	120	195	315
40	110	210	320
50	100	225	325
60	100	240	340

*As slope increases, total distance for cut-and-fill for road construction rapidly increases, improving fuelbreak effective width.

Stand Densities

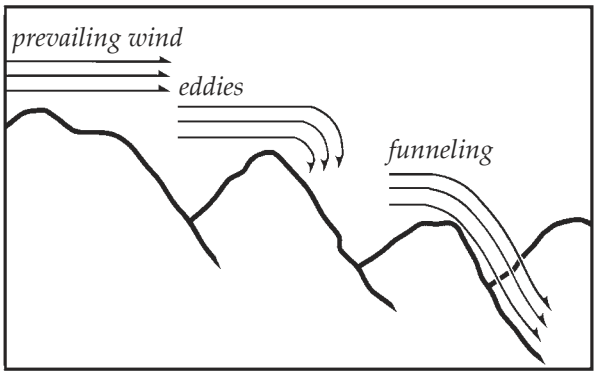
Crown separation is a more critical factor for fuelbreaks than a fixed tree density level. A *minimum* 10-foot spacing between the edges of tree crowns is recommended on level ground. As slope increases, crown spacing should also increase. However, small, isolated groups of trees may be retained for visual diversity. Increase crown spacing around any groups of trees left for aesthetic reasons and to reduce fire intensities and torching potential.



Plan view of fuelbreak showing minimum distance between tree crowns.

In technical terms, a fuelbreak thinning is classified as a heavy "sanitation and improvement cut, from below." Within fuelbreaks, trees that are suppressed, diseased, deformed, damaged, or of low vigor are removed along with all ladder fuels. Remaining trees are the largest, healthiest, most wind-firm trees from the dominant and co-dominant species of the stand.

Because such a thinning is quite heavy for an initial entry into a stand, prevailing winds, eddy effects, and wind funneling must be carefully evaluated to minimize the possibility of windthrow. It may be necessary to develop the fuelbreak over several years to allow the timber stand to "firm-up" — this especially applies to lodgepole pine and Engelmann spruce stands.



Topography affects wind behavior – an important consideration during fuelbreak construction.

Area-wide forest thinnings are recommended for any subdivisions. Such thinning is not as severe as a fuelbreak thinning, but generally should be completed to fuelbreak specifications along the roads (as outlined on page 6.) In addition, "defensible space thinnings" are highly recommended around all structures (see CSU Coop. Extension Fact sheet 6.302, *Creating Wildfire-Defensible Zones*).

Debris Removal

Limbs and branches left from thinning (slash) can add significant volumes of fuel to the forest floor, especially in lodgepole pine, mixed-conifer, or spruce/fir timber types. These materials can accumulate and serve as ladder fuels, or can become "jackpots," increasing the difficulty of defending the fuelbreak during a wildfire. **Slash decomposes very slowly in Colorado and proper disposal is essential.** Proper treatment reduces fire hazard, improves access for humans and livestock, encourages establishment of grasses and other vegetation, and improves aesthetics.

Three treatment methods are commonly used. These are lopping-and-scattering, piling and burning, and chipping. Mulching of small trees and slash using equipment similar to Hydro-axes or Timbcos equipped with mulching heads are becoming a popular method of treatment. Size, amount, and location of slash dictates the method used, in addition to cost and the final desired appearance. The method chosen will also depend on how soon an effective fuelbreak is needed prior to construction in new developments.

Lop and scatter: slash should be no deeper than 12'' above ground surface.

Chipping is the most desirable, but also the most expensive method of slash disposal.

Piled slash can be burned but only during certain conditions, such as after a snowfall.

Fuelbreak Maintenance

Following initial thinning, trees continue to grow (usually at a faster rate). The increased light on the forest floor encourages heavy grass and brush growth where, in many cases, where little grew before. The site disturbance and exposed mineral soil created during fuelbreak development is a perfect seed bed for new trees that, in turn, create new ladder fuels. Thus, in the absence of maintenance, fuelbreak effectiveness will decrease over time.

Fuelbreak maintenance is essential. Ingrowth, shown above, will minimize the effectiveness of this fuelbreak within a few years.

Fuelbreak maintenance problems are most often the result of time and neglect. Misplaced records, lack of follow-up and funding, and apathy caused by a lack of fire events are some of the major obstacles. In addition, the responsibility for fuelbreak maintenance projects is often unclear. For example, control of a fuelbreak completed by a developer passes to a homeowner's association, usually with limited funds and authority to maintain fuelbreaks.

If fuelbreak maintenance is not planned and completed as scheduled, consider carefully whether the fuelbreak should be constructed. An un-maintained fuelbreak may lead to a false sense of security among residents and fire suppression personnel.

Conclusion

An image of well-designed communities for Colorado includes:

• Forested subdivisions where the total forest cover is well-managed through carefully planned, designed, and maintained thinnings. This contributes to reduced wildfire hazards and a much healthier forest — one that is more resistant to insects and disease.

• A system of roads and driveways with their associated fuelbreaks that break up the continuity of the forest cover and fuels. These help keep fires small, while also providing safer locations from which to mount fire suppression activities. In addition to allowing fire personnel in, they will allow residents to evacuate if necessary.

• Individual homes that all have defensible space around them, making them much easier to defend and protect from wildfire, while also protecting the surrounding forest from structure fires.

Creation of such communities is entirely feasible if recognition of the fire risks, a spirit of cooperation, an attitude of shared responsibility, and the political will exists.

Colorado's mountains comprise diverse slopes, fuel types, aspects, and topographic features. This variety makes it impossible to develop general fuelbreak prescriptions for all locations. ***The previous recommendations are guidelines only.*** *A professional forester with fire suppression expertise should be consulted to "customize" fuelbreaks for particular areas.*