



**Northern Water**

# **Fires, flood risk, and water quality**

GRAD 592 Guest Lecture

November 7, 2023

Esther Vincent, P.E.



# Northern Water Today



District population

1,021,000



Ownership

Ag: 29%

M&I: 71%



Deliveries (2020)

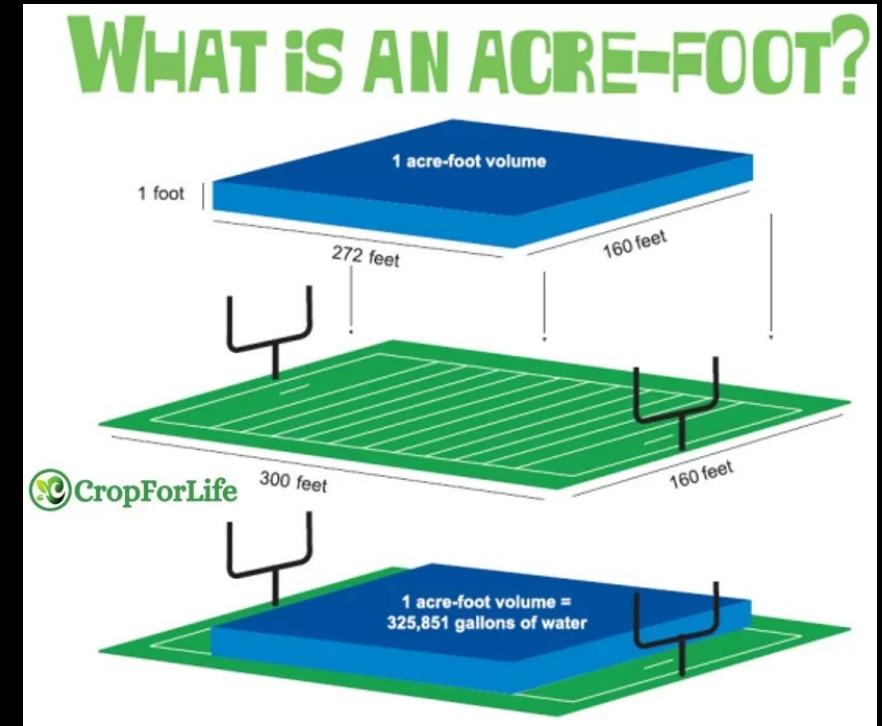
Ag: 40%

M&I: 60%



Raw Water Provider

210,000 acre-feet/year





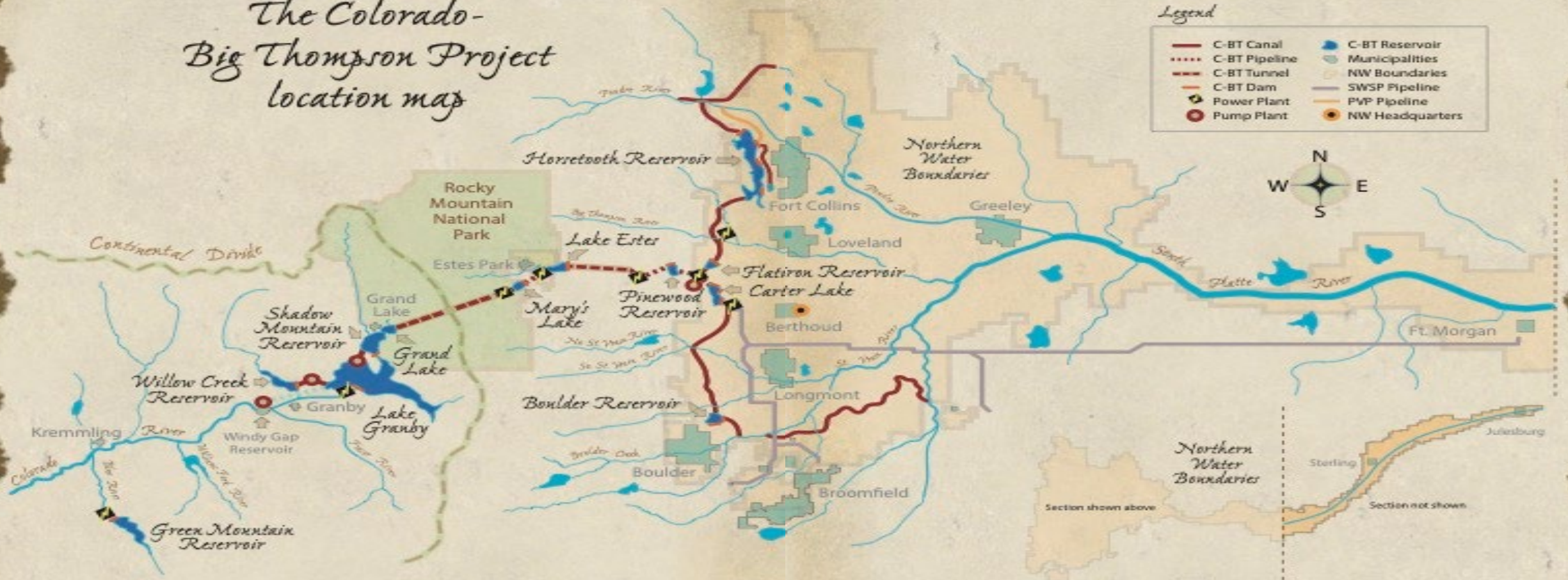
**CONSTRUCTED**

1938-1957

WYOMING  
COLORADO

NEBRASKA

# The Colorado- Big Thompson Project location map



Legend

- |  |               |  |                 |
|--|---------------|--|-----------------|
|  | C-BT Canal    |  | C-BT Reservoir  |
|  | C-BT Pipeline |  | Municipalities  |
|  | C-BT Tunnel   |  | NW Boundaries   |
|  | C-BT Dam      |  | SWSP Pipeline   |
|  | Power Plant   |  | PVP Pipeline    |
|  | Pump Plant    |  | NW Headquarters |



**Northern Water**  
Northern Colorado Water Conservancy District  
220 Water Ave. Berthoud, Colorado 80513  
[www.northernwater.org](http://www.northernwater.org)

US Index Map



Colorado Index Map



The background features a stylized, semi-transparent graphic. On the left, a globe shows the continents of North and South America. To the right of the globe is a vertical thermometer with a bulb at the bottom and a scale with horizontal tick marks. The entire graphic is rendered in shades of gray against a black background.

# Context

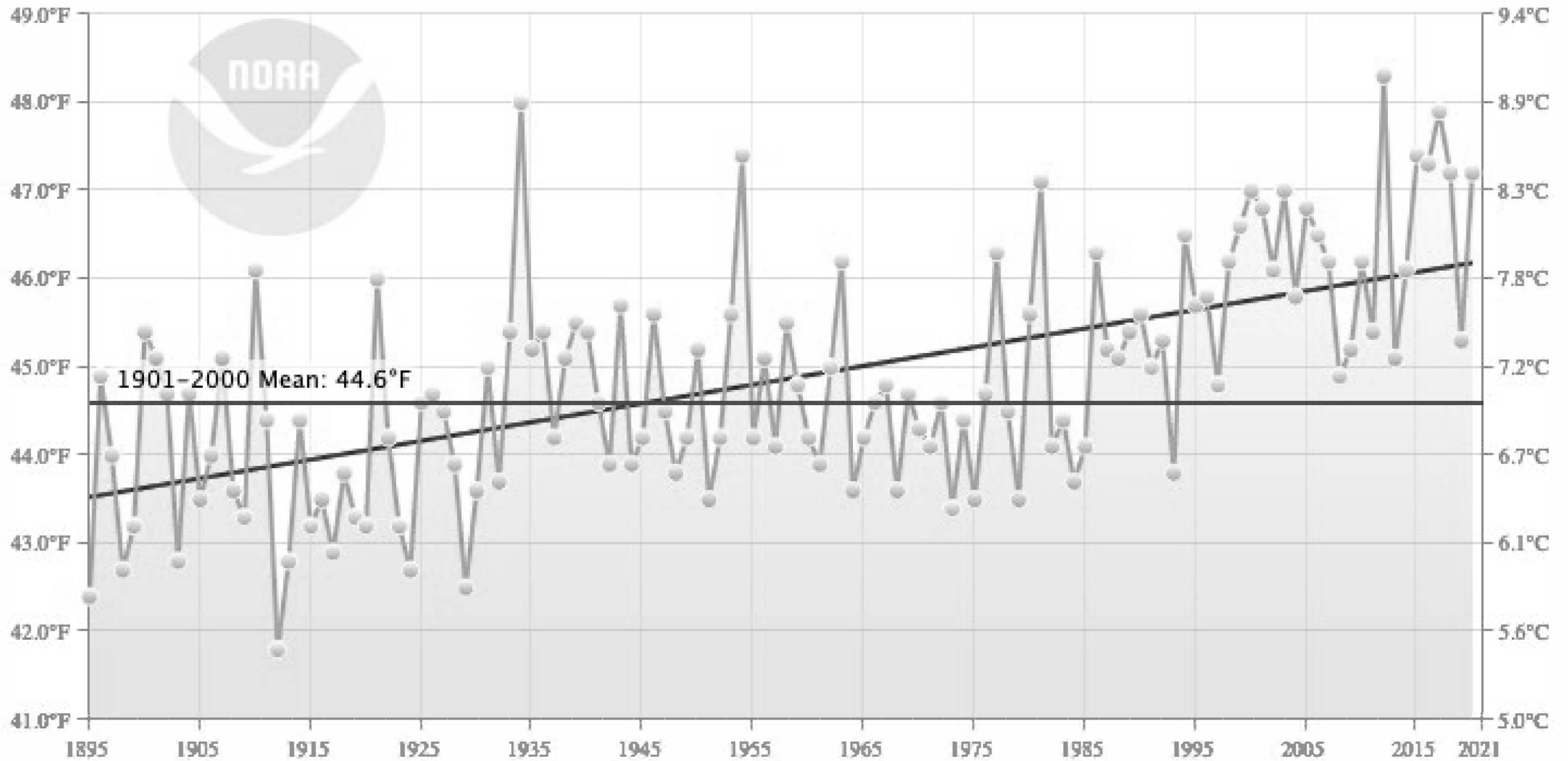
Climate Change and Compromised Forest Health



# Colorado Average Temperature

January-December

— 1895-2020 Trend  
(+0.2°F/Decade)



# Further change to come

Earlier springs

Earlier snowmelt and runoff

Hotter summers

More frequent and severe heat waves

Longer growing season

Greater evapotranspiration

Net water budget deficit

Longer fire season

## Statewide Average Annual Temperature

+ 2 F over the past 30 years

GCMs predict + 2.5 F – 6.5 F by 2050

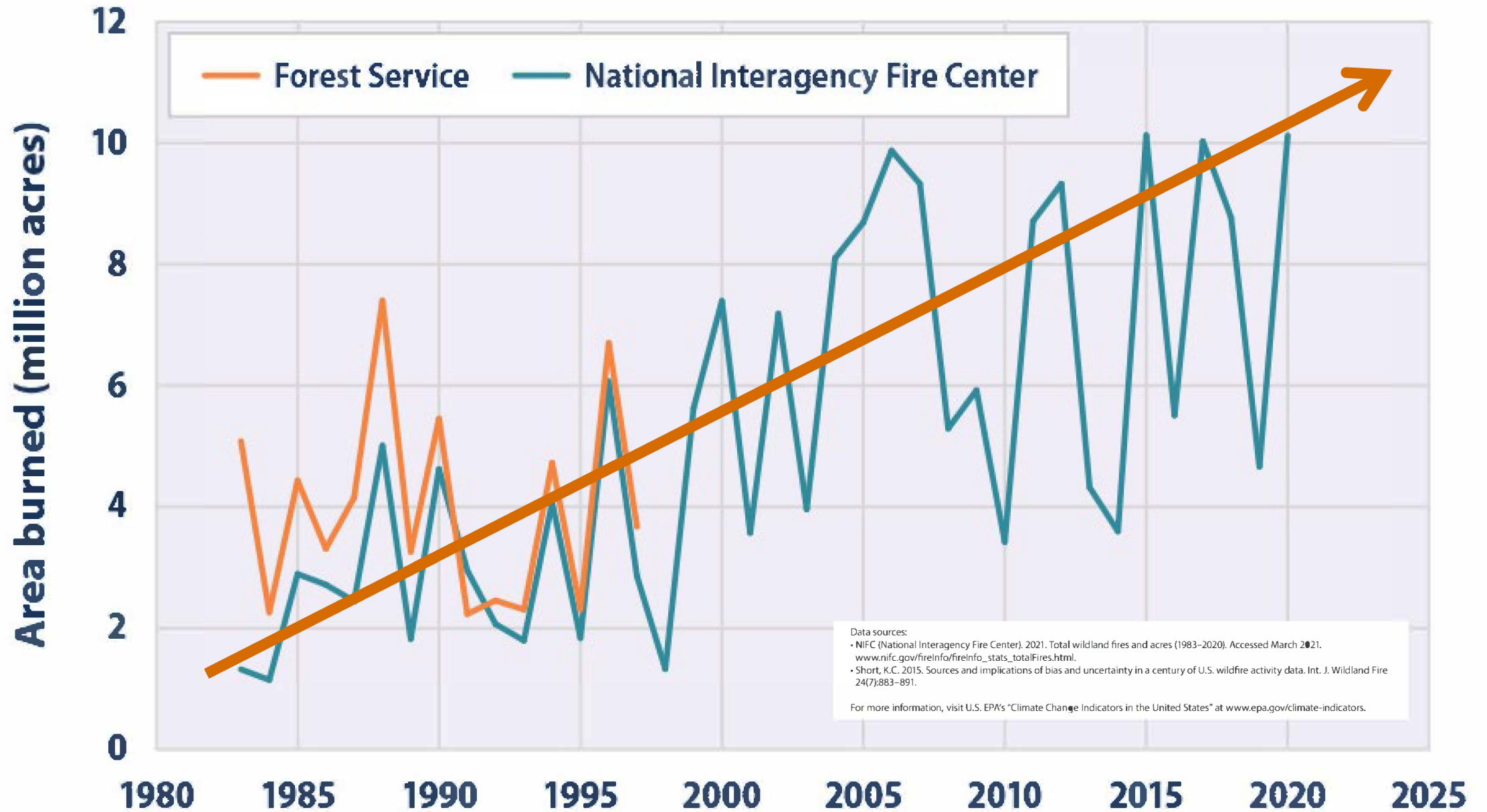




A wide-angle photograph of a mountain slope covered in a dense forest of tall, thin pine trees. The trees exhibit a mix of colors: vibrant green, brown, and grey. The brown and grey trees are dead, while the green ones are healthy. The forest extends to the top of the mountain under a clear blue sky. In the foreground, a small patch of green grass is visible.

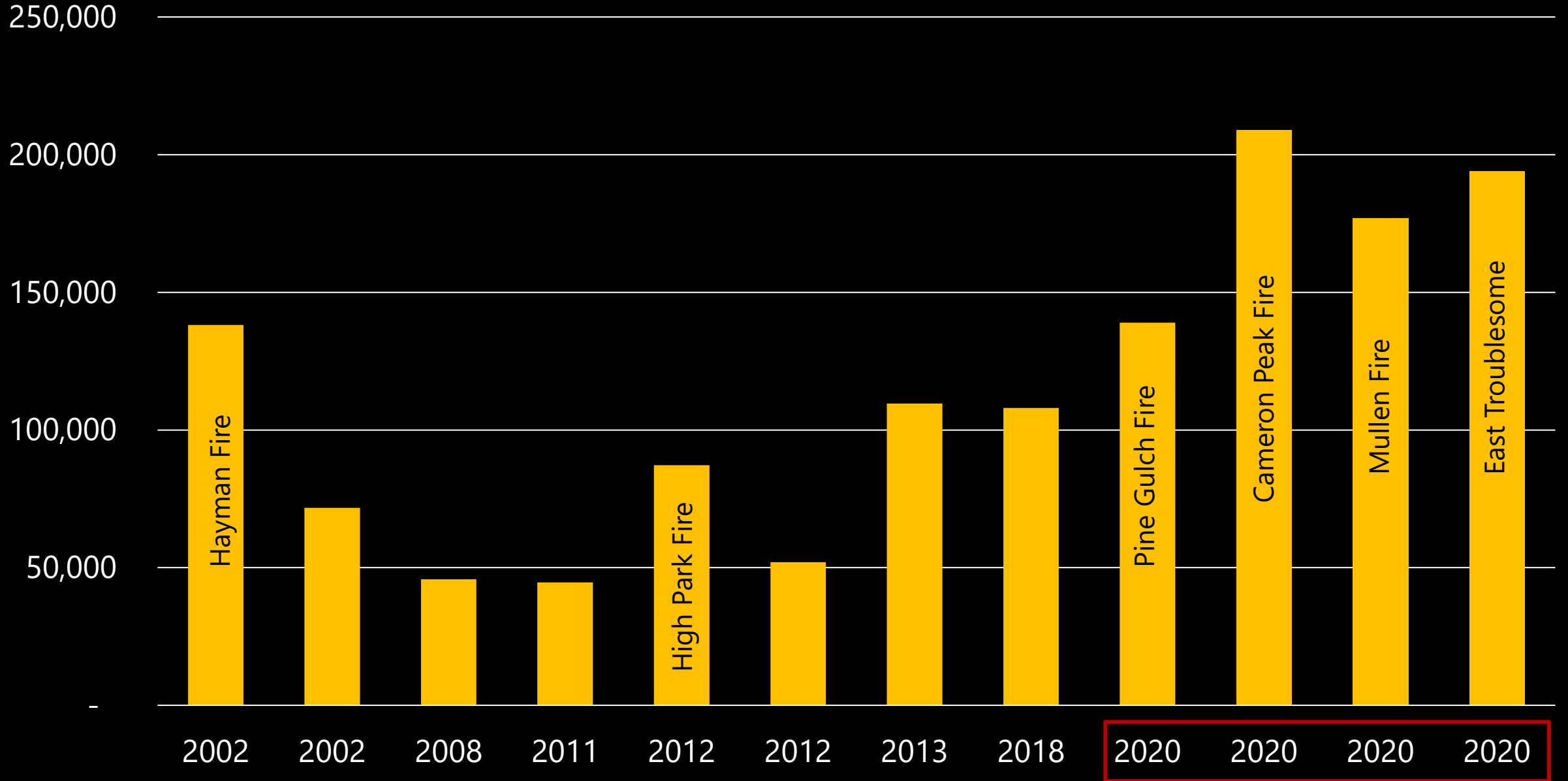
Extensive  
Mountain Pine  
Beetle Kill

## Wildfire Extent in the United States, 1983–2020





# Largest Wildfires in Colorado - Burn Area (acres)



# 2020 Wildfires



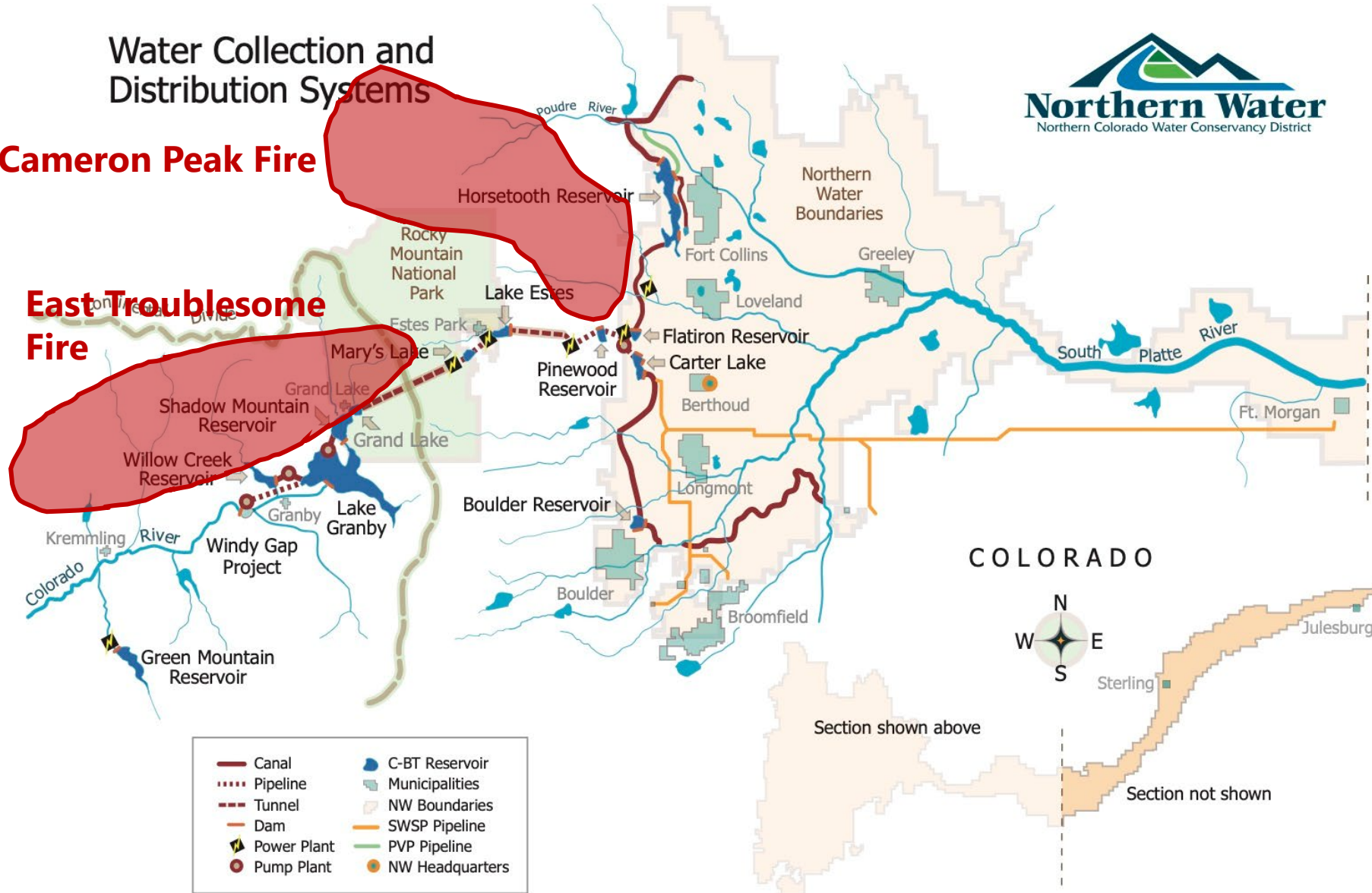


# Water Collection and Distribution Systems



**Cameron Peak Fire**

**East Troublesome Fire**



- |             |                 |
|-------------|-----------------|
| Canal       | C-BT Reservoir  |
| Pipeline    | Municipalities  |
| Tunnel      | NW Boundaries   |
| Dam         | SWSP Pipeline   |
| Power Plant | PVP Pipeline    |
| Pump Plant  | NW Headquarters |

COLORADO



Section shown above

Section not shown

**Kawuneeche Valley  
(East Troublesome Fire)**









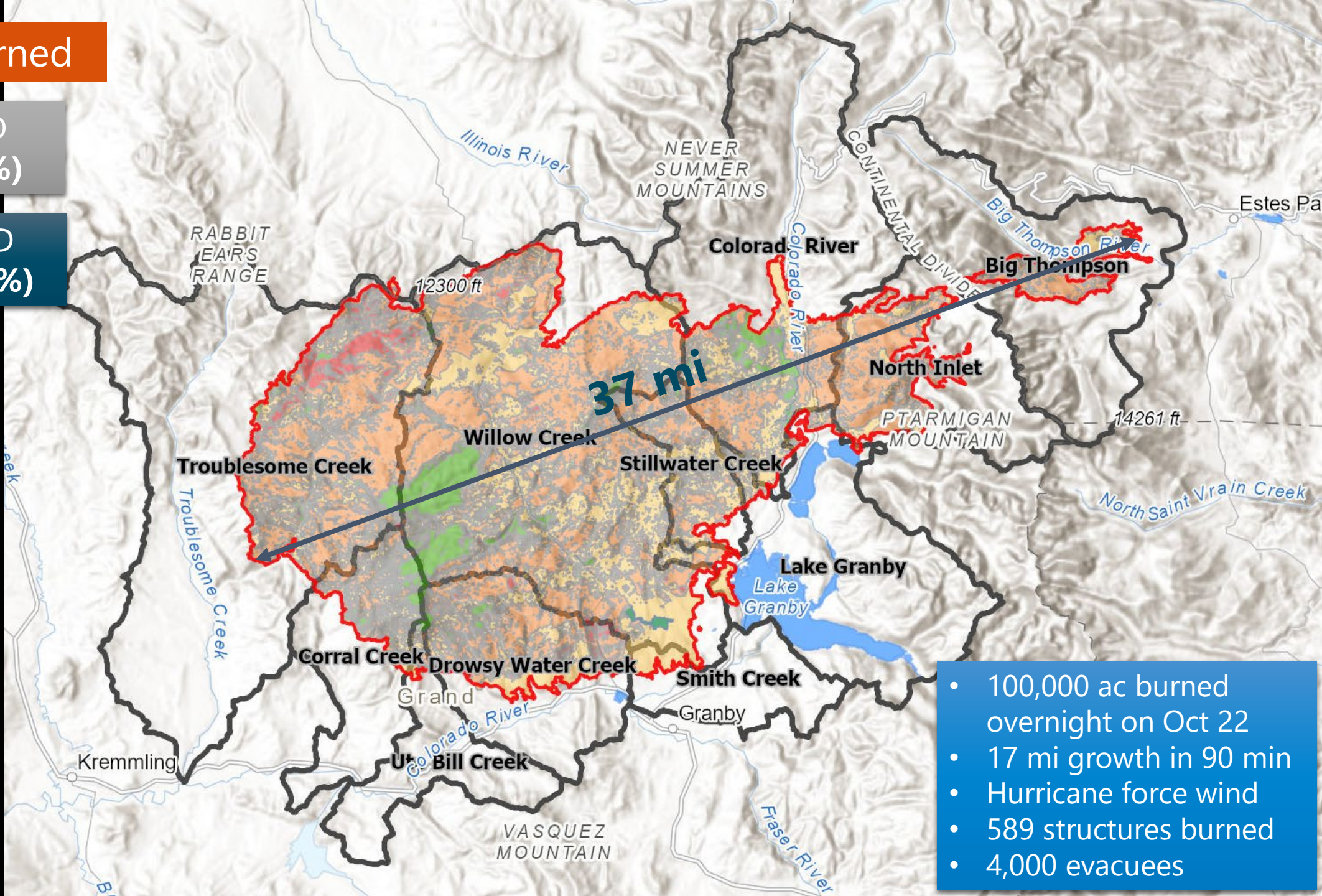
193,559 ac Burned

PRIVATE LAND  
19,757 ac (10%)

FEDERAL LAND  
168,908 ac (90%)

Soil Burn Severity

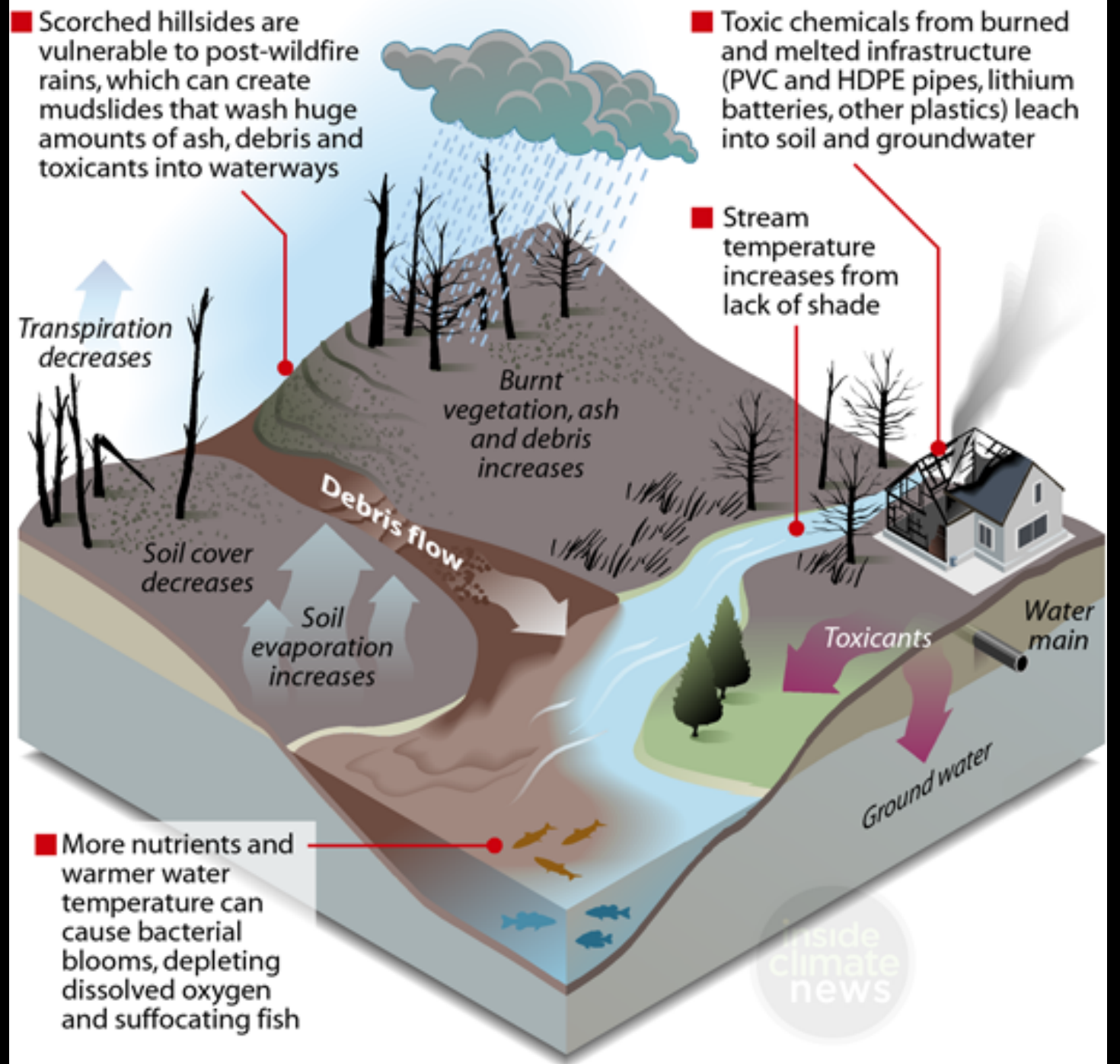
- High
- Moderate
- Low
- Unburned/Very Low
- Burn Area



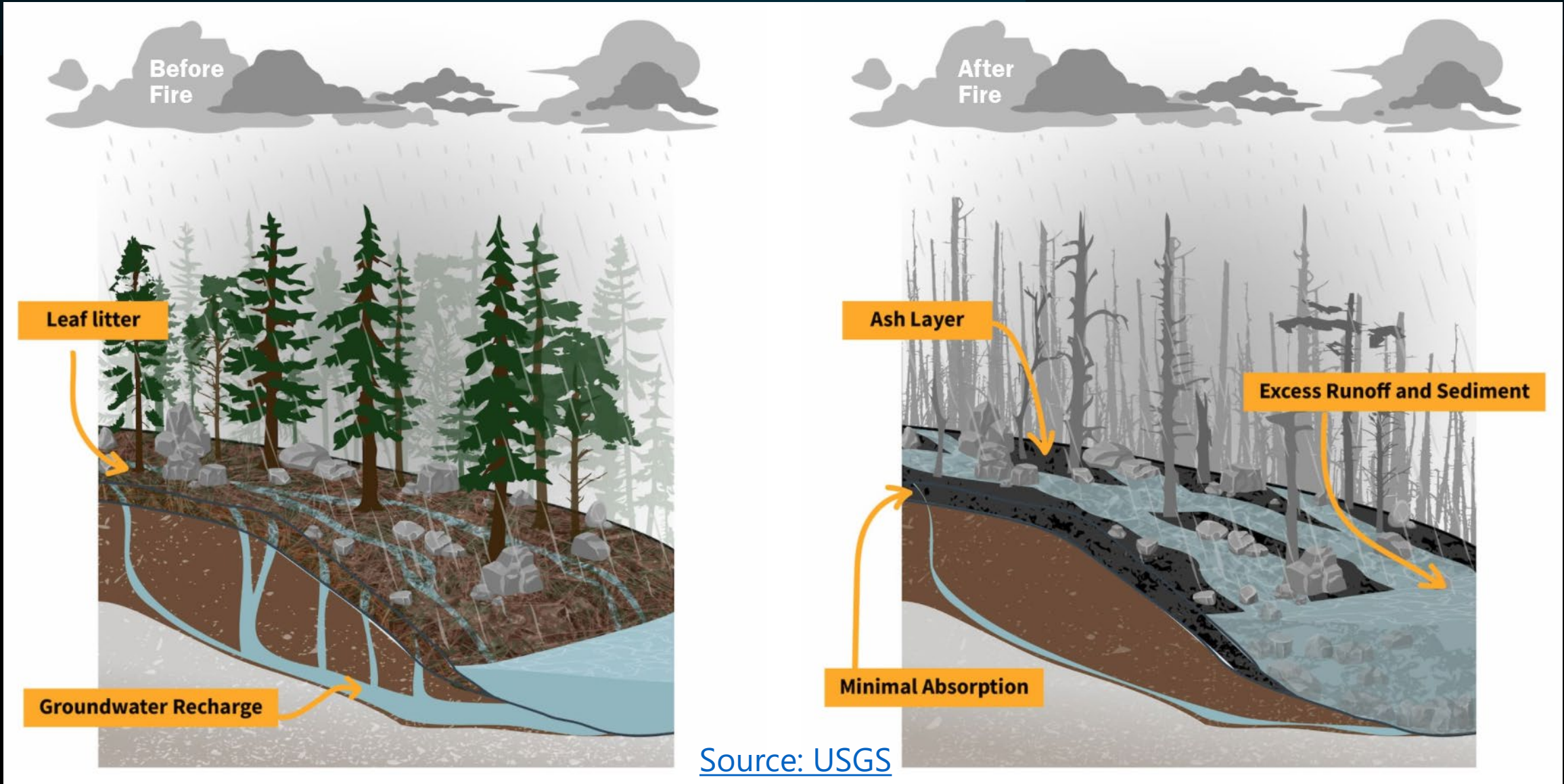
- 100,000 ac burned overnight on Oct 22
- 17 mi growth in 90 min
- Hurricane force wind
- 589 structures burned
- 4,000 evacuees



# Water Quality Impacts



# Flood After Fire



Source: USGS



A photograph showing a road completely blocked by a massive debris flow of dark, jagged rocks and thick, grey mud. The debris is piled high, covering the entire width of the road. In the background, a paved road with yellow double lines curves to the right, leading into a landscape of charred, blackened trees and a hazy, overcast sky. The foreground is dominated by the chaotic and heavy debris field.

# Wildfire Aftermath



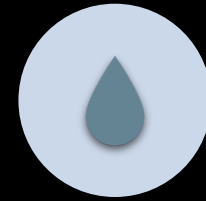
# OBSERVED IMPACTS



Debris flows



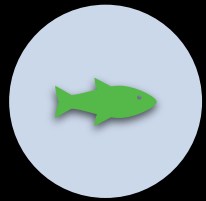
Flooding



Water  
Treatment  
Intakes Shut Off



Loss of storage  
capacity



Harmful algae  
blooms



Property loss



Frequent Road  
Closures

July 20, 2021



North Forty NEWS  
new scene weekly  
Click below to view our current edition.

Black Hollow Flood is Declared a Local Disaster Emergency

August 3, 2021 Annie Lindgren News Comments Off

Photo taken on July 26, 2021, less than a week after Black Hollow Flood in Poudre Canyon. Photo Credit Annie Lindgren

Want our news in your inbox? [CLICK HERE](#)

Coloradoan.

Massive search for last Black Hollow flood victim to take place Saturday in Poudre Canyon

Miles Blumhardt  
Fort Collins Coloradoan

Published 1:34 p.m. MT Sept. 17, 2021 | Updated 7:05 a.m. MT Sept. 18, 2021

BLACK HOLLOW ROAD

Loss of Life and Property





**CR 219 (Drowsy Water by Hwy 40  
West of Hwy 125) August 20, 2022**



*Source: grand County Sheriff*



August 11,  
2023



August 26,  
2022



# Stillwater Creek Road Crossing





Highway 125 Grand County  
(Willow Creek watershed)





# Degraded Water Quality Spring Runoff (2022)



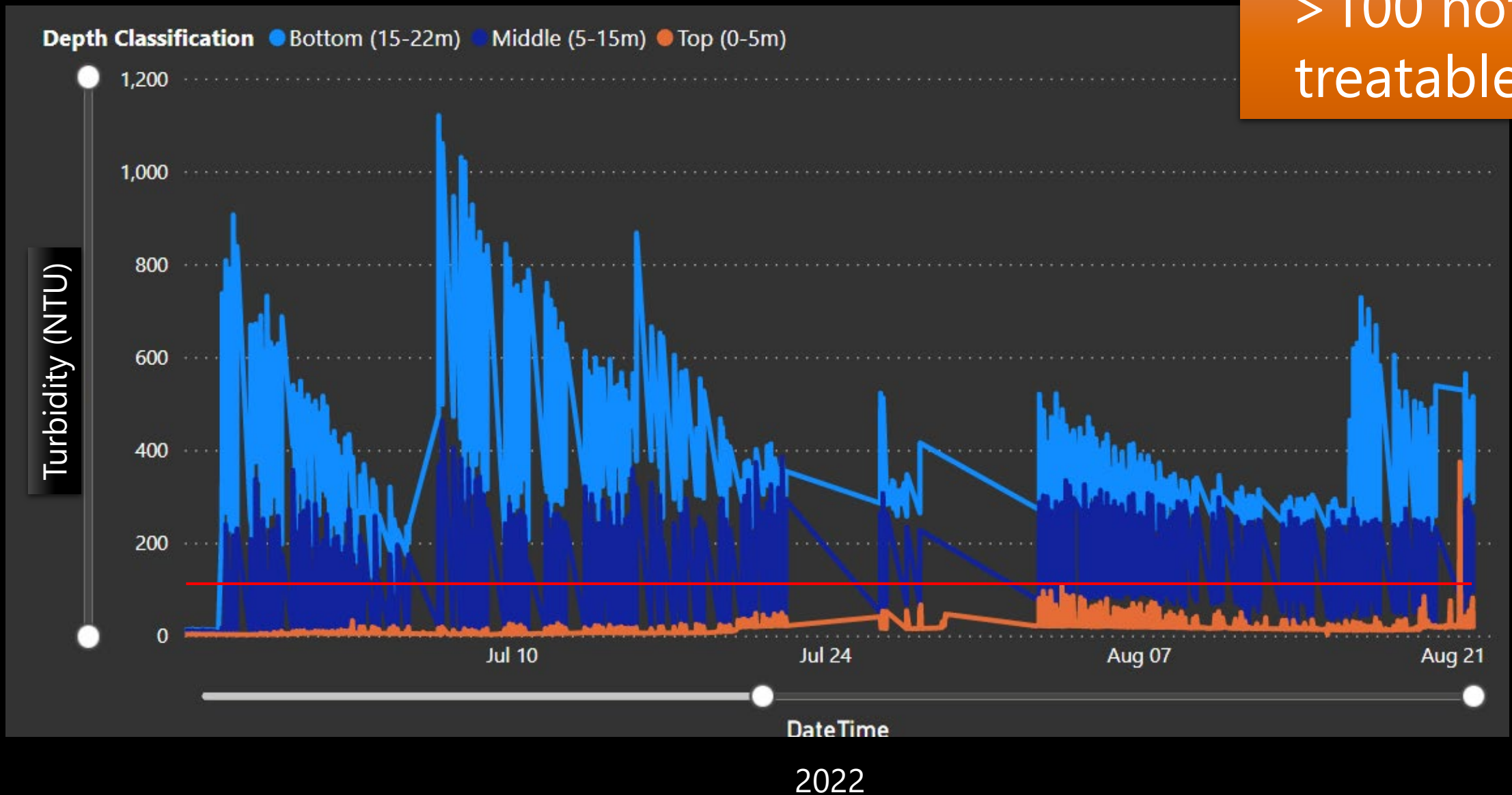
Fraser River

Colorado River



# Willow Creek Reservoir Turbidity (NTU)

> 100 not treatable





# Black water events



North Inlet  
Aug 3, 2021



North Inlet Samples,  
Aug 4, 2021



Aug 4, 2021  
Grand Lake Beach





**Willow Creek Reservoir  
July 27, 2021  
Harmful Algae Bloom**



An aerial photograph of Willow Creek Reservoir. The water is a murky, brownish-grey color, showing significant sedimentation and swirling patterns. A yellow floating barrier is visible along the right edge of the reservoir. The surrounding land is a mix of green vegetation and rocky terrain. A circular white overlay with a black border is positioned in the upper left corner, containing the text "Willow Creek Reservoir August 22, 2022".

**Willow  
Creek  
Reservoir  
August  
22, 2022**



Willow Creek Reservoir  
August 9, 2021







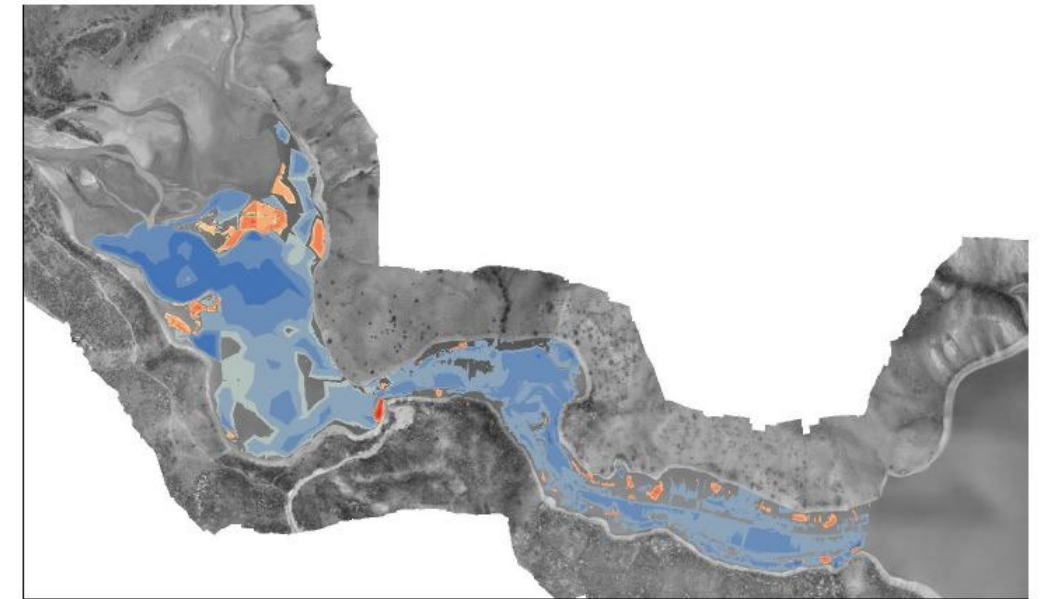
**WILLOW CREEK RESERVOIR DELTA – SEPTEMBER 2022**



# Loss of Storage

Timeframe	Annual Volume Lost (af)
1969 - 2020 Annual Average	14.8
2020 - 2021 Combined Survey	51.1
2021-2022 Survey	50.5

3.45 x baseline (2021)  
1% active storage annually



## Legend

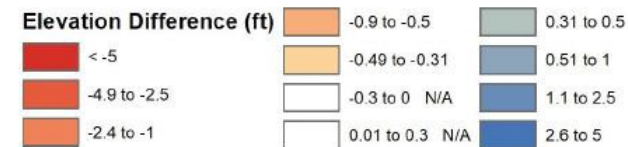


Figure 2: Change detection, or DEM of Difference, of the updated 2021 DEM (with Ice Survey 2022 data) and 2020 bathymetric DEMs calculated with spatially varying uncertainty and 95% confidence level.

Active Storage (as built)  
5,439 af  
Pre-fire (2020)  
4,241 af



A dark, atmospheric landscape with a helicopter in the sky and a large hill in the foreground. The scene is dimly lit, suggesting dusk or dawn, with a deep blue and black color palette. The helicopter is positioned in the upper left quadrant, and the large hill dominates the right side of the frame. The overall mood is somber and mysterious.

# Restoration & Protection



# Watershed Restoration & Infrastructure Protection Projects



**Self-Service Stations**



**Hillslope Stabilization**



**Debris Booms**



# AERIAL MULCHING



12,520 ACRES



980+ SEMI  
LOADS



87 DAYS



\$26.5 MILLION



19,000+  
DROPS





**Preparing  
for the  
Future:  
Strategies**

Landscape scale  
forest health  
management

Social  
infrastructure  
development

Relationship  
Building

Funding and  
Capacity

Preparing for  
scarcity

Water supply  
storage and  
portfolio  
diversification

Getting really good  
at post-fire  
restoration





## Questions & Comments

Esther Vincent, P.E.

970-622-2356

[evincent@northernwater.org](mailto:evincent@northernwater.org)