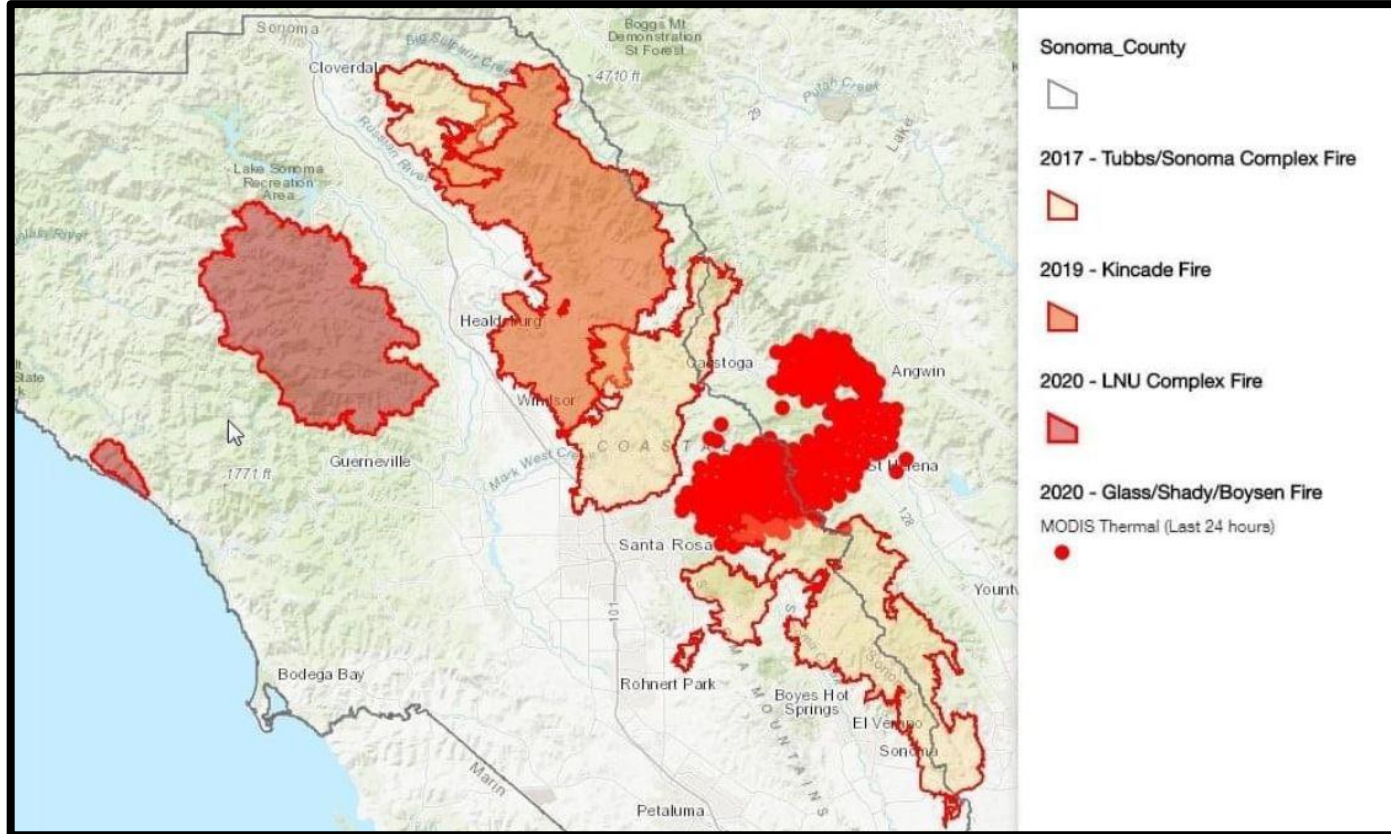




# **Extinguishing Bottlenecks:** Optimizing Fire Evacuation Routes

**Nick Crawford // Drew Horton**

# Motivation

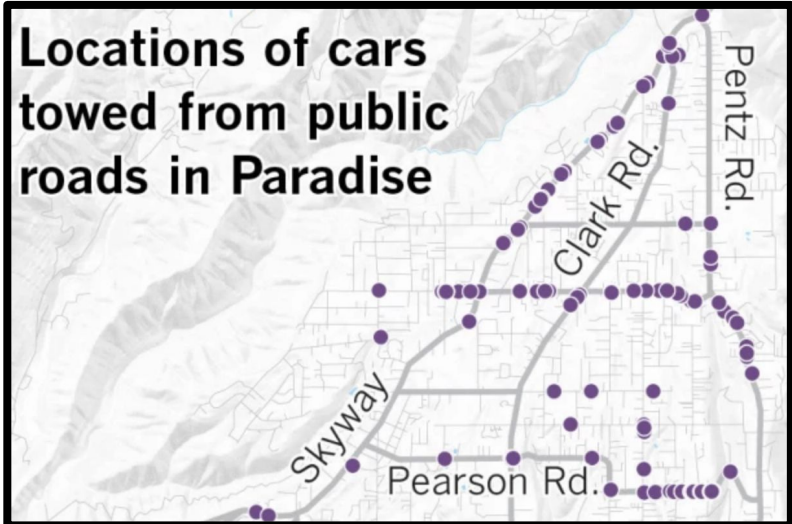


# The Camp Fire

- Paradise, CA
- Caused by downed power lines
- Deadliest Fire in California's History
  - 85 total deaths
  - 7 died in vehicles
- Fire spread 80 football fields a minute (at its peak).
- Only one way out of Paradise (Skyway, 4 lanes)
- Traffic jams caused people to abandon cars and flee by foot



## Locations of cars towed from public roads in Paradise



# Colorado Fires

## Top 3 Fires in Colorado History:

- *Cameron Peak (2020)*: 208,913 acres
- *East Troublesome (2020)*: 193,812 acres
- *Pine Gulch (2020)*: 139,007 acres

20 of 20 largest wildfires have occurred in the last 20 years (since 2001)

16 of the top 20 largest wildfires have occurred in the last 13 years (since 2008)

15 of top 20 largest wildfires have occurred in the last 9 years (since 2012)

11 of top 20 largest wildfires have occurred in the last 5 years (since 2016)

9 of top 20 largest wildfires have occurred in the last 3 years (2018 and 2020)

4 of top 5 largest wildfires have occurred in the last 3 years (2018 and 2020)

## This Year:

- Marshall Fire
- NCAR Fire
- & more

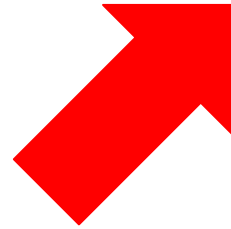
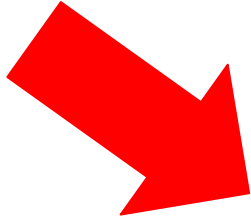


## Methods

**Determine  
Source and  
Sink Nodes**

**Determine  
Bottlenecks**

**Solve  
Maximum Flow  
Problem**

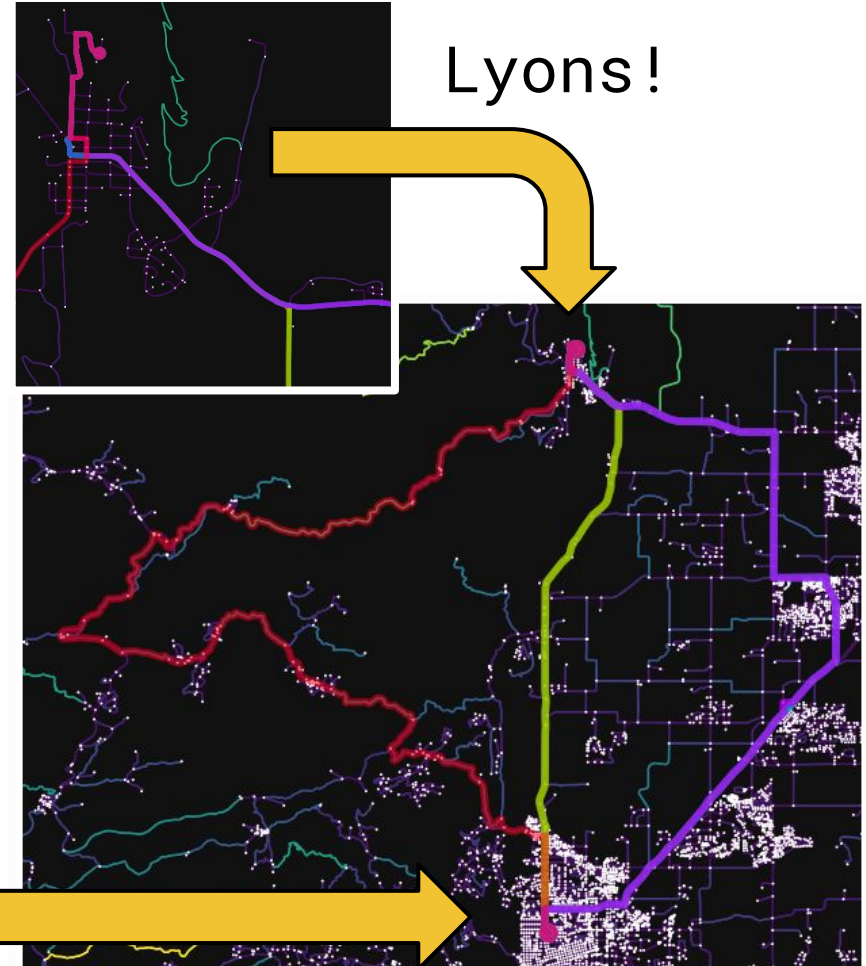




## Lyons, Colorado

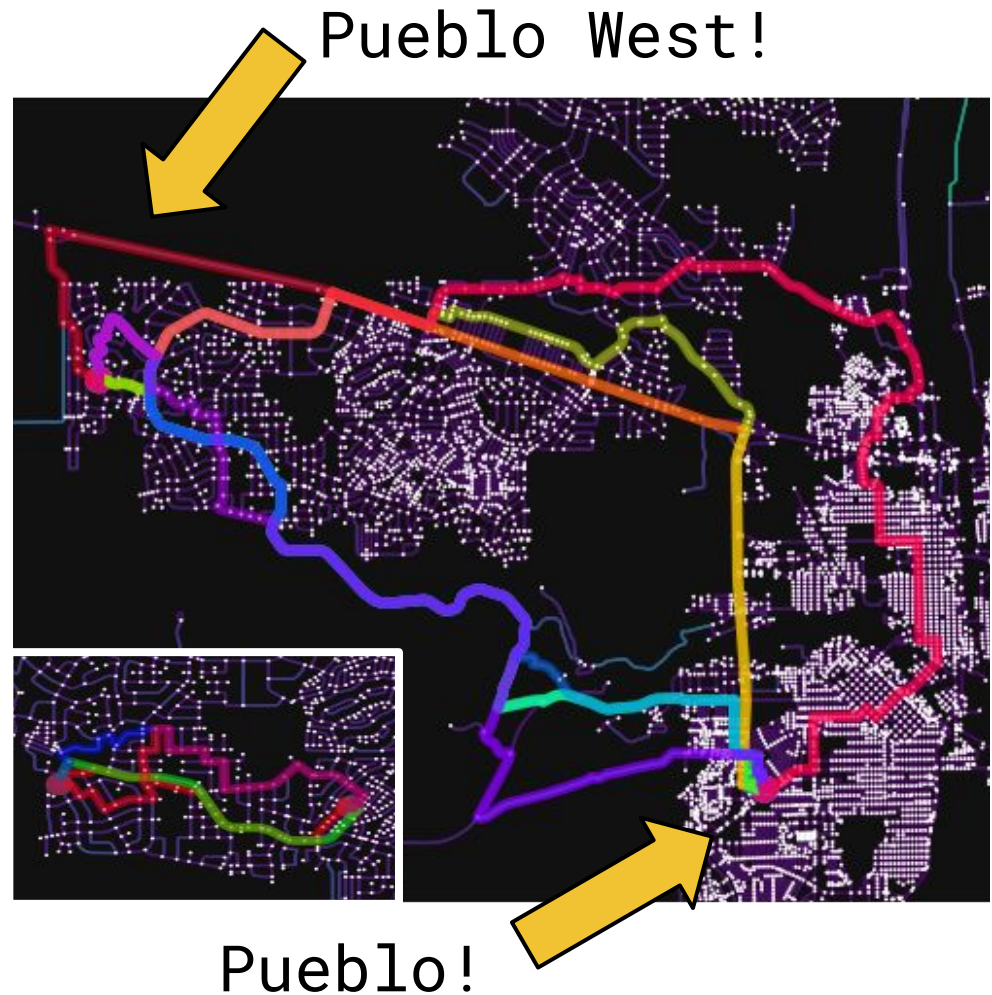
- **Population:** 2,228 (2019)
- **4 total exits**
- 59% of daily traffic uses the main exit route (Streetlight Data)
- **Maximum Flow** from Lyons Colorado to Evacuation Center in Boulder: 1958 vehicles per hour

Boulder!



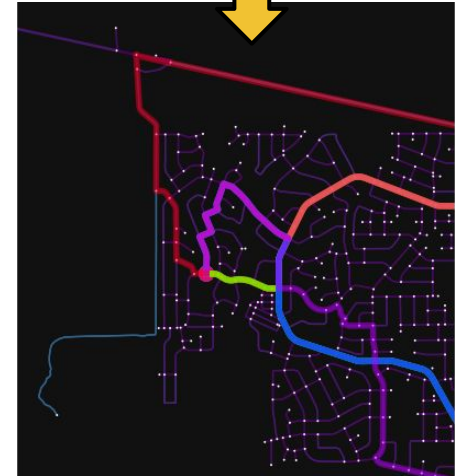
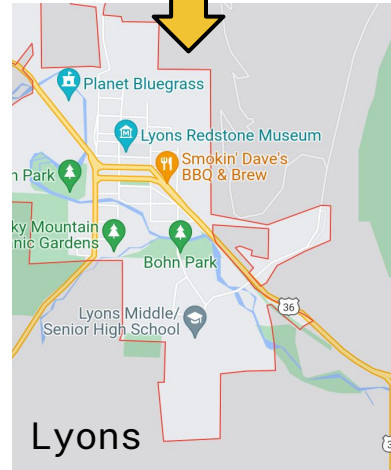
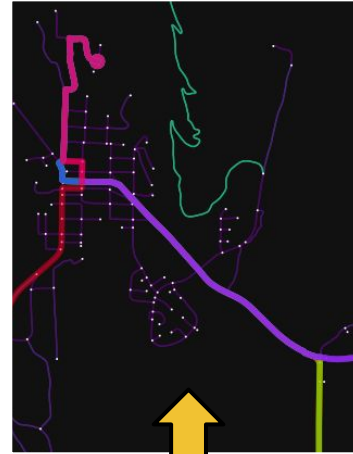
## Pueblo West, CO

- **Population:** 31,849 (2019)
- **12 total exits**
- 51% of daily traffic uses the main exit route (Streetlight Data)
- **Max Flow** from Pueblo West to Evacuation Center in Pueblo: 1841 vehicles per hour



# Policy Recommendations

- Shortest path and maximum flow algorithms can be used to assess current evacuation strategies.
- As populations grow, re-assess whether current road infrastructure is suitable for evacuating residents.
- Consider expanding roads that are 'bottlenecks' in evacuation routes.





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