



The Marshall Fire - Colorado

What: a wildfire that rapidly spread through dry grasslands and into suburban areas of Superior and Louisville, Colorado

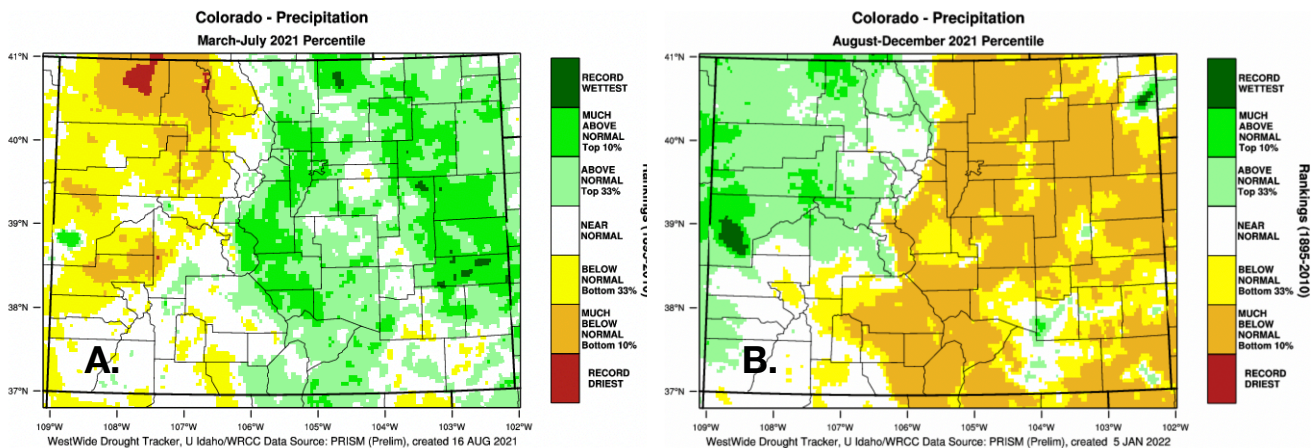
Where: ignited in the foothills of Boulder County, Colorado

When: December 30, 2021

How: a windstorm produced gusts exceeding 100 miles per hour (mph), with sustained winds of over 45 mph for 8 hours

Why: extreme drought conditions and a very warm and dry August–December primed the area for wildfire

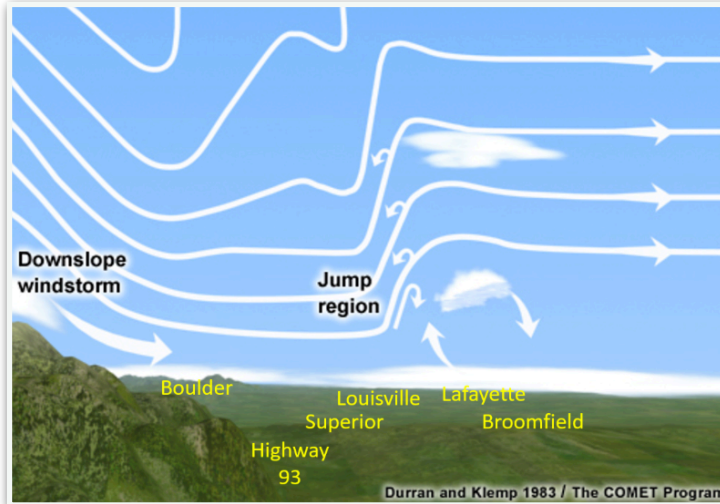
2021 Seasonal Precipitation Comparison



- (A) **March - July 2021:** 7th wettest on record in Boulder with 17.14" of precipitation. The anomalously wet spring supported high growth of grasses in the prairies that covers much of the open space in Boulder County east of the foothills, providing tinder for the fire months later.
- (B) **August - December 2021:** 2nd driest (1.86") on record in Boulder since 1893, and extremely warm, ranking as the 7th hottest August–December period and the 3rd hottest November–December period on record in Boulder since 1893.



December 30, 2021 Windstorm



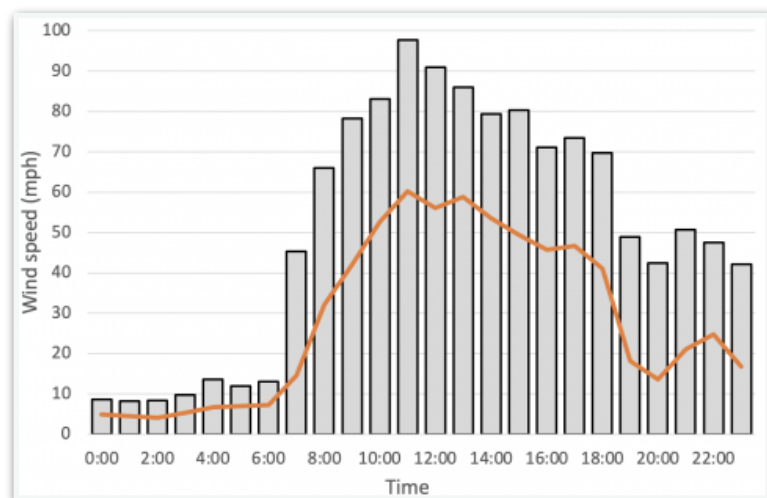
The **size, speed and magnitude** of destruction caused by the Marshall Fire was driven by a downslope windstorm that began at 7:30 AM on December 30, 2021.

Westerly winds were highest from the base of the foothills blowing eastward towards Superior and Louisville, with gusts peaking between 68–108 mph. The highest wind speeds were measured closer to the foothills, with peak gusts of 115 mph measured south of the fire in Arvada, Colorado.

Further east in Lafayette and Broomfield, wind speeds rapidly diminished and switched directions to blow from the east instead. This phenomenon is called an **atmospheric mountain wave**, where “winds accelerate down the slope of mountains, extend only a short distance downwind from the mountains, then subside further downwind and blow in the opposite direction, much like the backward flowing current behind a rock in a swift river” (Western Water Assessment).

Sustained winds of **more than 45 mph** were observed for 8 hours, from 9 AM - 5 PM, as seen in the graphic.

The fire started around **11:30 AM**, which coincided with the **peak intensity** of the windstorm. It ignited near the intersection of Marshall and Eldorado Roads south of Boulder.



Wind speeds in Boulder County, Colorado, December 30, 2021
 Western Water Assessment



Natural and Human Causes

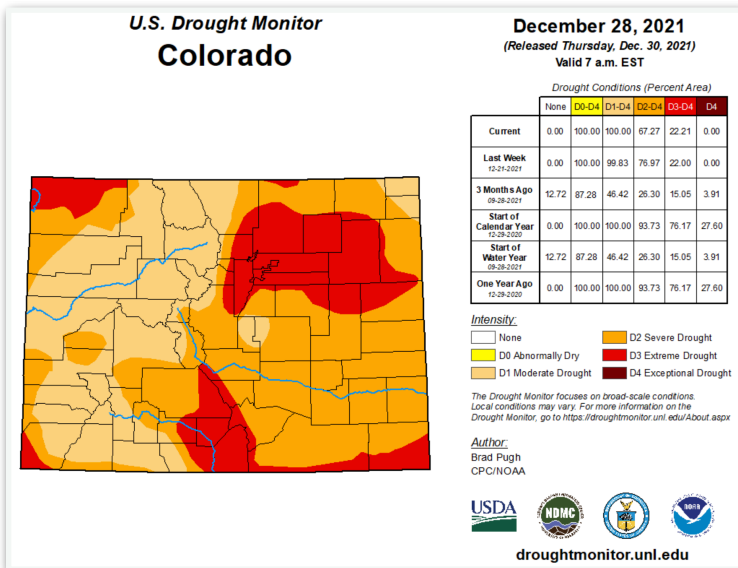
Snow drought played a significant role in creating the necessary conditions that would enable extreme fire behavior. Denver received its first snowfall (0.3”) on December 10th, the latest first snowfall ever recorded, breaking the previous record by three weeks.

From September 1st to December 30th, 2021, Boulder recorded only 1.7” of snow, the lowest snowfall total on record for those months. December 2021 received the 12th lowest snowfall since 1893. On December 30, 2021, the day of the windstorm, Boulder and the surrounding communities were **entirely snow-free**.



Year	Sept. – Dec 30 th total snowfall
2021	1.7
1910	5.1
1912	5.6
1977	7.2
1957	7.3
2005	8.3
1962	8.4
1914	8.4
1907	9.0
1933	9.0

Western Water Assessment

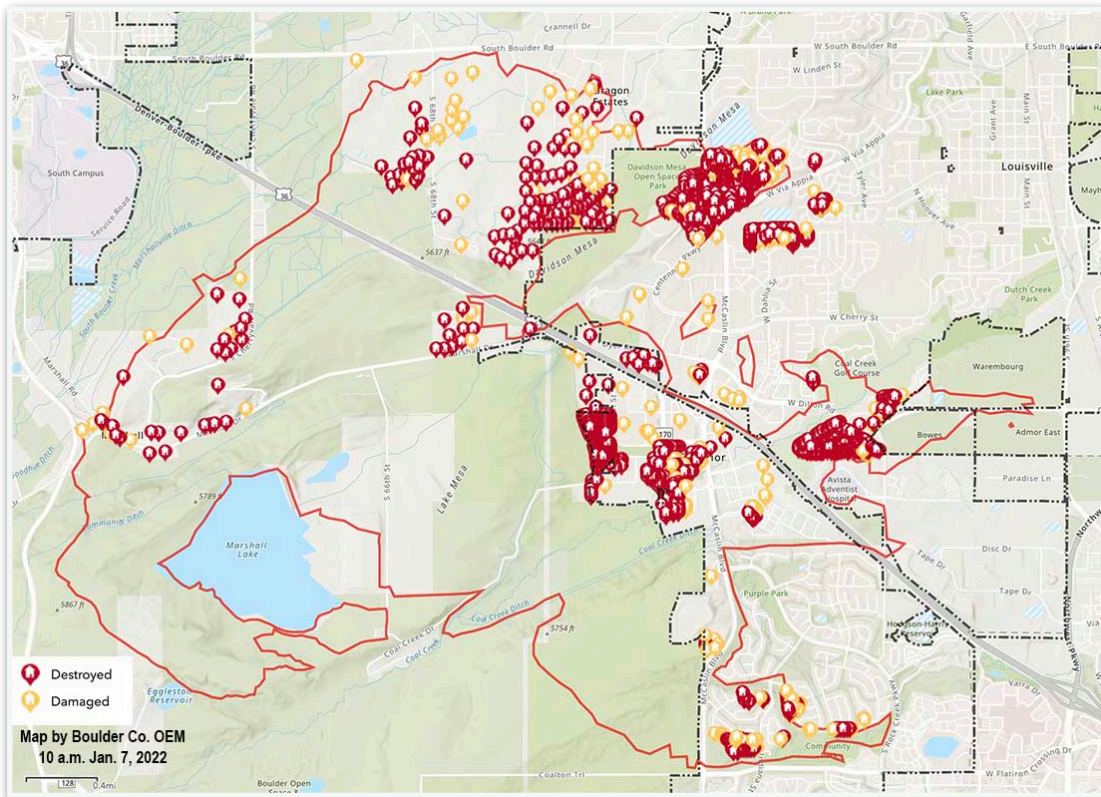


It is **extremely unlikely** that the following conditions, **alone**, would have led to the extent and devastation of the Marshall fire: a wet spring, drought (see graphic to the left), snow drought, high temperatures or the downslope windstorm. **All five of these natural hazards** were required to occur in the sequence they did to create the extreme fire conditions present on December 30, 2021.

Humans also played a significant role in creating conditions for the devastation. The way in which communities developed in Boulder County, the way the land is managed, and how humans relate to hazards were all involved in the outcome.



The Damage



Map of structures damaged or destroyed in the Marshall Fire (data through January 7, 2022).

Two fatalities and an estimated \$513 million in damages makes the Marshall Fire the **most destructive** in Colorado history in terms of cost and structures lost (1,084 including 991 residential homes and 7 commercial properties).

Sources

NOAA. NOAA Regional Climate Centers xmACIS2. <http://scacis.rcc-acis.org> (2022).

NOAA National Weather Service - Boulder WFO. NowData - NOAA Online Weather Data for Boulder, CO. <https://www.weather.gov/wrh/Climate?wfo=bou> (2022).

WWA. <https://wwa.colorado.edu/resources/intermountain-west-climate-dashboard>

D. Jager, A. A. NREL Report No. DA-5500-56489. <https://midcdmz.nrel.gov/apps/sitehome.pl?site=NWTC> (1996).

NWS Denver/Boulder Weather Forecast Office. High Winds and the Marshall Fire on December 30th, 2021. https://www.weather.gov/bou/HighWinds12_30_2021 (2022).