Colorado Wildfire Risk Public Viewer

Map Theme Descriptions

The purpose of this document is to explain each of the available map themes/layers that users can select in the Colorado Wildfire Risk Public Viewer. For more information, see the Colorado Wildfire Risk Assessment Final Report.

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Wildfire Risk Themes

Wildfire Risk

Wildfire Risk is a composite risk map created by combining the Values at Risk Rating and the Burn Probability layers. It identifies areas with the greatest potential impacts from a wildfire – i.e. those areas most at risk when considering the four values layers. The Values at Risk Rating is a key component of Wildfire Risk. It is comprised of several individual risk layers including Wildland Urban Interface (housing density), Forest Assets, Riparian Assets and Drinking Water Importance Areas risk outputs. The WUI component is a key element of the composite risk since it represents where people live in the wildland and urban fringe areas that are susceptible to wildfires and damages. The found individual risk layers are weighted to derive the Values at Risk Rating layer. The risk 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.

Burn Probability

Burn Probability (BP) is the annual probability of any location burning due to a wildfire. The annual BP was calculated as the number of times that a cell was burned and the number of iterations used to run the models. The annual BP was estimated for Colorado by using a stochastic (Monte Carlo) wildfire simulation approach with Technosylva's Wildfire Analyst software (www.WildfireAnaylst.com). A total number of 2,342,334 fires were simulated (3,200,000 if we consider those fires outside the Colorado border which were used in a buffer area around the study area to compute BP) with a mean ignition density of 8.68 fires/km2. The ignition points were spatially distributed evenly every 500 meters across the state. Only high and extreme weather conditions were used to run the single fires because they usually burn most of the annual burned area. All fires simulations had a duration of 10 h. After simulating all the fires, some cells were not burned by any simulated fire, resulting in a BP value of zero. Some cells were non-burnable due to the associated fuel type (water, roads, towns, agricultural areas, etc.). However, the lowest BP value found in 'burnable' cells was assigned to cells where the simulated fires did not reach. The Wildfire Analyst fire simulator considered the number of times that the simulated fires burned each cell. After that, results were weighted by considering the historical fire occurrence of those fires that burned in high and extreme weather conditions. The weighting was done by assessing the relation between the annual historical fire ignition 3 density in Colorado and the total number of simulated fires with varying input data in high and moderate weather scenarios and the historical spatial distribution of the ignition points. The probability 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 protection mitigation or prevention planning.

Fire Intensity Scale

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. Class 2, Low-Moderate: 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, Moderate-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.

The Fire Intensity Scale does not incorporate historical fire occurrence information. It evaluates the potential fire behavior for an area, regardless if any fires have occurred there in the past. This 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.

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.

Wildfire Effects Themes

Values at Risk Rating

The Values at Risk Rating (VAR) is an overall rating that combines the risk ratings for Wildland Urban Interface (WUI), Forest Assets, Riparian Assets, and Drinking Water Importance Areas into a single measure of values-at-risk. The individual ratings for each value layer were derived using a Response Function approach.

Response functions are a method of assigning a net change in the value to a resource or asset based on susceptibility to fire of different intensity levels. A resource or asset is any of the Fire Effects input layers, such as WUI, Forest Assets, etc. These net changes can be adverse (negative) or positive (beneficial).

Calculating the VAR at a given location requires spatially defined estimates of the likelihood and intensity of fire integrated with the identified resource value. This interaction is quantified through the use of response functions that estimate expected impacts to resources or assets at the specified fire intensity levels. The measure of fire intensity level used in the Colorado assessment is flame length for a location. Response Function outputs were derived for each input data set and then combined to derive the Values at Risk Rating.

Different weightings are used for each of the input layers with the highest priority placed on protection of people and structures (i.e. WUI). The weightings represent the value associated with those assets. Weightings were developed by a team of experts during the assessment to reflect priorities for fire protection planning in Colorado. Refer to the 5 Colorado WRA Final Report for more information about the layer weightings.

Since all areas in Colorado have the VAR calculated consistently, it allows for comparison and ordination of areas across the entire state. The VAR data was derived at a 30-meter resolution.

Wildland Urban Interface Risk

The Wildland-Urban Interface (WUI) Risk Index layer is a rating of the potential impact of a wildfire on people and their homes. The key input, WUI, reflects housing density (houses per acre) consistent with Federal Register National standards. The location of people living in the wildland-urban interface and rural areas is essential for defining potential wildfire impacts to people and homes.

The WUI Risk Index is derived using a response function modeling approach. Response functions are a method of assigning a net change in the value to a resource or asset based on susceptibility to fire at different intensity levels, such as flame length.

To calculate the WUI Risk Index, the WPL housing density data was combined with flame length data and response functions were defined to represent potential impacts. The response functions were defined by a team of experts led by Colorado State Forest Service mitigation planning staff. By combining flame length with the WPL housing density data, it is possible to determine where the greatest potential impact to homes and people is likely to occur. Customized urban encroachment algorithms were used to ensure those fringe urban areas were included in the WUI Risk outputs. Encroachment distances into urban areas were based on the underlying fuel models and their fuel types and propensity for spotting and spreading.

The range of values is from -1 to -9, with -1 representing the least negative impact and -9 representing the most negative impact. For example, areas with high housing density and high flame lengths are rated -9, while areas with low housing density and low flame lengths are rated -1.

The WUI Risk Index has been calculated consistently for all areas in Colorado, which allows for comparison and ordination of areas across the entire state. Data is modeled at a 30-meter cell resolution, which is consistent with other Colorado WRA layers.

Landscape Characteristics

Surface Fuels

Surface fuels, or fire behavior fuel models as they are technically referred to, contain the parameters needed by the Rothermel (1972) surface fire spread model to compute surface fire behavior characteristics, such as rate of spread, flame length, fireline intensity, and other fire behavior metrics. As the name might suggest, surface fuels account only for surface fire potential. Canopy fire potential is computed through a

separate but linked process. The Colorado WRA accounts for both surface and canopy fire potential in the fire behavior outputs.

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. There are two standard fire behavior fuel model sets published for use. The Fire Behavior Prediction System 1982 Fuel Model Set (Anderson, 1982) contains 13 fuel models and the Fire Behavior Prediction System 2005 Fuel Model Set (Scott & Burgan, 2005) contains 40 fuel models. The Colorado WRA uses fuel models from the 2005 Fuel Model Set.

The surface fuels for the 2017 Colorado Wildfire Risk Assessment Update uses a dataset based on 2014 LANDFIRE data supplemented with considerable enhancements and calibration to update the dataset to 2017. This included several calibration activities such as 1) removal of LANDFIRE mapping zone seamlines, 2) adjustments for disturbances that occurred from 2013-2017 including wildfires, treatments, and insect and disease, 3) fuel adjustments to consider high elevation fire behavior, oak shrublands, pinyon-juniper vegetation, and SH7 fuel model assignments. A team of local fuels experts led by the CSFS and supplemented by private industry and federal agency experts led this effort. More detailed information including a description of methods used for the CO-WRAP fuels calibration can be found in the 2017 Colorado Fuels Calibration Final Report, July 2018, Colorado State Forest Service.

Value	Fuel Model Name	Description
101	GR01	Short, sparse dry climate grass
102	GR02	Low load dry climate grass
103	GR03	Low load, very coarse, humid climate grass
104	GR04	Moderate load dry climate grass
105	GR05	Low load humid climate grass
106	GR06	Moderate load humid climate grass
107	GR07	High load dry climate grass
108	GR08	High load very coarse humid climate grass
109	GR09	Very high load humid climate grass
111	GR01	10,000 elevation
112	GR02	10,000 elevation
121	GS01	Low load dry climate grass-shrub
122	GS02	Moderate load dry climate grass-shrub
123	GS03	Moderate load humid climate grass-shrub

124	GS04	High load humid climate grass-shrub
131	GS01	GT 10,000 Elevation
141	SH01	Low load dry climate shrub
142	SH02	Moderate load dry climate shrub
143	SH03	Moderate load humid climate shrub
144	SH04	Low load humid climate timber-shrub
145	SH05	High load humid climate grass-shrub
146	SH06	Low load humid climate shrub
147	SH07	Very high load dry climate shrub
148	SH08	High load humid climate shrub
149	SH09	Very high load humid climate shrub
157	SH07	Oak shrubland without changes
161	TU01	Light load dry climate timber-grass-shrub
162	TU02	Moderate load humid climate timber-shrub
163	TU03	Moderate load humid climate timber-grass-shrub
164	TU04	Dwarf Conifer with Understory
165	TU05	Very High Load, Dry Climate Timber-Shrub
181	TL01	Low load compact conifer litter
182	TL02	Low load broadleaf litter
183	TL03	Moderate load conifer litter
184	TL04	Small downed logs
185	TL05	High load conifer litter
186	TL06	Moderate load broadleaf litter
187	TL07	Large downed logs
188	TL08	Long-needle litter
189	TL09	Very high load broadleaf litter
201	SB01	Low load activity fuel
202	SB02	Moderate load activity or low load blowdown
203	SB03	High load activity fuel or moderate load blowdown
204	SB04	High load blowdown
91	NB01	Urban
92	NB02	Snow and Ice
93	NB03	Agriculture
98	NB08	Water

99	NB09	Bare Ground

Vegetation

The Vegetation map describes the general vegetation and landcover types across the state of Colorado. In the Colorado WRA, the Vegetation dataset is used to support the development of the Surface Fuels, Canopy Cover, Canopy Stand Height, Canopy Base Height, and Canopy Bulk Density datasets.

The 2014 LANDFIRE program data product (Existing Vegetation Type) was used to compile the Vegetation data for the West Wide Risk Assessment and the Colorado WRA. This reflects data current to 2014. Some modifications were completed to reflect recent disturbances such as large wildfires and pine beetle infestations prevalent in central Colorado over recent years. The LANDFIRE EVT data was classified to reflect general vegetation cover types for representation with CO-WRAP.

Wildland Urban Interface

Colorado is one of the fastest growing states in the Nation, with much of this growth occurring outside urban boundaries. This increase in population across the state will impact counties and communities that are located within the Wildland Urban Interface (WUI). The WUI is described as the area where structures and other human improvements meet and intermingle with undeveloped wildland or vegetative fuels. Population growth within the WUI substantially increases the risk from wildfire.

The Wildland Urban Interface (WUI) layer reflects housing density depicting where humans and their structures meet or intermix with wildland fuels. In the past, conventional wildland-urban interface data sets, such as USFS SILVIS, have been used to reflect these concerns. However, USFS SILVIS and other existing data sources did not provide the level of detail needed by the Colorado State Forest Service and local fire protection agencies, particularly reflecting encroachment into urban core areas.

The new WUI data set is derived using advanced modeling techniques based on the Where People Live (housing density) data set and 2016 LandScan USA population count data available from the Department of Homeland Security, HSIP data. WUI is simply a subset of the Where People Live data set. The primary difference is populated areas surrounded by sufficient non-burnable areas (i.e. interior urban areas) are removed from the Where People Live data set, as these areas are not expected to be directly impacted by a wildfire. Fringe urban areas, i.e. those on the edge of urban areas directly adjacent to burnable fuels are included in the WUI. Advanced encroachment algorithms were used to define these fringe areas.

Data are modeled at a 30-meter cell resolution, which is consistent with other Colorado WRA layers. The WUI classes are based on the number of houses per acre. Class 9 breaks are based on densities well understood and commonly used for fire protection planning.

Historical Wildfire Occurrence

Federal Fire Ignitions

Fire history statistics provide insight as to the number of fires, acres burned and cause of fires in Colorado. These statistics are useful for prevention and mitigation planning. They can be used to quantify the level of fire business, determine the time of year most fires typically occur and develop a fire prevention campaign aimed at reducing a specific fire cause.

Federal wildfire ignitions data for Colorado were compiled for the period 1992-2017. The primary source was the dataset compiled by the USFS Fire Sciences Laboratory (Karen Short). Federal wildfire ignitions are spatially referenced by latitude and longitude coordinates. All ignitions references were updated to remove duplicate records and correct inaccurate locations.

Please reference the following publication for more information about the primary source: Short, Karen C., 2017. Spatial wildfire occurrence data for the United States, 1992-2015 [FPA_FOD_20170508]. 4th Edition. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2013-0009.4

Fire Occurrence

Fire Occurrence is an ignition density that represents the likelihood of a wildfire starting based on historical ignition patterns. Occurrence is derived by modeling historic wildfire ignition locations to create an ignition density map.

Historic fire report data was used to create the ignition points for all Colorado fires. This included both federal and non-federal fire ignition locations.

The class breaks are determined by analyzing the Fire Occurrence output values for the entire state and determining cumulative percent of acres (i.e. Class 9 has the top 1.5% of acres with the highest occurrence rate). Refer to the Colorado WRA Final Report for a more detailed description of the mapping classes and the methods used to derive these.

The Fire Occurrence 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 sufficient for site specific analysis, it is appropriate for regional, county or local protection mitigation or prevention planning.

Non-Federal Fire Ignitions

Fire history statistics provide insight as to the number of fires, acres burned and cause of fires in Colorado. These statistics are useful for prevention and mitigation planning. They can be used to quantify the level of fire business, determine the time of year most fires typically occur and develop a fire prevention campaign aimed at reducing a specific fire cause.

Non-federally reported fire ignition locations for Colorado were compiled for 2009 to 2017. All ignitions data sources were updated to remove duplicate records and correct inaccurate locations. The original source of the data is reported by local fire departments through the National Fire Incident Reporting System (NFIRS). It is the system used by structural (regular) fire departments for collecting all kinds of fires. Wildland fires are just a portion of them. It is administered nationally by FEMA. Reference info https://www.nfirs.fema.gov/. Annually, the Colorado Division of Fire Control & Prevention sends data to CSFS of the wildland fires that are reported within NFIRS. CSFS then formats and submits that data through the National Association of State Foresters to the USDA-Forest Service Data Warehouse, Fire and Aviation Management Web Applications (FAMWEB) site where it is hosted for all the federal, state, and local wildland fire management agencies. Reference site is https://fam.nwcg.gov/fam-web/.