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# After the Flames: Strategies for Managing Post-Wildfire Flood and Debris Hazard Flows

**Mark Strudley, PhD** | Executive Director - Pajaro Regional Flood Management Agency
**Liz Russell, CFM** | VP of Customer Success - Forerunner

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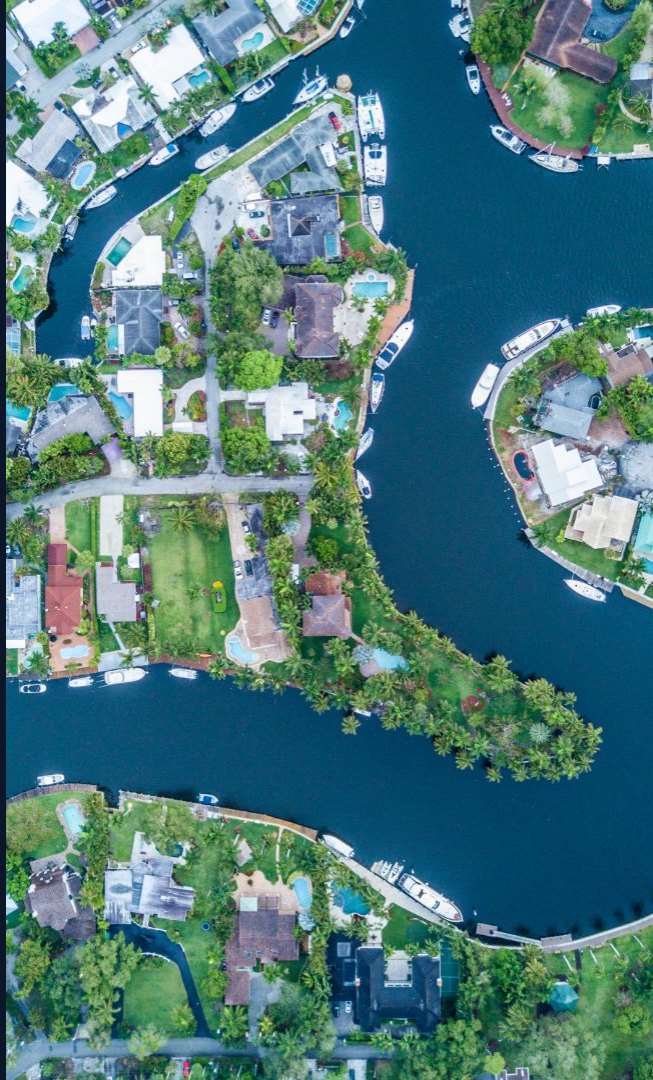
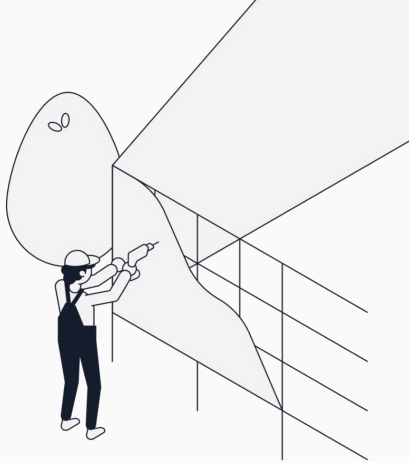


# Housekeeping

- This presentation is being recorded.
- The recording will be shared via email after the webinar.
- If you have a question, please post it in the chat.
- At the end of the webinar, complete the attendance survey to receive your 1 ASFPM CEC and .10 ICC CEU. The certificates will be sent via email to you, ASFPM, and ICC next week.
- Please reach out after the webinar for additional questions.



# Poll

Contents

# We work with over 190 of the most at-risk cities, counties, and states throughout the U.S.


**FDEM**
Florida

**DWR**
California

**MEMA**
Mississippi

**Santa Barbara County**
California


**Concord**
California

**Maui County**
Hawaii

**Palm Beach County**
Florida

**Gila County**
Arizona

**Raleigh**
North Carolina

**Cottage Grove**
Oregon

**Cedar Rapids**
Iowa

**Las Cruces**
New Mexico

**Stockton**
California

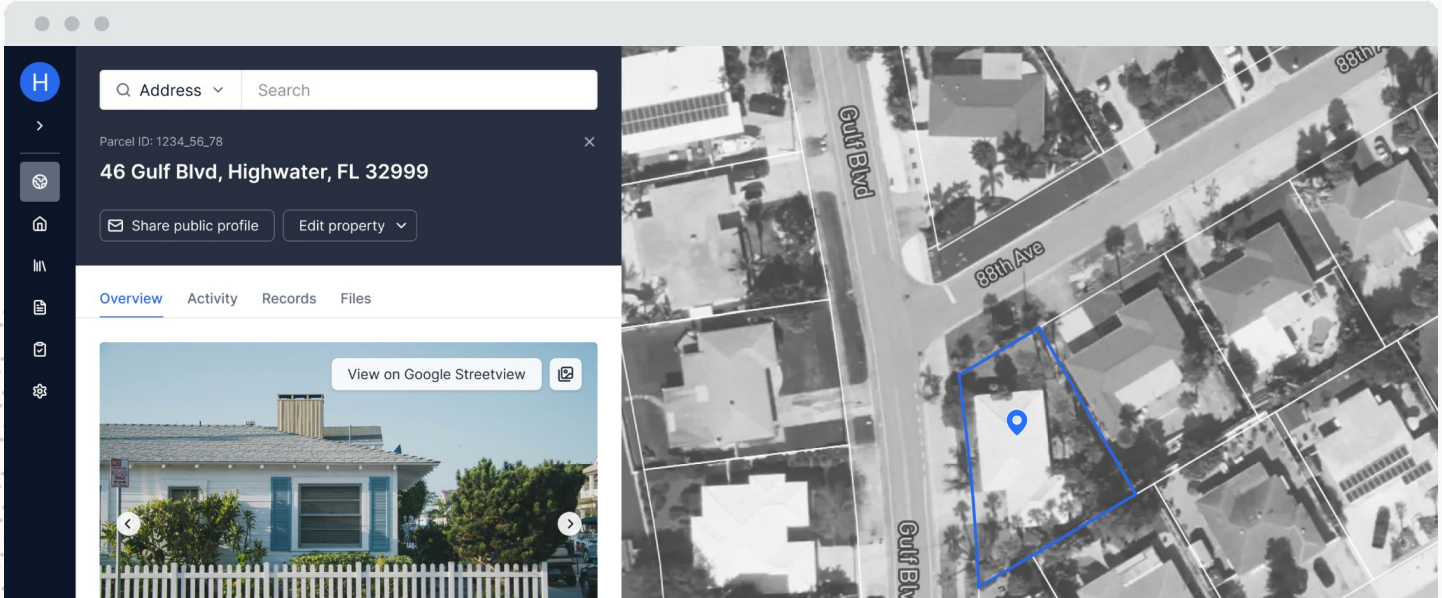
**Lincoln**
Nebraska

**Orting**
Washington

**Tohono O'odham**
Nation

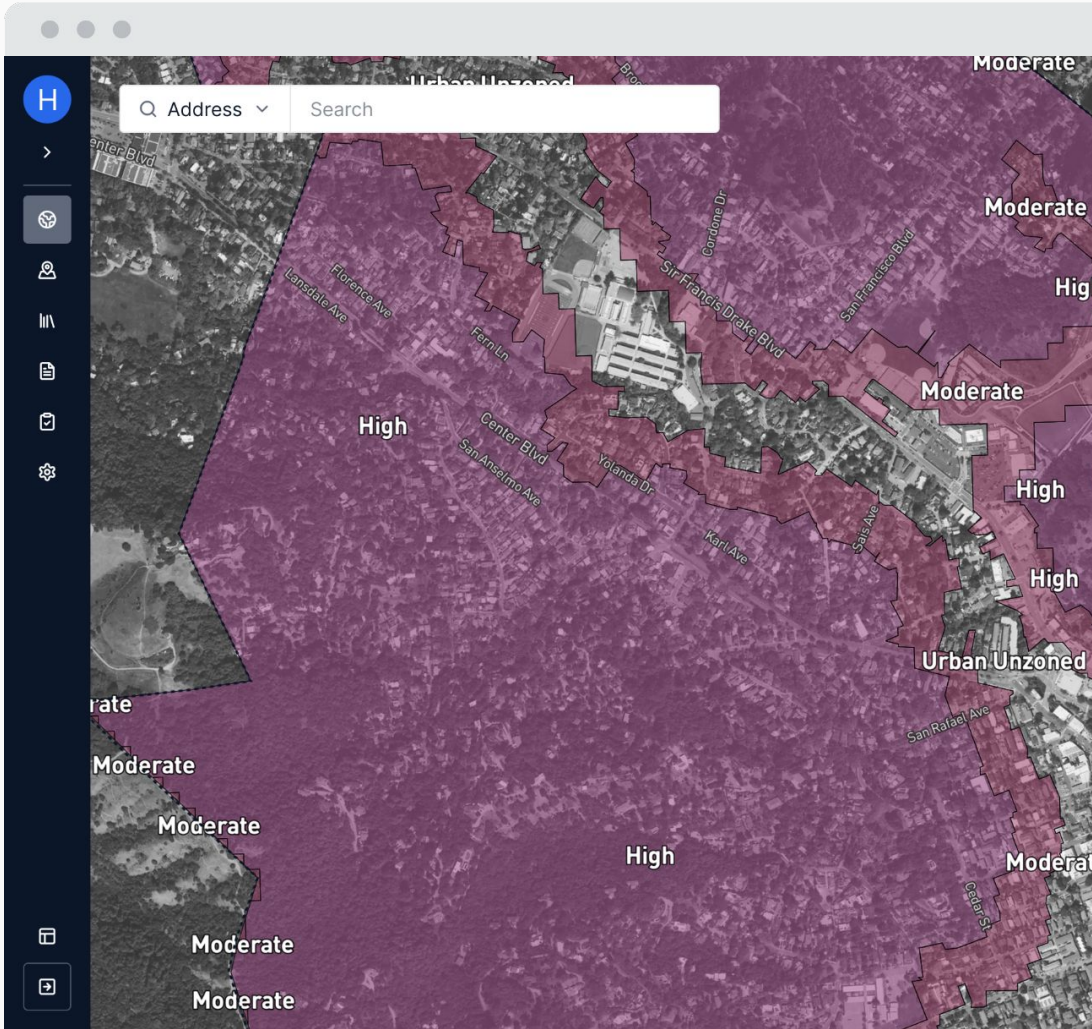
Our solution

# One AI-powered system for stronger, safer communities.



# One AI-powered platform for all your geospatial data.

- FIRMs
- Tsunami and storm surge zones
- WUIs
- Fire Hazard Severity Zones
- State Responsibility Area
- Shake and liquefaction zones
- Landslide zones
- Evacuation routes and zones

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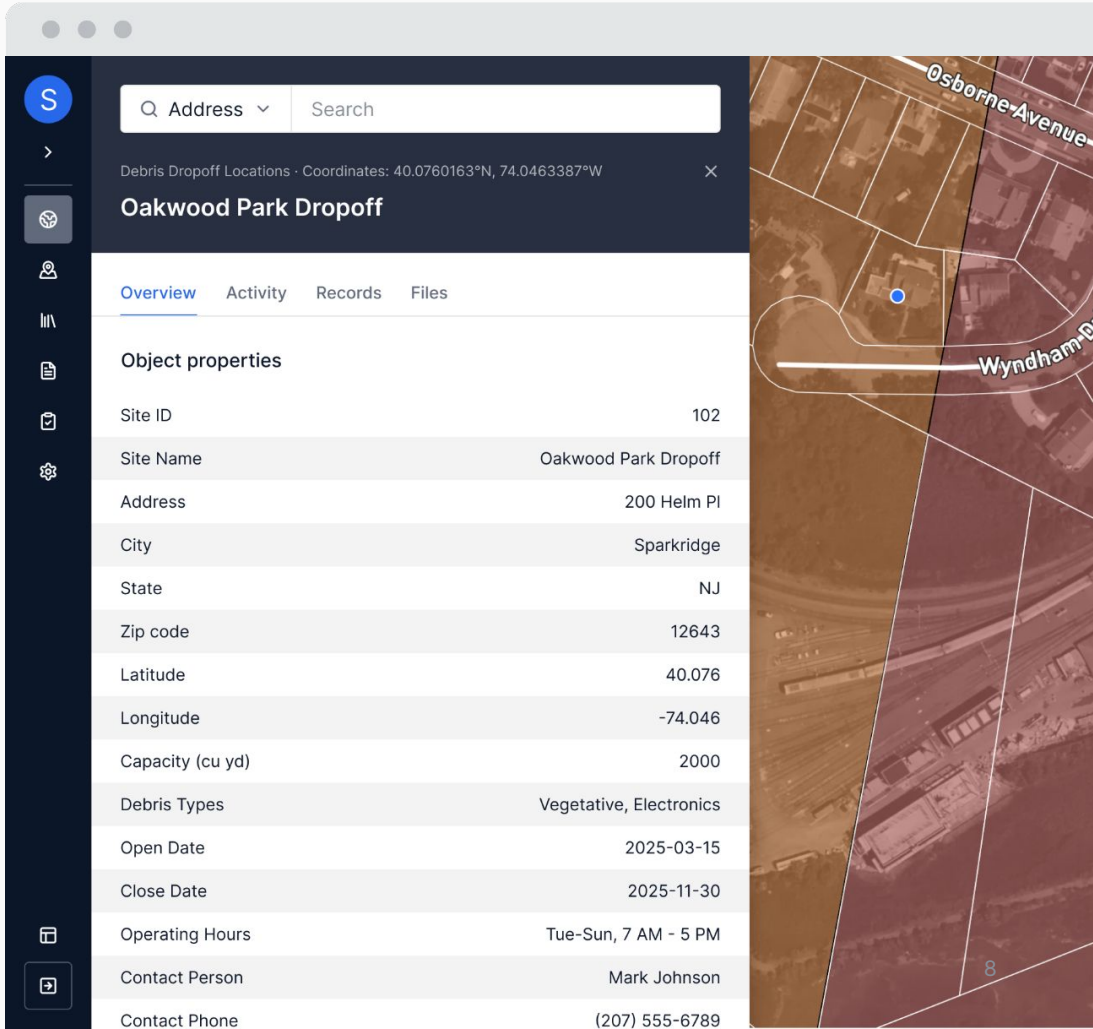
# Coordinate debris removal from location to drop-off.

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## Mark Strudley, PhD

Executive Director

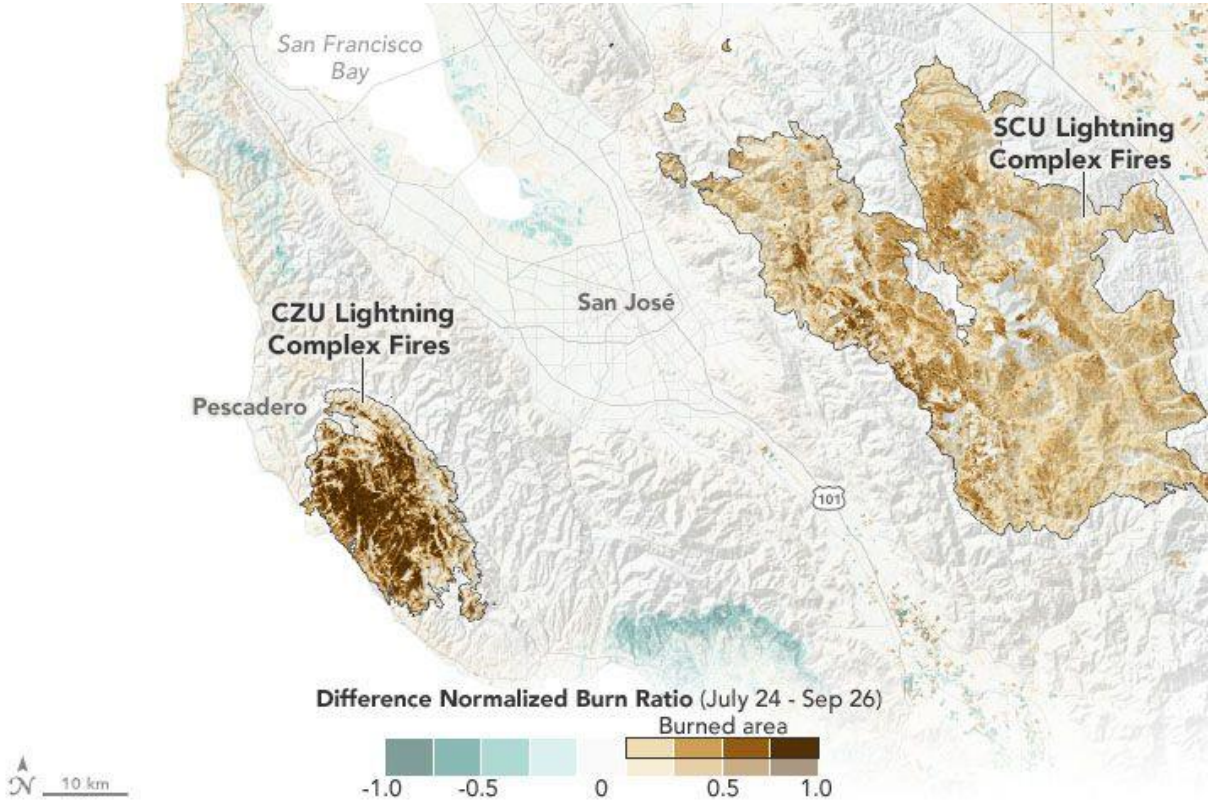
Pajaro Regional Flood Management Agency

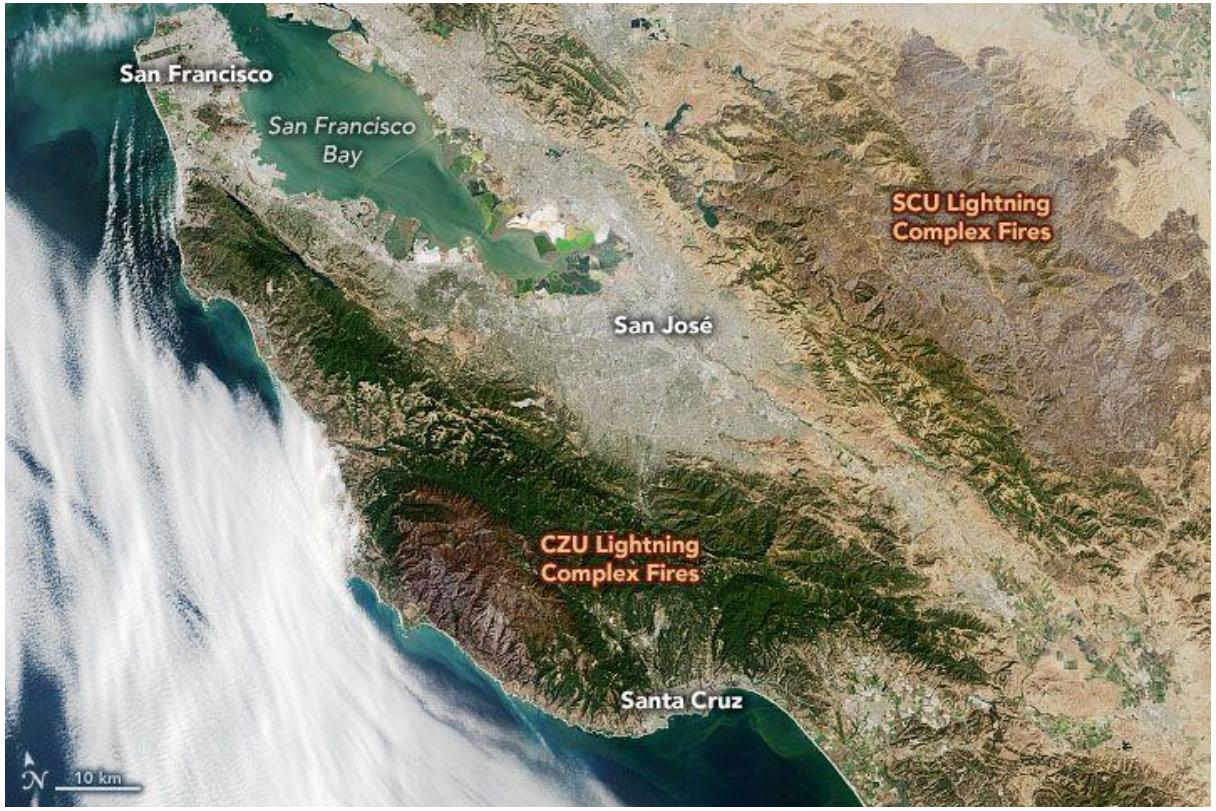
# The Playbook Following the 2020 CZU Lighting Complex Fires

Mark Strudley, Ph.D.
Executive Director, Pajaro Regional Flood Management Agency
Forerunner Webinar 2026

Paul N Babb

# CZU Lightning Complex Fire, August 16, 2020; 86,509 acres

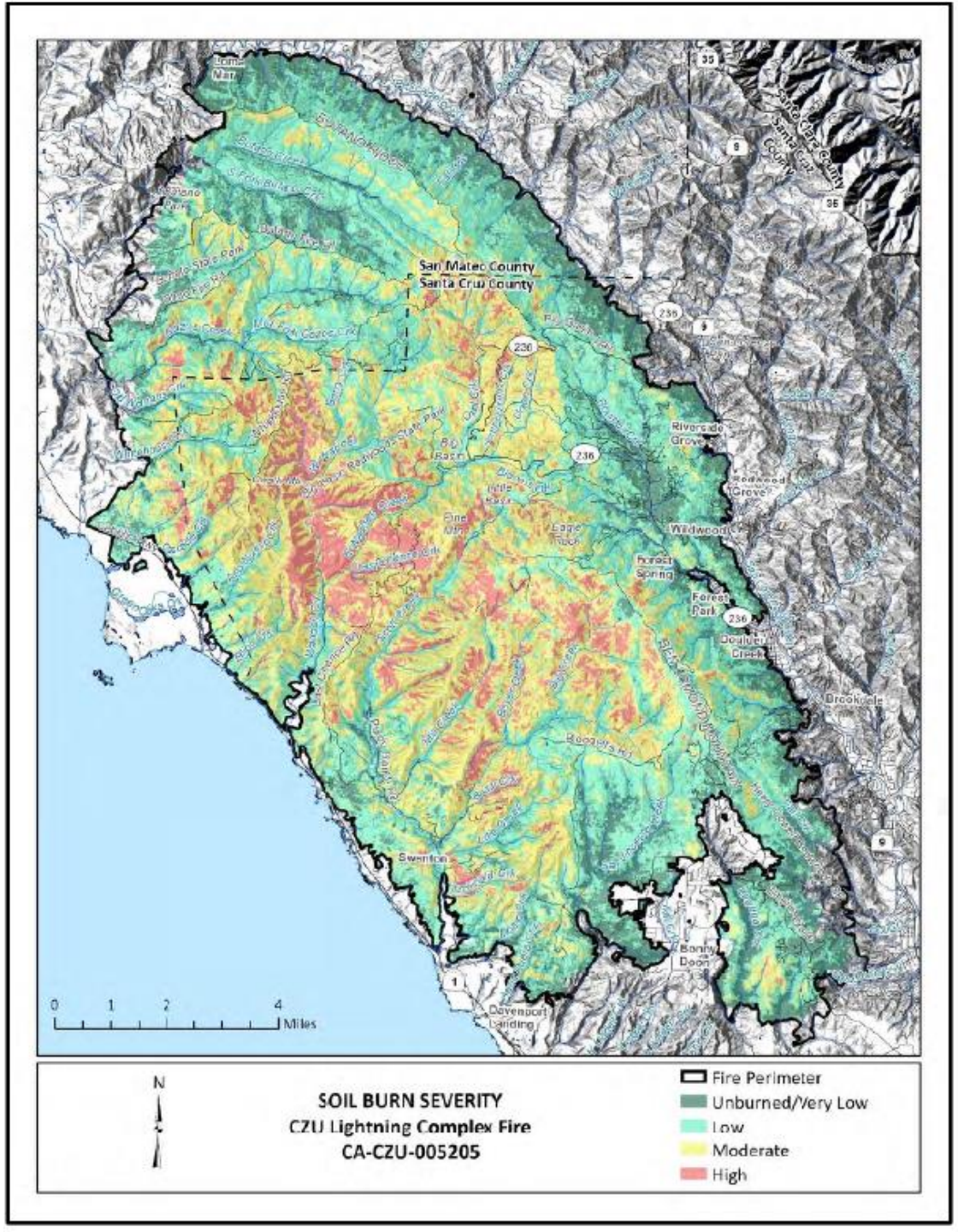


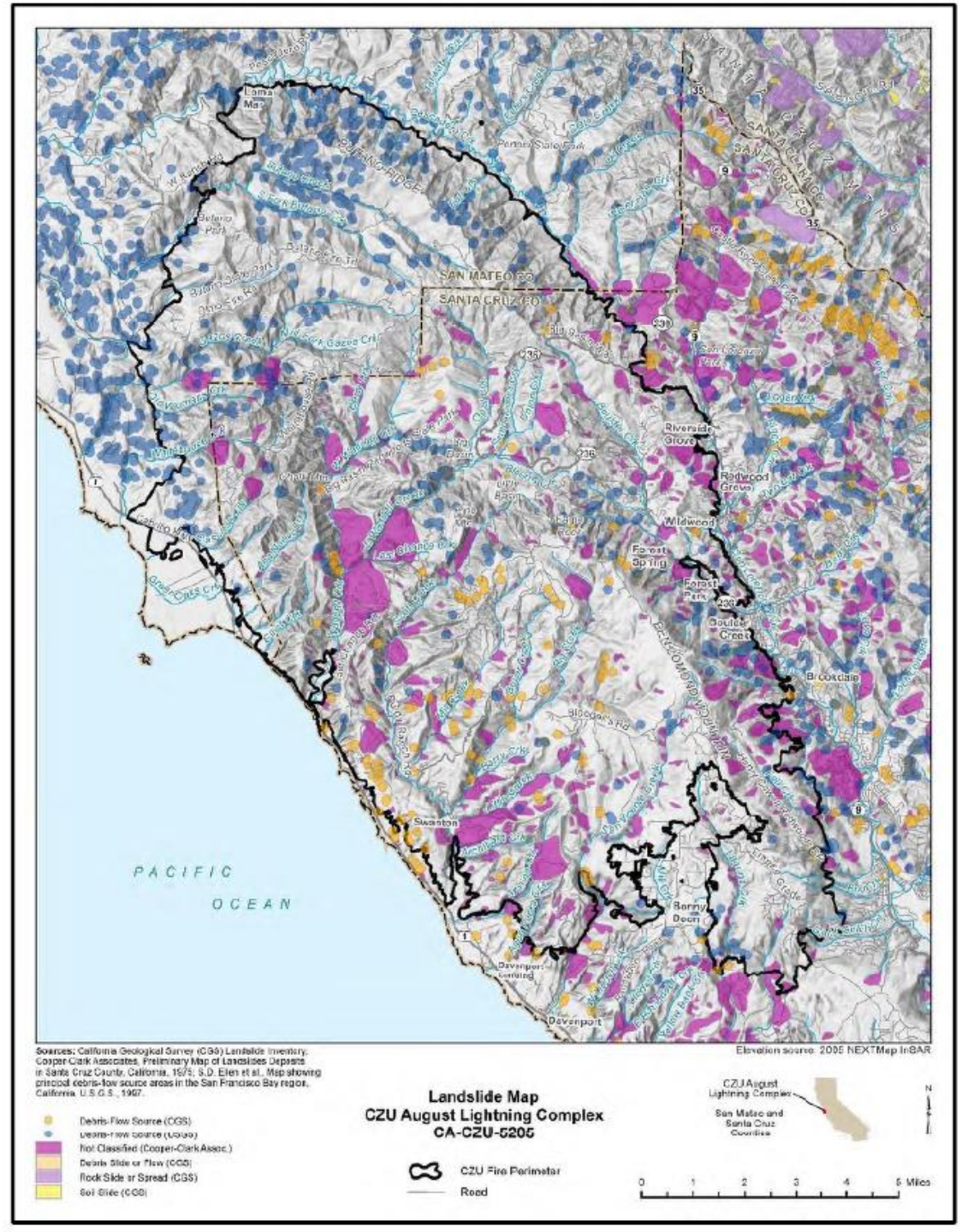



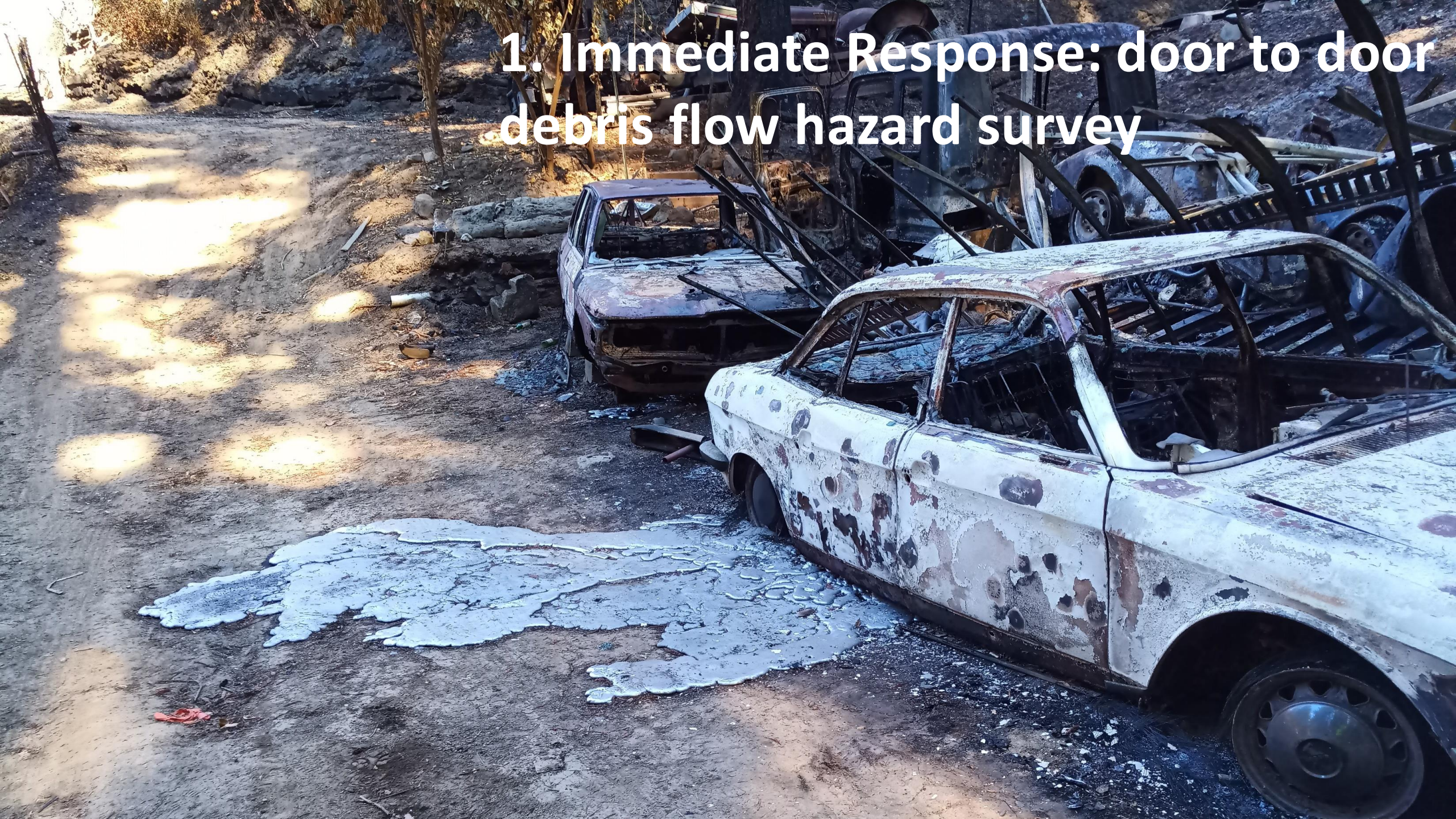

https://www.space.com/california-wildfire-damage-2020.html

# The Considerations for the Playbook:

- Scorched earth vs. dirty burn
- Immediate response: door to door survey of debris flow susceptibility and mapping
- Pre-season response: Debris flow probability and rainfall thresholds (with USGS/CGS), rain gage support, evacuation planning and messaging
- Winter response: Implement ALERT gaging triggers for evac, winter messaging concerns
- Mid-term to long-term: USACE FPMS Study on Debris Flow bulking and blockage, additional CGS and USGS verification studies
- Very long-term: A lot of “X’s” (X-band Radar, X-Prize Wildfire, and Insurance)

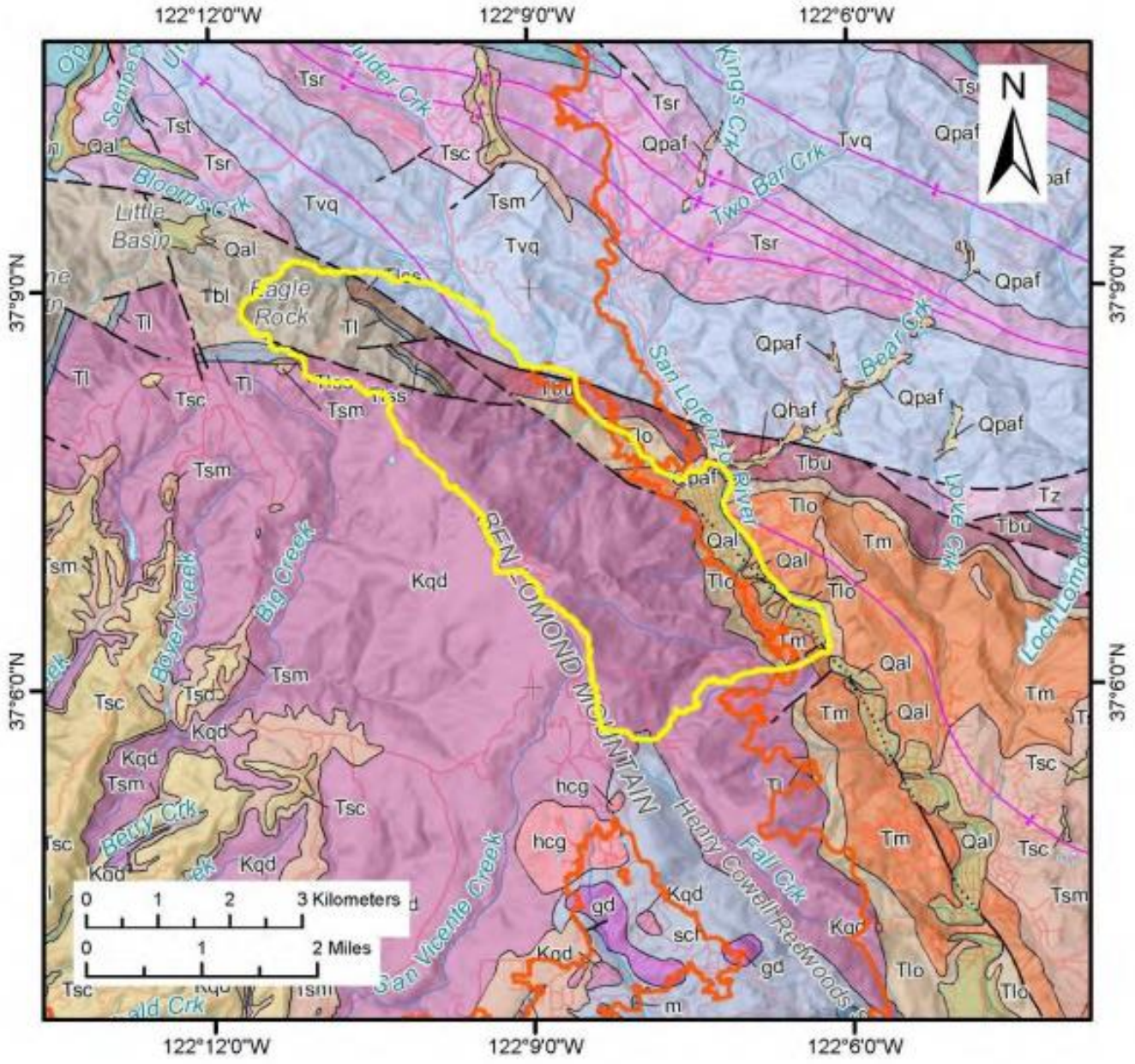

San Mateo County
Santa Cruz County
Riverside Grove
Redwood Grove
Wildwood
Forest Spring
Forest Park
Brookdale
Swanton
Davenport Landing
Bonny Doon
0 1 2 4 Miles
N
SOIL BURN SEVERITY
CZU Lightning Complex Fire
CA-CZU-005205
Fire Perimeter
Unburned/Very Low
Low
Moderate
High


SAN MATEO CO
SANTA CRUZ CO
Riverside Grove
Redwood Grove
Wildwood
Forest Spring
Forest Park
Brookdale
Swanton
Davenport Landing
Bonny Doon
PACIFIC
OCEAN
Sources: California Geological Survey (CGS) Landslide Inventory; Cooper-Clark Associates, Preliminary Map of Landslides Deposits in Santa Cruz County, California, 1975; S.D. Ellen et al., Map showing principal debris-flow source areas in the San Francisco Bay region, California. U.S.G.S., 1997.
Debris-Flow Source (CGS)
Debris-Flow Source (Cooper-Clark Assoc.)
Not Classified (Cooper-Clark Assoc.)
Debris Slide or Flow (CGS)
Rock Slide or Spread (CGS)
Soil Slide (CGS)
Elevation source: 2005 NEXTMap InBAR
Landslide Map
CZU August Lightning Complex
CA-CZU-5205
CZU Fire Perimeter
Road
CZU August Lightning Complex
San Mateo and Santa Cruz Counties
N
0 1 2 3 4 5 Miles



# 1. Immediate Response: door to door debris flow hazard survey

# A note on local geology's effect on style of mass wasting




**Holocene**

Qal — Alluvium: unconsolidated gravel, sand, silt, clay

**Pleistocene**

Qpaf — Alluvial fan and fluvial deposits

**Map Symbols**

Contact – Solid where accurately located; long dash where approximately located; short dash where inferred

Fault – Solid where accurately located; long dash where approximately located; short dash where inferred; dotted where concealed; queried where uncertain

Anticline – Dashed where approximately located

Syncline – Dashed where approximately located; dotted where concealed

**Miocene**

Tm — Basin deposits

Tlo — Alluvial fan and fluvial deposits

**Miocene**

Tvq — Sand dune and beach deposits

**Oligocene and Eocene**

Tbl — Lower conglomerate and sandstone member

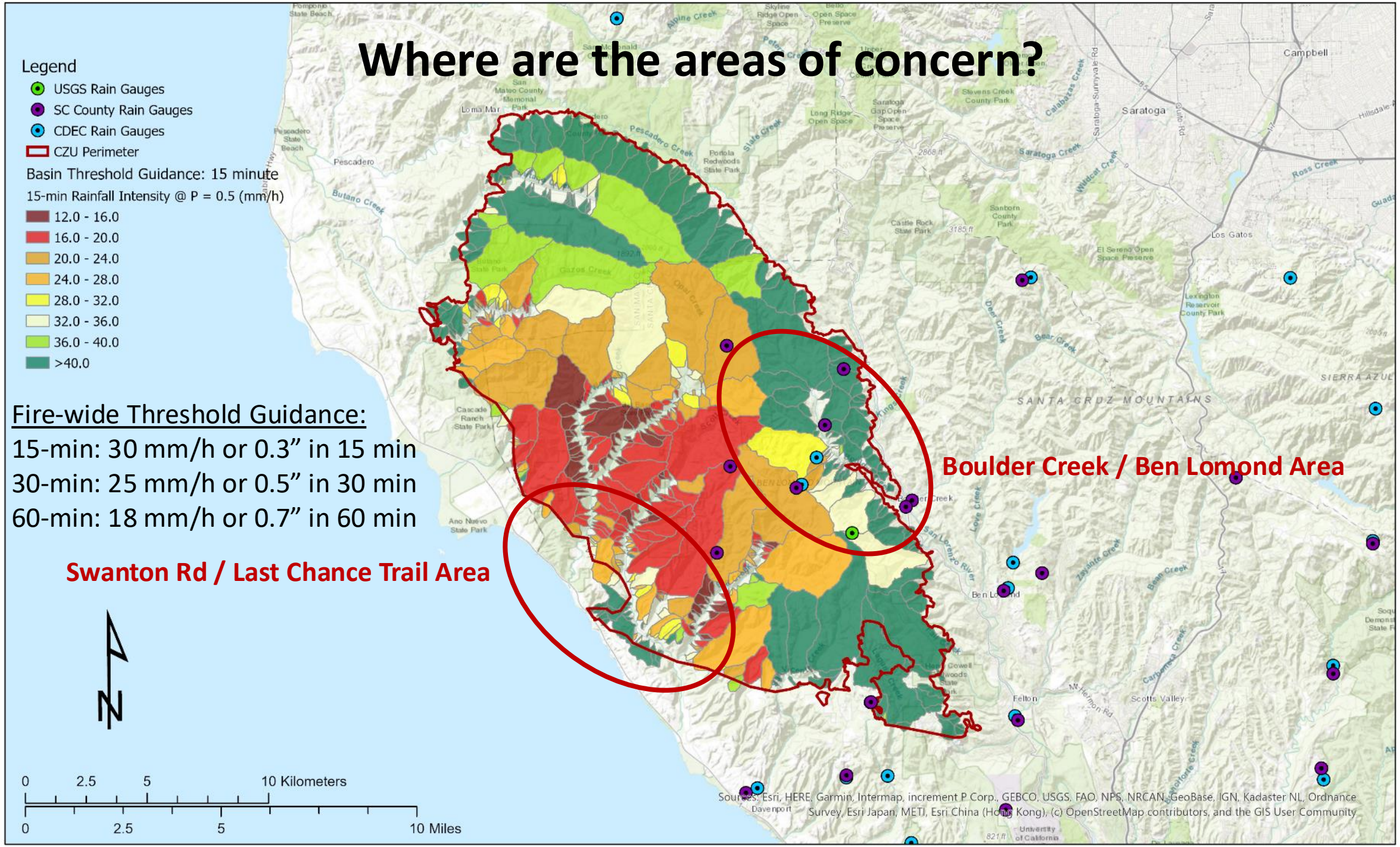
**Paleozoic and Mesozoic**

Tl — Locatelli Formation: micaceous siltstone

Tlss — Sandstone: medium-grained arkosic sandstone

Kqd — Granitic rocks of Ben Lomond Mountain

# Where are the areas of concern?




## Fire-wide Threshold Guidance:

15-min: 30 mm/h or 0.3” in 15 min

30-min: 25 mm/h or 0.5” in 30 min

60-min: 18 mm/h or 0.7” in 60 min

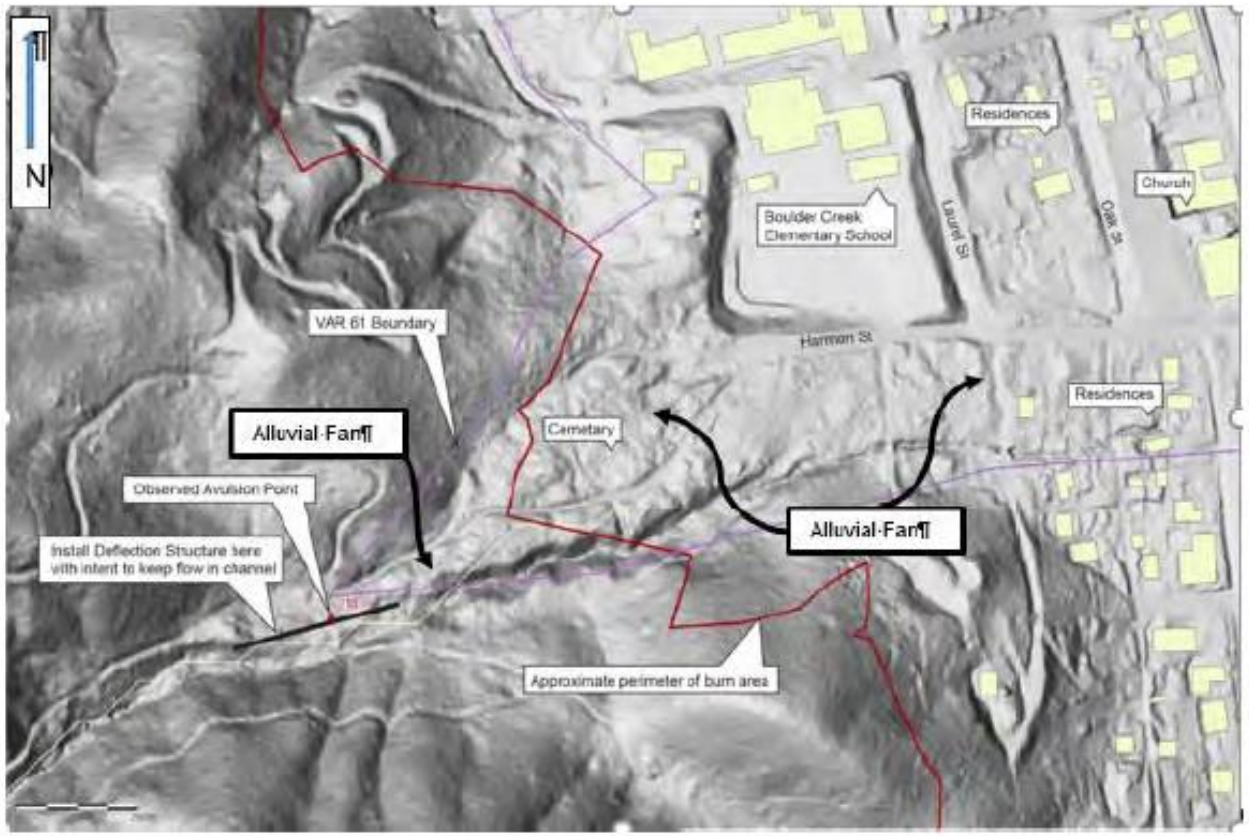



**Figure 17.** Site map of Boulder Creek (VAR 61) showing the potential location of a properly designed deflection structure to reduce the chance of avulsion from the current channel on an unnamed tributary southwest of the town. The red triangle denotes the location of the observed avulsion point.

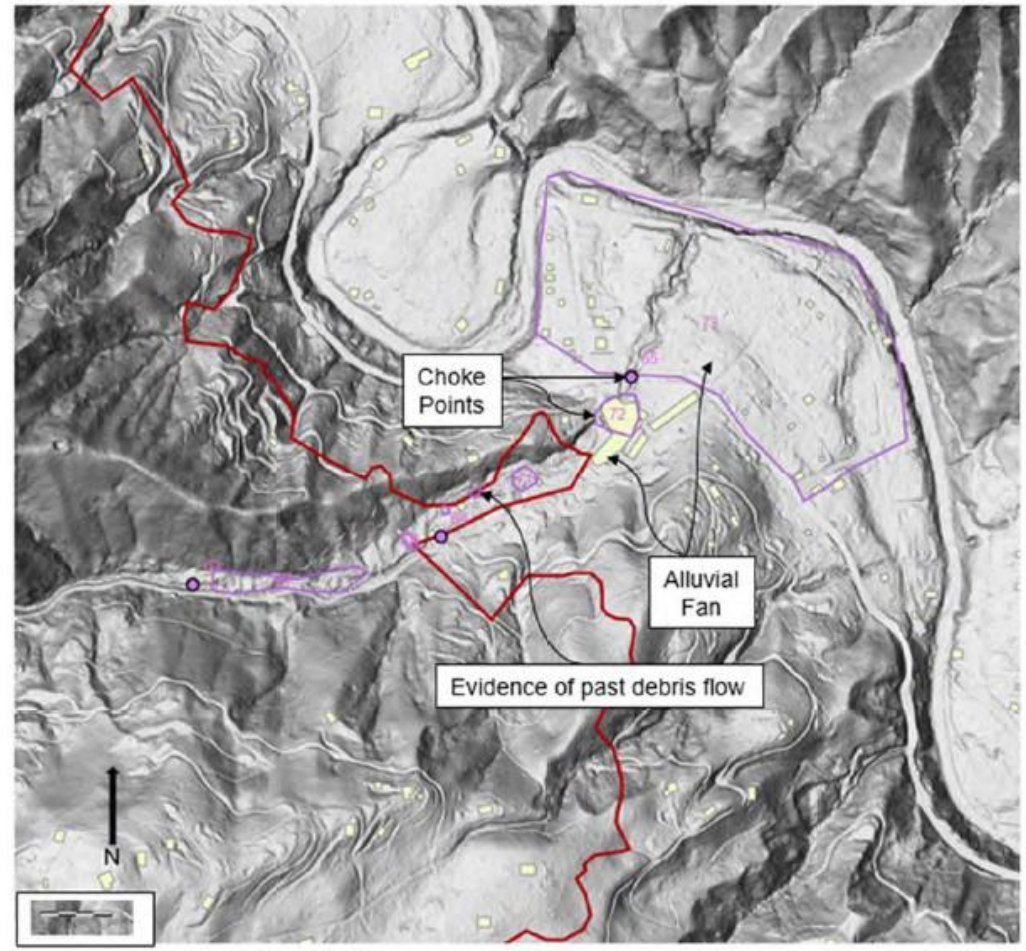
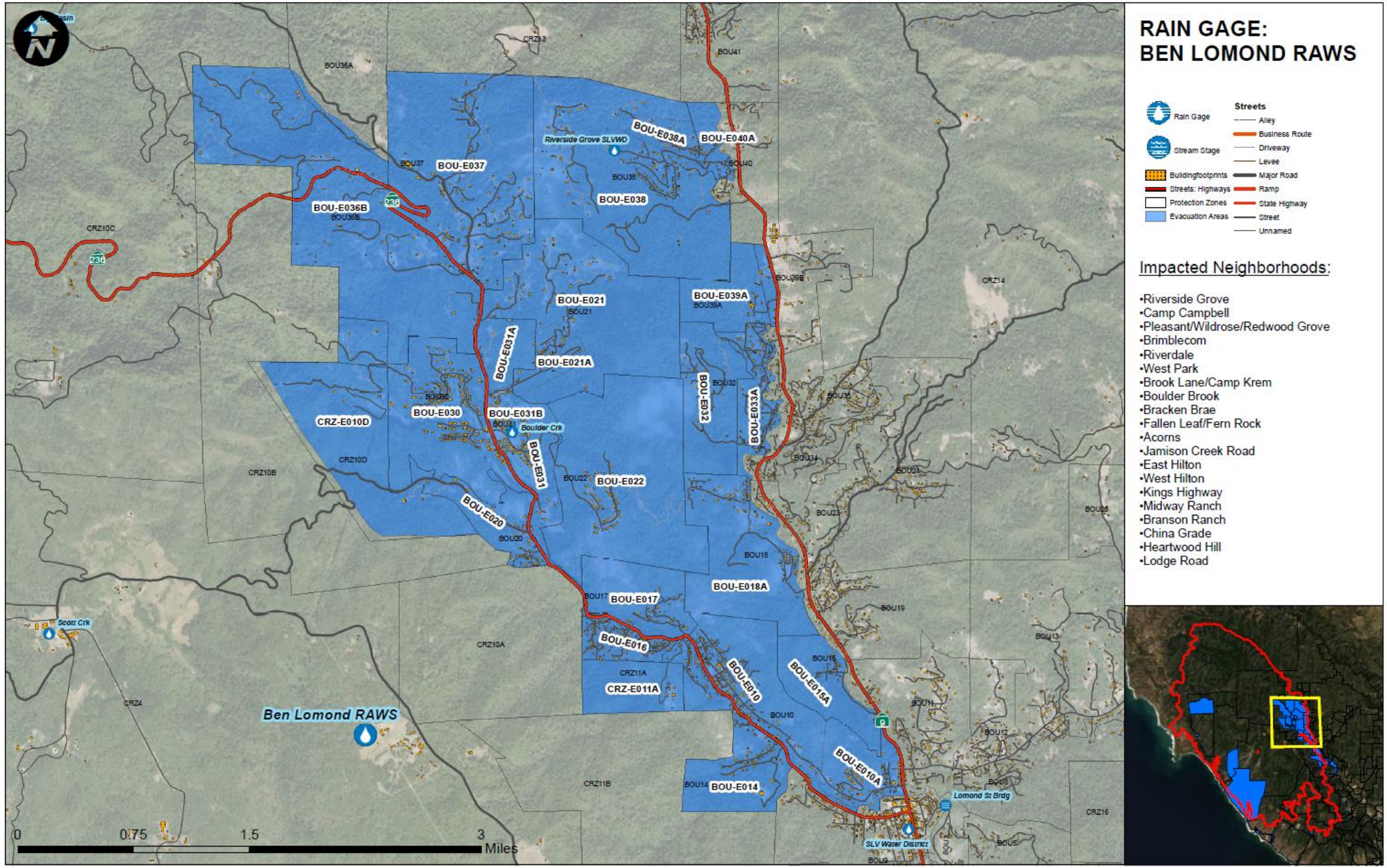
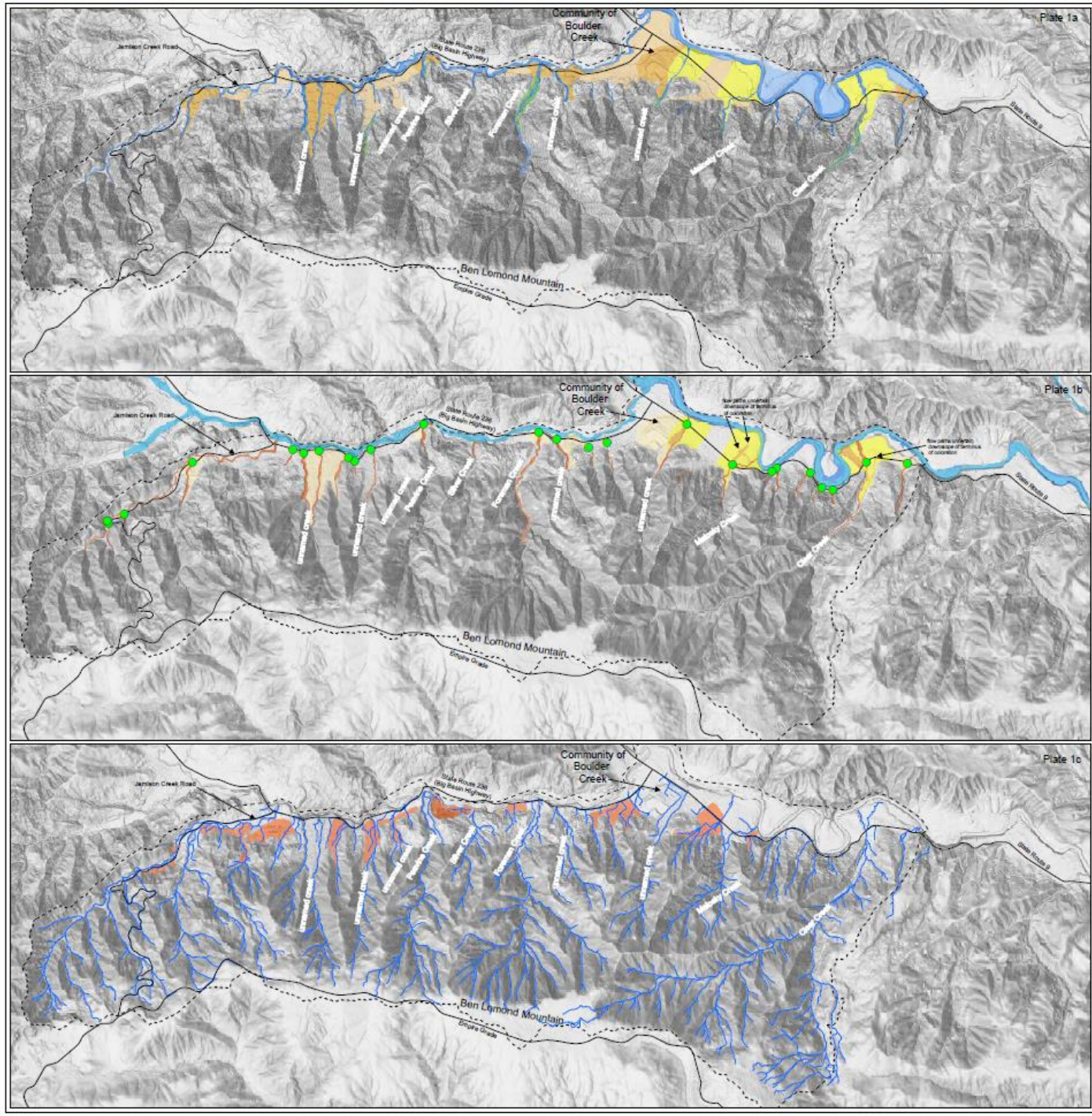




**Figure 18.** Site map of Clear Creek and Brookdale (VARs 65 – 73) showing potential locations of choke points (potential avulsion points) and alluvial fans. Past debris flow deposits were observed in the channel.




Santa Cruz County Department of Public Works - 1/13/2021




# Plate 1: Geomorphic and Potential Inundation Hazard Maps

Maps completed under Cal OES Mission Task 2020–SOC–42611 by the California Geological Survey. Map frame 1a depicts interpretation of geomorphic surfaces of landforms in the project area. Map frame 1b depicts potential hazard areas on channelized alluvial fans due to post-wildfire runoff based on geomorphic mapping and field observations of potential choke points, and given a 1-year return interval storm. The active fan areas in map frame 1b depict areas that may be inundated during extreme storm rainfall. Map frame 1c depicts areas underlain by coalescing debris flow deposits resulting from landslides on nearby hillslopes, swales and ravines. Mapping effort utilized 0.6-meter resolution lider collected in 2020 (bare earth model). Potential inundation hazards evaluated in the field, with some downstream flow paths uncertain downslope of terminus of colorization.

## Geomorphic Surface Map Legend (1a):

- Qac: Active channel areas, mapped up to and including risers
- Qtr: Terraces deposited along axial river
- Qtf: Terraces deposited along channels within alluvial fan and along upland channel
- Qfa: Active fan surfaces below hydrologic apex that have likely been Holocene active
- Qf: Undifferentiated alluvial and debris fan surfaces in low-sloping areas (below ~30%)
- Qfi: Inactive fan surfaces with latest deposition likely pre-Holocene
- Study Area
- 20 meter contours

## Runoff Inundation Hazard Map Legend (1b):

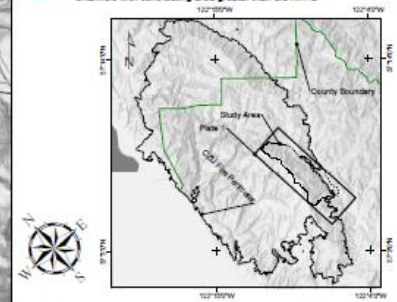
- High Energy: Regions likely to be occupied by high energy flows (concentrated channel flow)
- Moderate Energy: Regions likely to be occupied by moderate energy flows (overbank and thinner flows)
- Active Fan: Areas of alluvial fan with possible inundation after significant avulsion events at or above hydrologic apex of fan
- Inactive Fan: Areas of alluvial fan unlikely to be inundated unless dramatic avulsions occur due to exceptional blockage and/or above the hydrologic apex
- Large Channel Crossings: Points where channels with drainages areas >0.05km^2 cross major highways and roads

FEMA Flood Zones:

- 100-IC, A, and AE: 100-year flood area
- X500: 500-year flood area

## Debris Fan and Threshold Drainage Area Map Legend (1c):

- Debris Fans: Unchannelized fan deposits derived from debris flows and shallow landslides
- Channels with contributing area greater than 0.01km^2



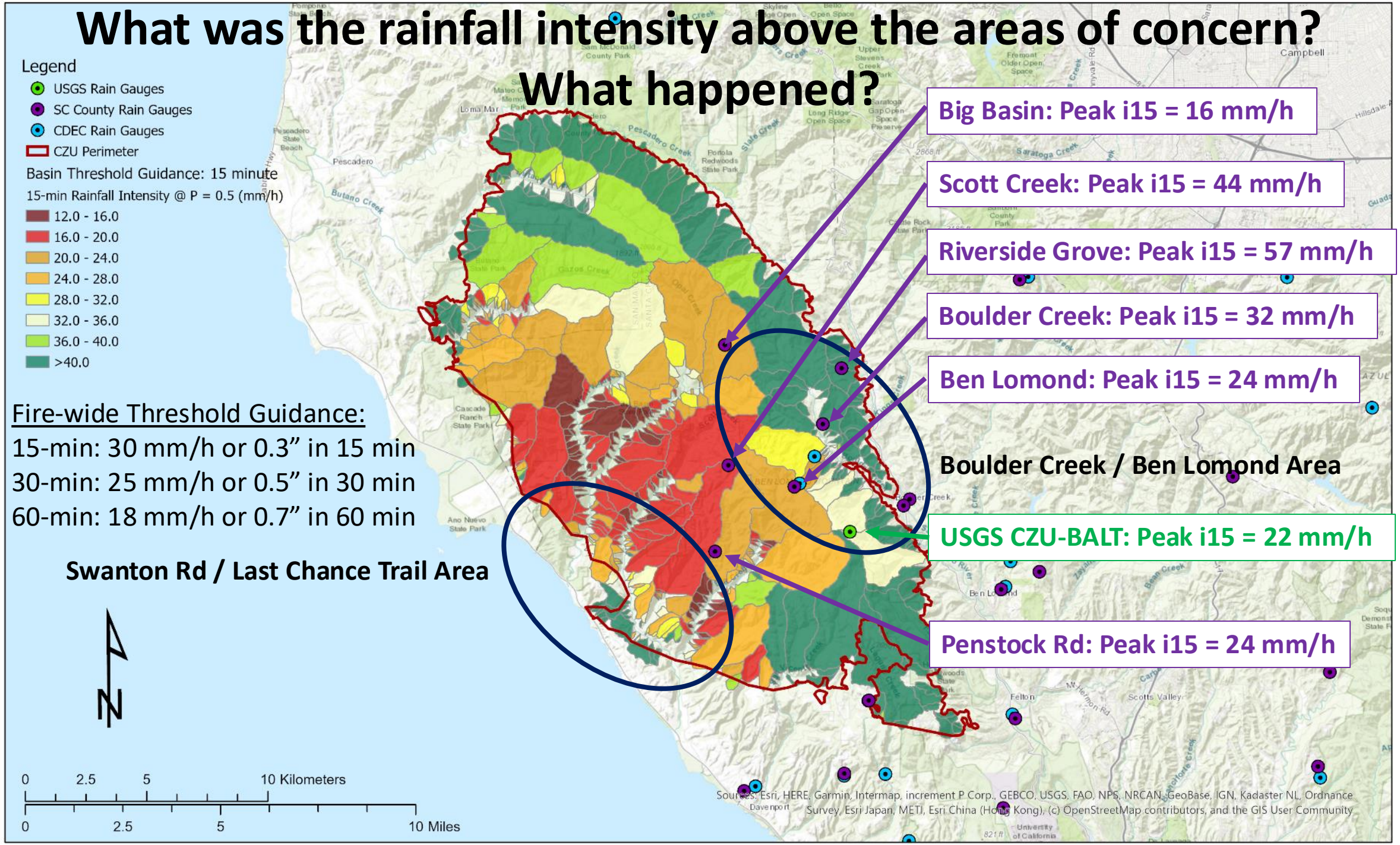

0 0.5 1 2 Kilometers

0 0.25 0.5 1 Miles

Scale: 1:19,000

# What was the rainfall intensity above the areas of concern?

# What happened?




Fire-wide Threshold Guidance:

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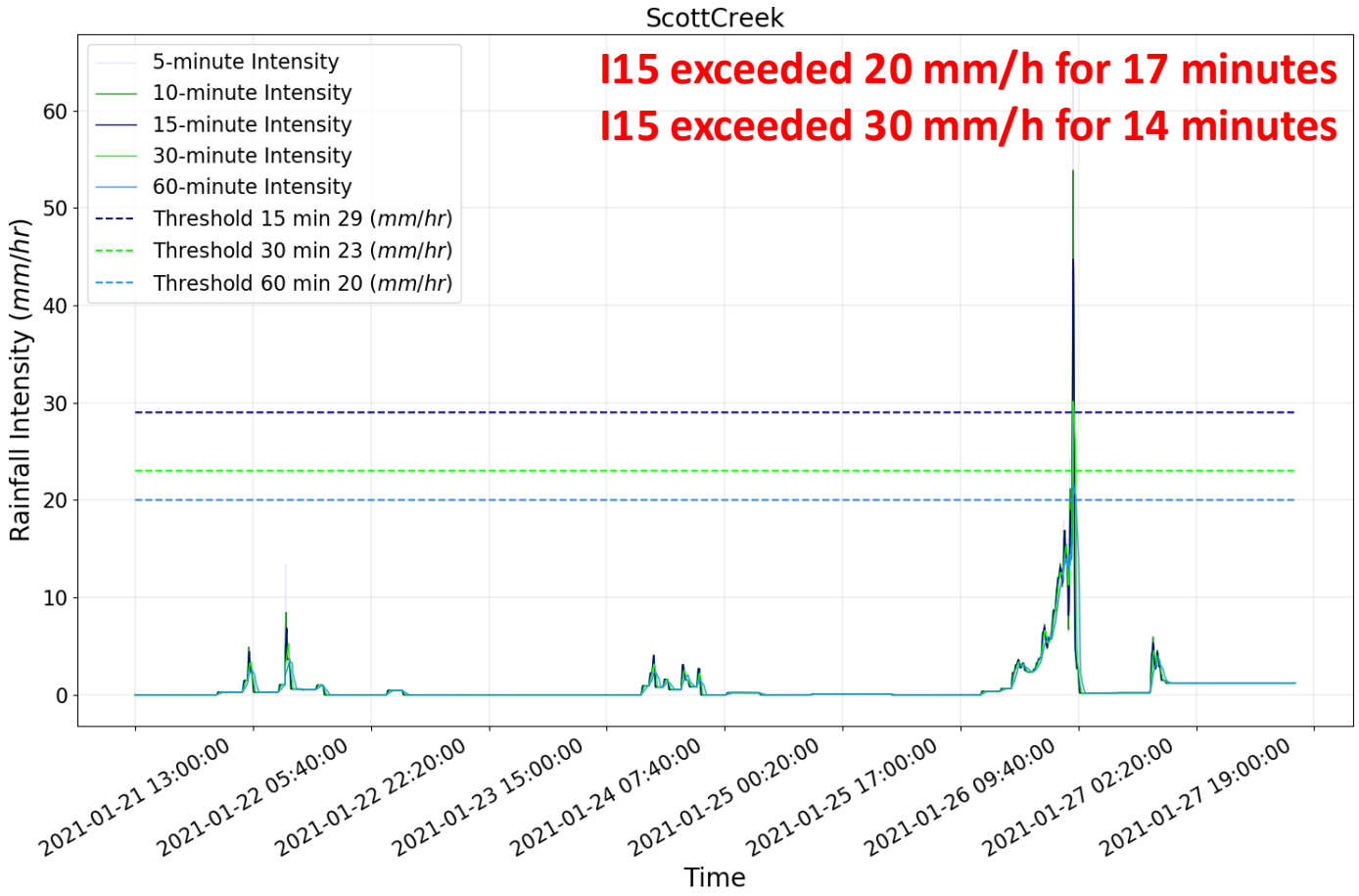
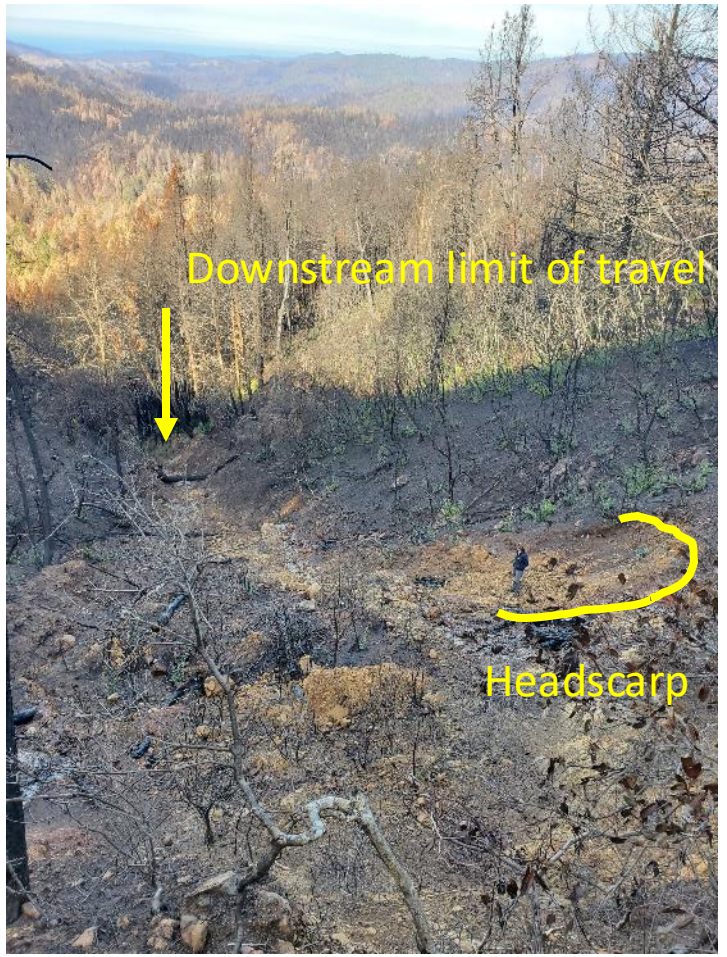
30-min: 25 mm/h or 0.5” in 30 min

60-min: 18 mm/h or 0.7” in 60 min

# Where was the most intense rainfall? What happened?
# Scott Creek, i15 = 44 mm/h




Near Eagle Rock Lookout. High burn severity.
Photos by Matt Thomas




Shallow landslide mobilized into a small, short-travel debris flow

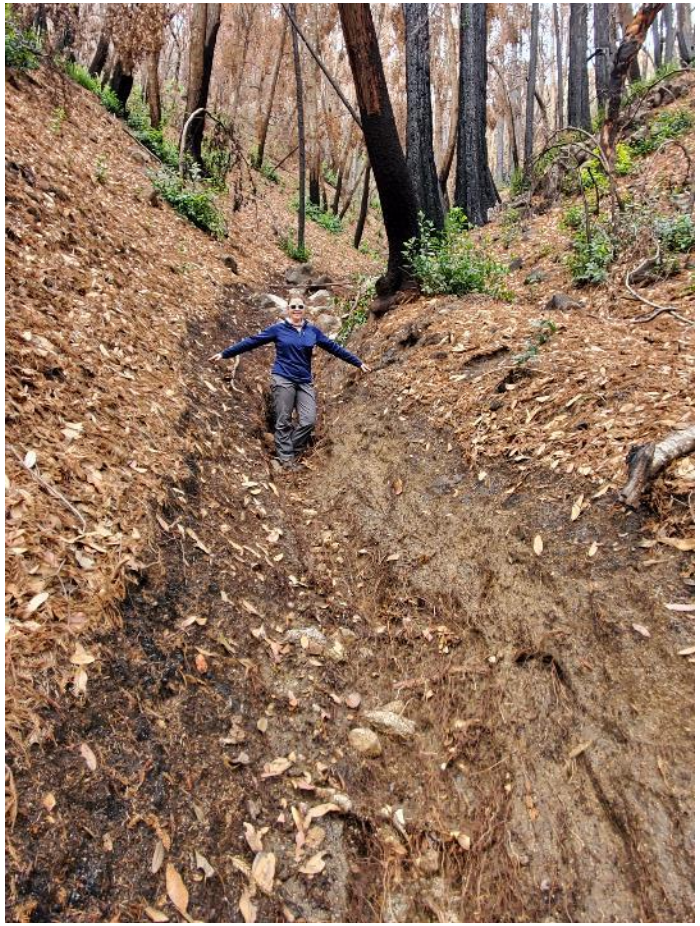
# Where was the most intense rainfall? What happened?
# Scott Creek, i15 = 44 mm/h

Near Last Chance drainage, ~4 km west of Scott Creek Rain Gage. High burn severity. Photos Matt Thomas

Small, runoff-generated debris flow (no landslide headscarp) with well-developed levees

# Where was the most intense rainfall? What happened?
# USGS BALT CZU monitoring site (link here)

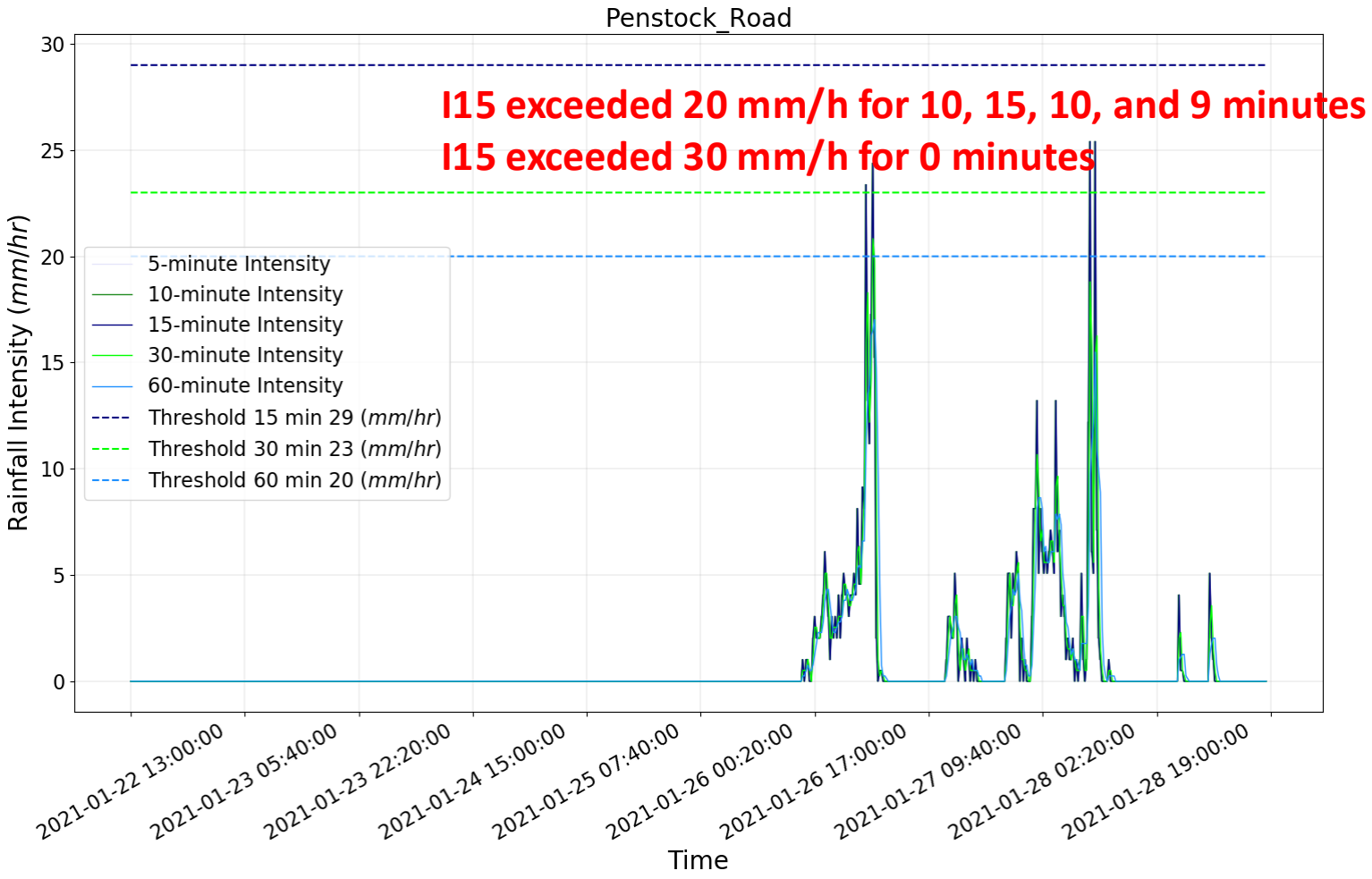
Peak 15-minute rainfall intensity = 22 mm/hr (below threshold). Moderate/high burn severity. Photos Matt Thomas



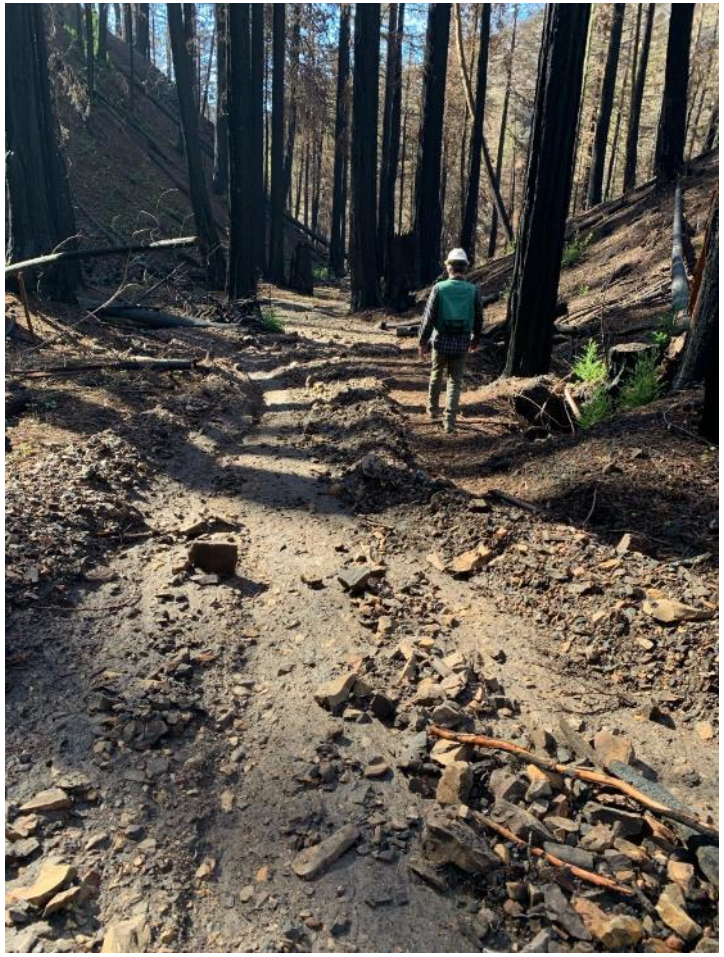
Probable small, runoff-generated debris flow below site.
New channel incision into swale

Small shallow landslide on slope nearby.

# Where was the most intense rainfall? What happened?
# Penstock Rd




Near Berry Creek drainage near confluence with Big Creek. Photos by Amy East



Small debris flow. Style of initiation unknown. One of three observed in vicinity.

# Where was the most intense rainfall? What happened?
# Penstock Rd

Near Berry Creek drainage and confluence with Big Creek. Photos courtesy of Amy East

Small debris flow. Style of initiation unknown. One of three debris flows observed in vicinity.

# Foreman Creek Debris Flow, December 2021

# USACE FPMS Santa Cruz Post-Fire Debris Flow Flood Mapping Project Objectives

- Develop and apply a 2D HEC-RAS Debris Flow model to estimate debris-flow induced flood depth and extent along the San Lorenzo River and Boulder Creek tributary in 2020 CZU Fire burn area.
- Evaluate various high-likelihood flooding scenarios using the model.
- Use mapping to inform County-led evacuation planning.

# Project Anticipated Outcomes

- Calibrated, reasonable model to predict debris flow flooding
- Flood maps produced using the model for various debris flow scenarios
- Brief and concise technical report

# X-band radar


Contents

Upcoming Webinars

# Strengthening Coastal Communities: Resilience and Preparedness Through Regional Partnerships

**Jennifer Gilbert**

Resilience Project Manager
New Hampshire Department of Environmental Services
*Former New Hampshire State NFIP Coordinator*

**Thursday, January 29 @ 12 pm ET**
1 ASFPM CEC | .10 ICC CEU

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# Thank you!

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