



## 2018 Update to Colorado Wildfire Risk Assessment and Portal

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The CSFS developed the Colorado Wildfire Risk Assessment (CO-WRA) in 2012 to help decision-makers, landowners and communities assess wildfire risk. CO-WRA tailored the west-wide (17 western states and the Pacific islands) quantitative risk assessment framework developed in U.S. Forest Service (USFS) Technical Report RMRS-GTR-315 to Colorado. The Colorado Wildfire Risk Assessment Portal (CO-WRAP; [www.coloradowildfirerisk.com](http://www.coloradowildfirerisk.com)) is a web-mapping tool that provides access to statewide data associated with CO-WRA. Through CO-WRAP, wildfire mitigation/prevention planners and interested citizens can generate maps and download data and reports highlighting areas that may benefit from focused wildfire mitigation efforts. In 2018, the CSFS updated CO-WRA and CO-WRAP, and to our knowledge we are the first state to have state-level WRA products that are comparable between two time periods (i.e. consistent methodology with updated data, recognizing that there have been major improvements in the vegetation, fuels, weather, and population data since the 2012 version). CO-WRA and CO-WRAP provide a consistent set of scientific results for wildfire mitigation and prevention planning in Colorado. The data and information can be used to: (1) create public awareness about wildfire risk; (2) provide state and local planners with information to support mitigation and prevention efforts; (3) identify areas that may require additional planning related to wildfire mitigation projects; (4) assist in the development of Community Wildfire Protection Plans (CWPPs) and other hazard mitigation plans; (5) complement forest stewardship and forest management plans; and (6) inform decision-making at local and state levels.

### **The Colorado Wildfire Risk Assessment:**

- ✓ **Is based on the best available science**
- ✓ **Covers all lands in Colorado**
- ✓ **Has a spatial resolution of 30 m, which is applicable for community-level analysis or greater**
- ✓ **Uses consistent methods and is comparable across Colorado**
- ✓ **Is repeatable and can be updated as new data become available**
- ✓ **Is displayed through the Colorado Wildfire Risk Assessment Portal (CO-WRAP)**

CO-WRAP features two viewers, one for interested citizens and one for planning professionals.

#### ***The Public Viewer:***

- Provides interested citizens a simple-to-use tool that allows them to explore wildfire risk
- Quickly generates maps and wildfire risk ratings for specific locations

#### ***The Professional Viewer:***

- Is tailored for use by professional planners, natural resource agencies and researchers
- Generates maps and detailed risk summary reports that include:
  - Risk statistics for defined project areas
  - Maps, charts, tables, photos and text that describe project areas
- Can be used to download data

Registered professional users include the CSFS; USFS; US Geological Survey (USGS); Bureau of Land Management (BLM); State, County, and Local Natural Resource Agencies; Denver Regional Council of Governments; Colorado Oil and Gas Conservation Commission; local fire departments and fire rescue teams; conservation districts; municipalities; home owner associations; Excel Energy; private forestry consultants; emergency Management Agencies; Colorado Army National Guard; tribal agencies; university researchers, and more.

## *Notable enhancements/results from the 2018 CO-WRA and CO-WRAP update*

- The **new CSFS statewide seamless vegetative fuels dataset** is an enhancement to 2014 Landfire and better represents observed and expected fire behavior in Colorado through the incorporation of disturbance data (fire perimeters, CSFS forest treatments greater than 50 acres, and insect and disease); Landsat imagery analysis through 2016; and expert knowledge from a fuels team (CSFS, Technosylva, Anchor Point Group, USFS, Wildfire Management Solutions LLC - methodology modified from Scott et al. 2005 RMRS-GTR-15).
- The **weather data used to assess fire behavior and spread are improved**. The data cover the years 1988-2017 and were acquired from the National Center for Environmental Prediction - North American Regional Reanalysis. Temperature, relative humidity, and wind speed and direction variables were incorporated in potential weather scenarios (Extreme, High, Moderate and Low). The variables were selected at 2 pm local time, considered the most adverse scenario for a fire start. A 1-h dead fuel moisture variable was estimated using the Rothermel and Rinehart (1983) model, and incorporated elevation and aspect to accumulate solar radiation at 14-h. Then, 2% and 4% were added to the 1-h dead fuel moisture content to estimate 10h and 100h content, respectively. Herbaceous, woody and foliar canopy moisture content were included as constants across the state; these values were estimated using the weather scenarios.
- A **new wildland-urban interface (WUI) layer was produced using the best available population data** from Landsat 2016 (U.S. Department of Homeland Security), and incorporated imagery of nighttime lights, ownership parcels, building footprints, and postal service addresses. Overall, the WUI pattern across Colorado has not changed dramatically from 2012, which was expected. However, there was a very large reduction (2,720,209 acres) from 2012 to 2017 in WUI housing density classes 1-3 (less than 1 house/40 acres to 1 house/10 acres), therefore the entire footprint of the 2017 WUI is smaller (there were 6,606,348 WUI acres in 2012 and 3,886,139 WUI acres in 2017). This is primarily a result of improvements in population data, but is also a result of the improved fuels dataset. In 2016, Landsat performed a quality assessment of the nighttime lights data, which resulted in many rural areas being removed (e.g. lights on barns do not qualify as less than 1 house/40 acres). Up to a 300-meter buffer into urban fringe is considered WUI because it is susceptible to encroachment of wildfire; this buffer is not consistent across the state and is based on flame length data. Core urban areas are excluded from the WUI.
- There is a **new statewide burn probability layer**, produced using Technosylva's Wildfire Analyst™, an advanced GIS tool for modeling wildfire behavior and spread. Burn probability is based on millions of wildfire simulations and weighted by historical wildfire density, weather scenarios and ignition points. This layer replaces the "Wildfire Threat layer" in 2012 CO-WRA.
- **Based on the data and analysis, as of 2017 approximately 2.9 million people live in Colorado's WUI, compared to 2 million people just four years earlier. The new figure represents approximately half of the state's total population.** The increased WUI population is due not only to more people moving into these areas, but also to better, more refined data and ongoing changes in land use and vegetation patterns. The largest recent increases in population growth within the interface are in areas where land use is changing; especially conversion from agriculture to suburban development. Although these areas are in a low-risk category in the assessment, it is important to recognize they are at higher risk for wildfire than core urban areas.
- **CSFS Forest Management Activity data (2008 - 2017) went through an extensive QA/QC process**; only completed activities are now available and there are two broad categories: silviculture and fire (fire only includes pile or broadcast). Note these data only include federally reported CSFS treatment data.
- The **new non-federal fire ignition data are no longer by zip code** – they are discrete point data, which also **improves the accuracy of the derived fire occurrence layer** (likelihood of a wildfire ignition based on historical ignition patterns).

## 2018 CO-WRA and CO-WRAP Update – Layers quick reference

(note for additional details there is a comprehensive 2018 CO-WRA report available on CO-WRAP)

### CO-WRA source data notes:

Seamless vegetation and fuels data for Colorado were derived from 2014 Landfire and updated using 2013-2016 Landsat imagery; ancillary federal, CSFS, and local disturbance data (includes fire perimeters, CSFS treatments, and USFS Forest Health Technology Enterprise Team insect and disease data); and expert knowledge from fuels update team (CSFS, Anchor Point Group, USFS, Wildfire Management Solutions LLC and Technosylva). Detailed methodology available in CSFS CO-WRA fuels report.

Weather data (1988-2017; temperature, relative humidity, and wind speed and direction, averaged) from the National Center for Environmental Prediction North American Regional Reanalysis product were used to analyze potential weather scenarios and assess fire behavior and spread in the fire simulations.

Population and Housing Density data were derived from Landsat 2016 (U.S. Department of Homeland Security) which includes nighttime lights; supplemented by 2010 U.S. Census Bureau data, and 2014 U.S. Postal Service addresses.

### CO-WRAP 2018 update layer notes:

- 1) Reference Base Layers:
  - a. Cities
  - b. County boundaries
  - c. Fire Protection Districts 2017 (CSFS/ CO. Department of Fire Prevention and Control)
  - d. Large fire perimeters 2000 - 2018 (US Geological Survey (USGS- GeoMAC)
  - e. Disturbances 2013-2017 - includes fire, treatments, and insect and disease data used for the seamless vegetation and fuels dataset described in source data notes
  - f. HUC 12 subwatersheds 2015 (USGS)
  - g. Community Wildfire Protection Plans (CWPPs) through 2017 (CSFS)
  - h. Firewise USA communities active through 2017 (CSFS/National Fire Protection Association)
- 2) Wildfire Risk Themes:
  - a. Wildfire risk – 2017 probability of loss or harm from a wildfire; combines burn probability and fire effects (areas affected are weighted by population, forest assets, riparian assets, and drinking water importance values)
  - b. Burn probability – 2017 - replaces “wildfire threat” from 2012 CO-WRA) – probability of a wildfire occurring anywhere on the landscape based on conditions defined by fuels, terrain, and weather – uses Technosylva’s advanced Wildfire Analyst™
  - c. Fire intensity scale – 2017 measure of fuel hazard and associated fire behavior; values 1-5 where each value is 10x greater fire intensity, similar to the Richter scale for earthquakes. Class 1 represents very low intensities and Class 5 very high intensities
- 3) Wildfire Effect Themes:
  - a. Values at risk rating – 2017 identifies areas with important values at risk to wildfire and the level of that risk; uses a response function defined by the CSFS, where values at risk = WUI risk + drinking water risk + forest assets risk + riparian assets risk + fire intensity
  - b. Suppression difficulty rating – 2017 difficulty or relative cost to suppress a fire given terrain (slope steepness) and vegetation (fuels from 2017 CSFS) conditions that may impact machine operability; National Wildfire Coordinating Group Fireline Handbook 3, PMS 401-1
  - c. WUI risk – 2017 potential impact of wildfire on people and homes - housing density data combined with fuels types and flame length to represent potential impacts
  - d. Drinking water risk – 2017 measure of the risk to drinking water importance areas (see description in Landscape Characteristics) based on potential negative impacts from wildfire

- e. Forest assets risk – 2017 measure of the risk to forest assets (see description in Landscape Characteristics) based on the potential negative impacts from wildfire
  - f. Riparian assets risk – 2017 measure of the risk to riparian areas (see description in Landscape Characteristics) based on the potential negative impacts from wildfire
- 4) Wildfire Behavior:
- a. Characteristic flame length – 2017 typical or representative flame length (in feet) of a potential fire based on fuels, topography, and weather
  - b. Characteristic rate of spread – 2017 typical or representative rate of spread of a potential fire based on fuels, topography, and weather
  - c. Fire type –extreme – 2017 crown fire potential under extreme (97<sup>th</sup> percentile) weather category- represents the average weather based on the top 3 percent fire weather days in the analysis period - not intended to represent a worst case scenario weather event
- 5) Landscape Characteristics:
- a. Surface fuels – 2017 CSFS Fuels Update of Landfire 2014 (see data description in CO-WRA Source Data notes)
  - b. Vegetation – Landfire 2014 existing vegetation type (EVT) re-classified to reflect general vegetation types for Colorado
  - c. Wildland Urban Interface (WUI) – 2017 WUI is any area where structures and other human developments meet or intermingle with wildland vegetative fuels – (*see population and housing density data descriptions in source data notes; core urban areas not included*)
  - d. Forest assets – 2014 Landfire canopy cover, canopy height, and existing vegetation type used to classify forests as adaptive (*tree species adapted with the ability to regenerate following a fire by sprouting or serotinous cones*), resilient (*tree species have characteristics that help the tree resist damage from fire and whose adult stages can survive low intensity fires*), or sensitive (*tree species are intolerant or sensitive to damage from fire with low intensity*)
  - e. Riparian assets – 2012 CALFIRE model; represents spatial extent of riparian zones based on the National Hydrography Dataset (NHD), the National Wetlands Inventory (NWI) and LANDFIRE’s existing vegetation dataset. Riparian Assets are ranked from 1 to 3 reflecting relative level of importance, with 3 being the most important and 1 the least important
  - f. Drinking water importance areas – 2011; index derived from USFS Forests to Faucets data that reflects quality and quantity of surface drinking water characterized by HUC 12 watershed, where 1 is least important and 100 is most important
  - g. Ownership – from 2016 Colorado Ownership, Management and Protection (COMaP; Colorado State University)
  - h. Threats to forest health – 1996 – 2016 insect and disease disturbance data from USFS – FHTET. Note that these data can be replicates covering more than one year
- 6) Historical Wildfire Occurrence:
- a. federal fire ignitions – 1992 – 2017 data from the USFS Fire Sciences Laboratory 2017 Fire Program Analysis (FPA) database
  - b. Non-federal fire ignitions – 1992 – 2015 FPA, supplemented by 2012 – 2017 data from the National Fire Incident Reporting System (NFIRS) and USFS Data Warehouse, Fire and Aviation Management Web Applications (FAMWEB) . Note some of these ignitions are multi-jurisdictional and could include federal
  - c. Fire occurrence (2017 wildfire ignition density model); derived from 1992 – 2017 federal ignitions and 2009 – 2017 non-federal ignitions
- 7) Forest Management Activities – CSFS activities by year 2008 – 2017 classified as silviculture or fire. 2008 – 2012 data associated with stands; 2013 – 2017 data include stands and managed areas