Watershed Emergency Response Team Evaluation

SCU LIGHTNING COMPLEX

CA-SCU-005740

September 21, 2020

Contents

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WATERSHED EMERGENCY RESPONSE TEAM EVALUATION

September 21, 2020

EXECUTIVE SUMMARY

The SCU Lightning Complex started on August 16, 2020 as seven different incidents that were combined under the SCU Lightning Complex as the largest burned areas merged. The SCU Lightning Complex burned approximately 396,624 acres within six counties: Alameda, Contra Costa, Santa Clara, San Joaquín, Stanislaus, and Merced. San Benito County is outside of the burned area but was identified as having postfire flooding impacts. In addition, a total of 222 structures were destroyed and 26 structures were damaged in the combined fires. Areas affected by the SCU Lightning Complex have an increased risk for debris flows, flooding, and sediment loading that may impact downslope property and municipal water infrastructure threatening public safety.

To identify post-fire hazards and their potential impacts to life-safety and property, CAL FIRE conducted a post-fire watershed evaluation. A Watershed Emergency Response Team (WERT) composed of California Department of Forestry and Fire Protection (CAL FIRE) and California Department of Conservation-California Geological Survey (CGS) personnel deployed to the fire on September 4, 2020. Field work was completed on September 8, 2020.

The following summarizes the WERT findings for the SCU Lightning Complex:

- Almost 93% of the fire areas consists of soils burned at low to very low/unburned severity, with the remaining area soils burned at moderate severity. The highest concentration of moderate soil burn severity occurs in a broad band across the central portions of the fire that extends from Mount Hamilton northwest to Mount Boardman.
- The predominantly low to very low/unburned soil burn severity reduces the potential for significant post-fire changes to hydrology and lowers the magnitude of potential contributions to pre-fire peak flows and slope stability issues during watershed response to storm events within in burned area.
- Post-fire runoff is expected to increase within and downstream of the burned area. Estimated post-fire bulked runoff for the 30-minute, 2-year and 10-year recurrence interval events are expected to increase by a factor of 1 to 1.8 times the pre-fire, clearwater flow conditions. Estimates of increased, post-fire flows are provided for nine basins that exhibit the highest threats to public safety, drinking water, and property/infrastructure, including reservoirs at Pacheco, Coyote, Arroyo Valle, Arroyo Hondo (Calaveras), and Los Vaqueros.
- Post-fire flows were also calculated for selected drainages that presented flood hazards downstream, including on Hollow Corral, Penitencia, and Orestimba Creeks.
- Soil erosion modeling using batch ERMiT predicts approximately a 7-fold to 32-fold increase in post-fire surface erosion rates for the SCU Lightning Complex, respectively, compared to pre-fire conditions. This is based on a 2-year recurrence interval storm and is for the first year following fire. These modeled increases in post-

fire erosion for year one following fire decrease by about 50% for year two following fire.
- USGS debris flow modeling shows that 7% of 2,972 modeled basins in the SCU Lightning Complex have a likelihood of 50% or greater to produce debris flows when subjected to a storm event with a 15-minute rainfall intensity of 28 mm hr^{-1} (1.1 in hr^{-1} or 0.28 inches accumulation in a 15-minute period).
- Steep catchments with moderate debris flow hazard that extends from Mount Hamilton to Mount Boardman are estimated as having the highest likelihood of generating debris flows.
- Debris flow magnitude is limited in some areas by the small average basin size. However, debris yields in excess of 10,000 m^3 (~13,000 yd^3) are predicted for areas draining steep basins in the headwaters of Arroyo Mocho, headwaters of Isabel Creek, Arroyo Valle, headwaters of Corral Hollow, Lone Tree and Hospital Creeks, and the upper portions of Orestimba Creek.
- Although flood flow and debris flow modeling suggest low to moderate levels of risk, uncertainties within the models don't preclude the threat of increased debris-laden floods and hyperconcentrated flows from impacting the built environment. This condition is pronounced during periods of high-intensity, short-duration (15 minute) storms.
- Rock-Fall hazards are not widespread across the burned area but are likely on some sections of main roads including San Antonio Valley Road on Mount Hamilton and Del Puerto Road.

A total of 50 Values-at-Risk (VARs) were identified including:

- 49 VARs are associated with residential structures located immediately adjacent to or near existing watercourses and flow paths that may be damaged by floodwater and debris.
- One VAR in Del Puerto Canyon Road was identified for debris flow hazards. Twelve (12) other VARs were identified for combined flood and debris flow hazards, mostly in the upper Arroyo Hondo and Isabel Creek watersheds.
- A damaged spillway on Pacheco Reservoir was identified as a high hazard to life-safety and property from flooding.

The following are general recommendations proposed to mitigate post-fire impacts, including those from debris flows, landslides, erosion, and sedimentation on identified VARs:

- Utilize early warning systems available to homeowners, particularly those located in debris flow- and flood-prone areas. The WERT recommends the use of county emergency alert notification systems (see specific county sections of this report).
- Increase the situational awareness of affected residents, water infrastructure operators, and the communities regarding the hazards and risks associated with living downstream/downslope of burned areas.
- Perform monitoring and maintenance of road drainage and storm drain infrastructure. Motorists and responsible agencies should be aware of the potential for flooding along

roads during large storm events. Residents should also be aware of potential flooding or debris flows that may occur on private channel crossings during storm events.

- Place temporary signage in areas of potential post-fire flooding, debris flow, sedimentation, rock-fall, and flooding hazards (e.g., low-water crossings, undersized culverts, areas of known past flooding).
- Utilize temporary flood control and structure protection (sand bags, K-rails, Muscle Wall) where appropriate.
- Monitor and/or remove accumulated debris from within channels and drainage structures that are subject to post-fire flooding, where there is an elevated risk to life-safety, property, and/or infrastructure. Culverts and drainage structures should be cleaned prior to storms and maintained after each storm.
- Properly locate temporary and permanent housing when rebuilding.
- Burned debris from structures and vehicles should either be properly disposed of, or mitigations put in place to prevent runoff from burned sites from entering watercourses. Areas with the highest density of burned structures near watercourses or with storm drainage systems that drain directly to watercourses should be the priority.

It should be noted that the findings included in this report are not intended to be fully comprehensive or conclusive, but rather to serve as a preliminary tool to assist the Offices of Emergency Management, Departments of Public Works, and Parks Departments in the seven affected counties, as well as Office of Emergency Services and Public Works, the California Governor's Office of Emergency Services, State Parks, Water Facility Operators, the United States Department of Agriculture Natural Resource Conservation Service, utility companies, and other responsible agencies in the development of more detailed post-fire emergency response plans. It is intended that the agencies identified above will use the information presented in this report as a preliminary guide to complete their own more detailed evaluations and develop detailed emergency response plans and mitigations.

1. INTRODUCTION

This report presents the results of a rapid evaluation of post-fire geologic and hydrologic hazards to life-safety and property (i.e., collectively known as “Values-at-Risk”, or VARs) for private lands affected by the 2020 SCU Lightning Complex in Alameda, Contra Costa, San Joaquin, Santa Clara, Merced, and Stanislaus counties, California. San Benito County is outside of the burned area but was identified as having postfire flooding impacts. Wildfire can have profound effects on watershed processes. A primary concern for burned watersheds is the increased potential for damaging flood flows, debris flows, rockfall, and hillslope erosion. This report identifies life-safety and property hazards associated with the post-fire environment, determines preliminary mitigative and/or protective measures, and communicates these findings to responsible agencies and affected parties.

Background

The SCU Lightning Complex started on August 16, 2020 as a result of lightning strikes in the northern Diablo Range of eastern Santa Clara County, southern Alameda and San Joaquin counties, eastern Contra Costa County, and western Stanislaus and Merced counties (Table 1). The complex is comprised of seven incidents that were grouped according to geographical location and incident command structure (Del Puerto, Ohlone, Welch, Arroyo, Round, Palm, and Briones incidents) (Figure 1). The SCU Lightning Complex burned a total of 396,624 acres (approximately 620 square miles) (Figure 1). As of September 10, 2020, the fire was 97% contained. The fire destroyed approximately 222 structures with 26 structures damaged. The fire resulted in five confirmed fire personnel and civilian injuries. The fire burned almost entirely in State Responsibility Areas (SRA) (Figure 2).

Table 1. SCU Lightning Complex Burned Area by County

County	Acres Burned
Contra Costa	3,104
Alameda	24,408
San Joaquin	24, 332
Stanislaus	175,804
Santa Clara	165,205
Merced	3,769
Total	396,622*

* - 2-acre difference in fire perimeters is considered within error of area calculations

CAL FIRE’s Incident Management Team 6 requested assistance with post-fire watershed evaluation. CAL FIRE assembled a WERT comprised of individuals with expertise in engineering geology, geomorphology, hydrology, forestry, and GIS for the SCU Lightning Complex. WERT members and their qualifications are summarized in Table 2. The WERT process was initiated on September 4, 2020. Team leads held a scoping and informational meeting with emergency response personnel and other stakeholders on Saturday, September 5th. Appendix A contains a list of contacts. Field observations were made from September 5th through September 9th (see Appendix B, C and D).

Table 2. SCU Lightning Complex WERT members.

Main Team			
Name	**Position**	**Agency**	**Expertise-Position**
Jon Woessner RPF No. 2571	Team Leader	CAL FIRE	Forestry
John Oswald CEG No. 2291, PG No. 7219	Team Co-Leader	CGS	Engineering Geology
Sara Gallagher PG No. 9461	Team Member	CGS	Engineering Geology
Ellie Spangler PG No. 9440	Team Member	CGS	Engineering Geology
Brian Mattos RPF. 2476	Team Member	CAL FIRE	Forestry
Chris Curtis RPF No. 2541	Team Member	CAL FIRE	Forestry
Adjunct Team			
Pete Roffers PG No. 9100	Team Member	CGS	Engineering Geology/GIS
Sol McCrea CFM 3527	Team Member	CGS	GIS
Will Olsen	Team Member	CAL FIRE	Hydrology, GIS
Pete Cafferata PH 1676, RPF 2184	Team Member	CAL FIRE	Forestry, Hydrology

Objectives and Scope

The two primary objectives of the SCU Complex WERT are (1) to identify types and locations of on-site and downstream threats to life-safety or property from debris flows, rockfall, landslides, flooding, erosion, road hazards, and other post fire-related geologic hazards, and (2) to develop preliminary emergency protection measures needed to avoid potential life-safety and property threats.

The scope of work performed included the following:

- Compiling geology map layers and reviewing the general distribution and relationships between geology and past occurrence of debris flows and landslides in the burned area.
- Reviewing aerial photography, including Google Earth images.
- Reviewing local topography, including high resolution digital elevation models (DEMs).
- Reviewing available satellite imagery and the soil burn severity map.
- Reviewing USGS generated debris flow model results.
- Producing Batch ERMiT soil erosion model results.

- Estimating post-fire flood flows for selected watershed with the highest threat to life-safety and property.
- Meeting and/or contacting local government agency and affected parties to discuss potential post-fire impacts to life-safety, property, and existing infrastructure.
- Performing field reconnaissance to identify potential hydrologic and geologic hazards, as well as potential VAR sites.
- Developing a list of preliminary recommendations to mitigate possible post-fire hazards as they pertain to identified VAR sites.
- Holding a closeout meeting with Office of Emergency Services sand other state and local agencies.
- Drafting this report documenting data, findings, and recommendations.

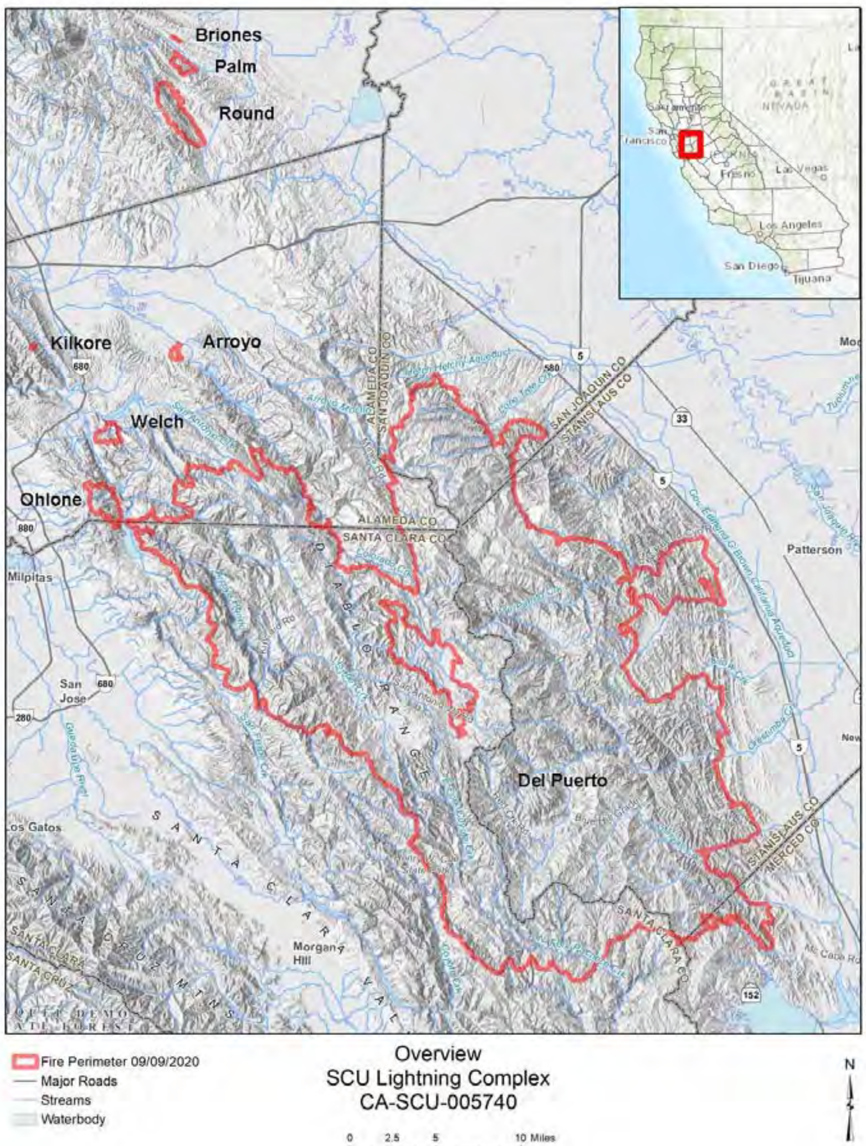


Figure 1. Overview map for the SCU Lightning Complex burned areas showing incidents combined in to the complex.

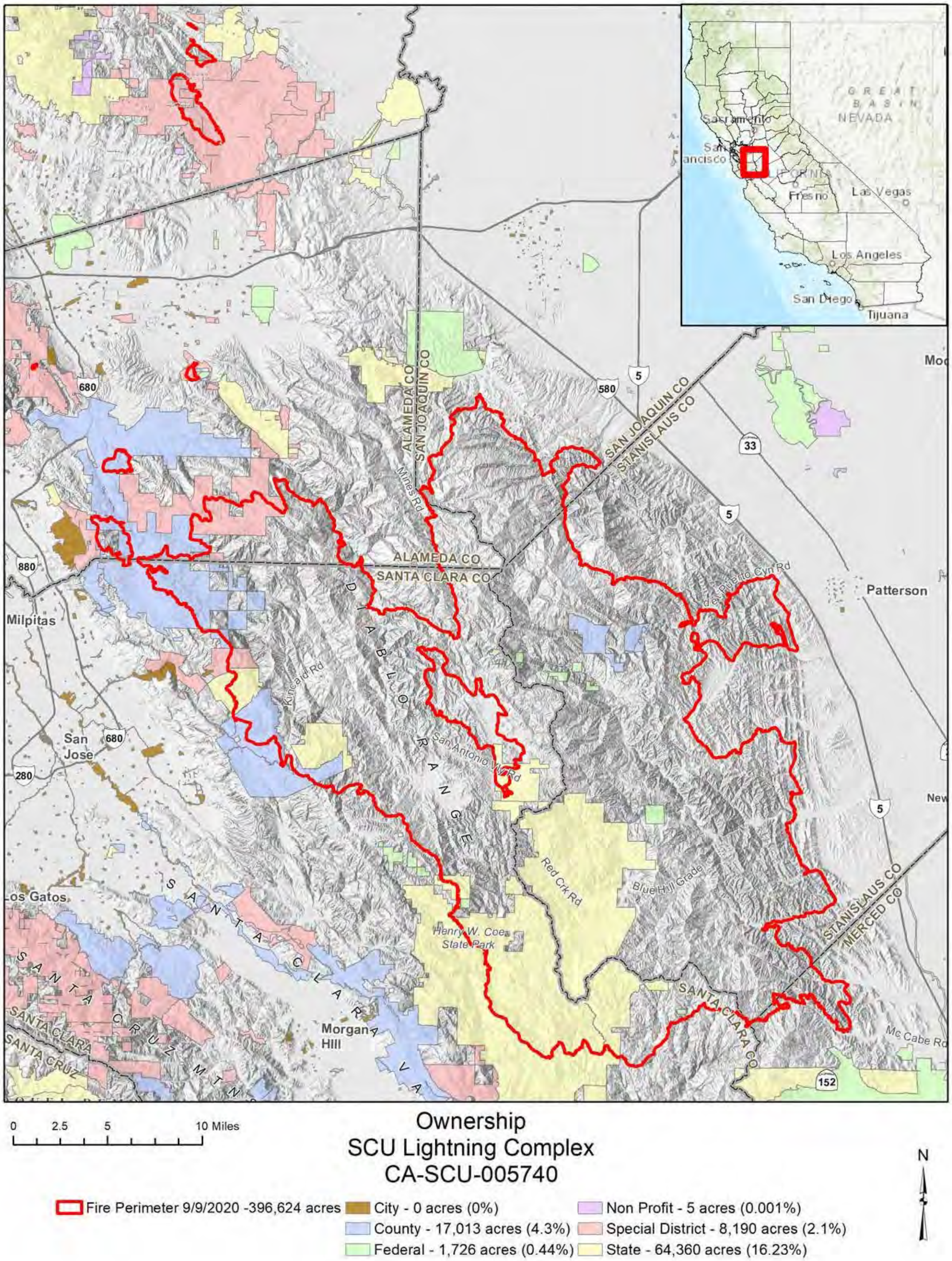


Figure 2. Ownership map of the SCU Lightning Complex burned areas. Areas with no shading are private lands.

2. PHYSICAL SETTING

Topography and Climate

The SCU Lightning Complex is in the central part of the northwest-southeast-trending Diablo Range within the Coast Ranges of California. The burned area is bound to the north by the Livermore Valley, to the east by the San Joaquin Valley, to the south by Pacheco-Pass Highway, and to the west by the Santa Clara Valley. The eastern part of the burned area drains towards the east through tributaries of the San Joaquin River, including Del Puerto Creek, Orestimba Creek, Garzas Creek, Corral Hollow Creek, Hospital Creek, Lone Tree Creek, and Quinto Creek. This part of the burned area encompasses numerous canyons dissected into a gently inclined range front that drains east towards Interstate 5 (I-5), the California Aqueduct, and the San Joaquin Valley. The western part of the burned area is drained by north and south flowing tributaries that flow into a number of reservoirs, including Lake Del Valle, San Antonio Reservoir, Calaveras Reservoir, Anderson Reservoir, Coyote Reservoir, and Pacheco Reservoir. Major tributaries draining the hillslope catchments within this part of the burned area include Arroyo Mocho, Arroyo Valle, Alameda Creek, Arroyo Hondo, Coyote Creek, Penitencia Creek, and North Fork of Pacheco Creek. Within the central part of the burned area there are two flat-bottomed alluvial valleys, Isabel Valley and San Antonio Valley.

Much of the SCU Lightning Complex burned area contains moderate to steep terrain with an average slope gradient over 35% (USGS StreamStats) (Figure 3a and 3b). Steep slopes (>56%) with moderate to very long slope lengths are located within headwall swales and along canyon sidewalls in the burned area. The most prevalent steep slopes are along Arroyo Hondo and Alameda Creek canyon sidewalls in the northwestern part of the burned area. Side slopes of northwest-southeast trending ridges in the southeastern part of the burned area along Orestimba Creek and portions of Del Puerto Creek also exceed 56%. Relatively gentle slopes (<20%) within the burned area are along ridgetops at high elevations and within valley bottoms at lower elevations. The burned area exhibits 4,076 feet of vertical relief and ranges in elevation from about 300 feet AMSL along Del Puerto Canyon Road near Patterson in the eastern part of the burned area to 4,376 feet AMSL at Copernicus Peak in the west-central part of the burned area. Most of the burned area consists of undeveloped canyon side slopes, with development occurring mainly as isolated residential structures in canyon bottoms or on ridge tops.

The fire area has a Mediterranean climate with warm dry summers and cool wet winters, where precipitation occurs almost entirely as rain. Mean annual precipitation varies across the burned area from 23.6 inches at the National Weather Service (NWS) COOP Mt. Hamilton Station (4,210 ft AMSL) in the west-central part of the burned area to 13.13 inches at the NWS COOP Del Puerto Road Camp station (1,113 ft AMSL) in the east-central part of the burned area (Western Regional Climate Center, 2020). Annual precipitation ranges from 7.75 to 45.38 inches at the Mt. Hamilton station (1948 to 2012) and from 8.61 to 20.7 at the Del Puerto Road Camp station (1959 to 1977) (Western Regional Climate Center, 2020).

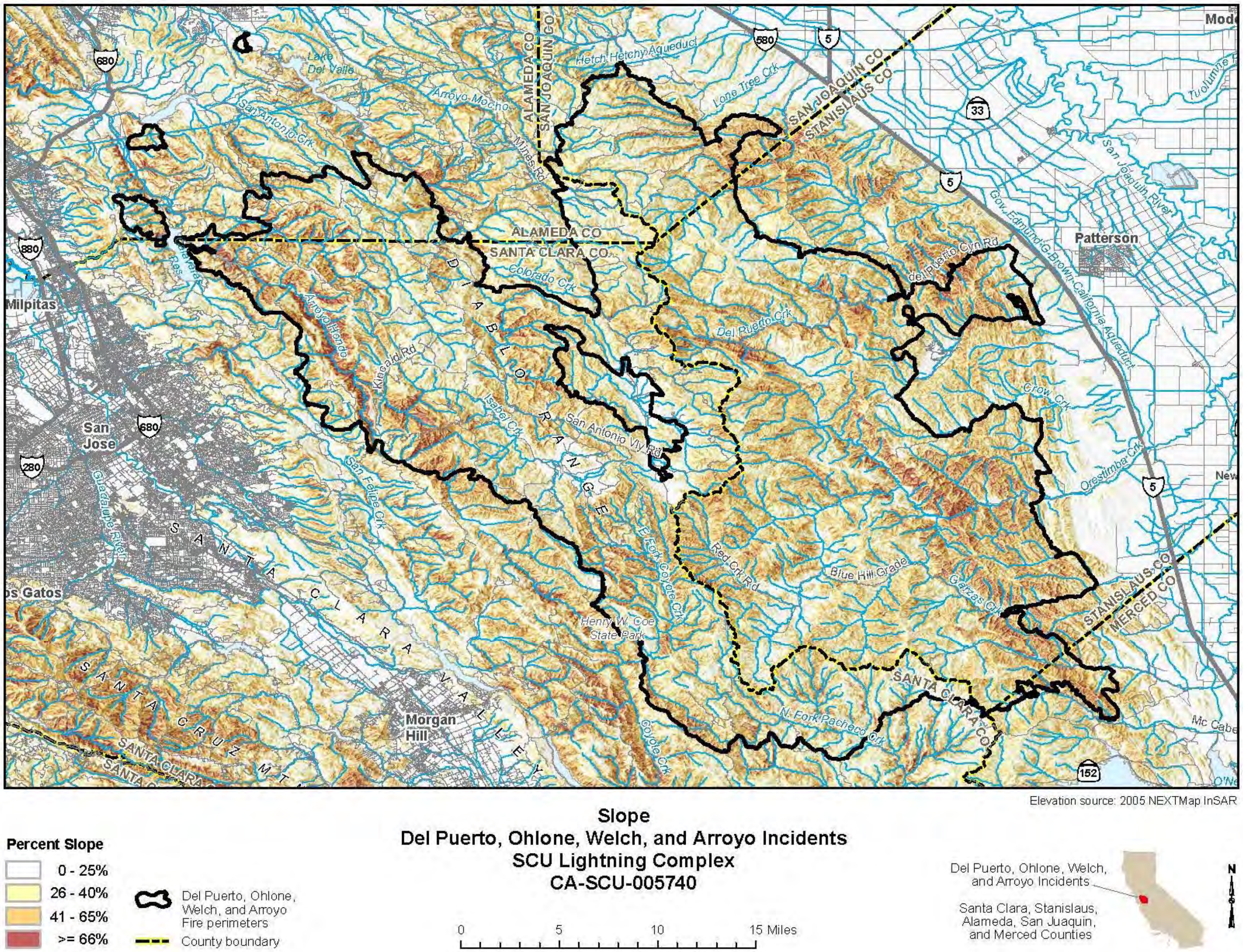


Figure 3a. Slope map for the main portion of the SCU Lightning Complex.

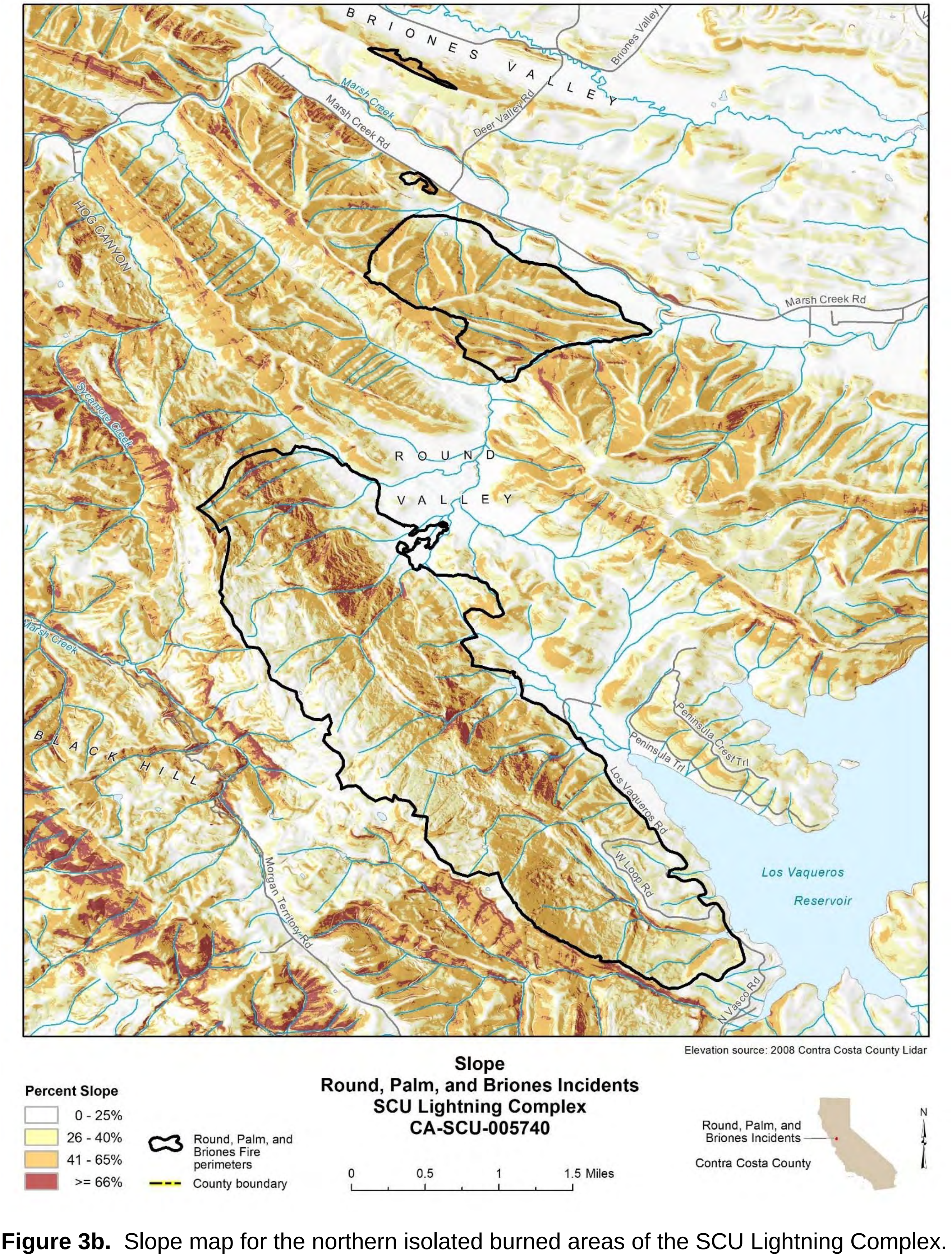


Figure 3b. Slope map for the northern isolated burned areas of the SCU Lightning Complex.

Flood History

Flooding events occur in the Diablo Range when atmospheric rivers tap into tropical moisture creating warm, long duration storm-events with periods of intense rainfall. A gage on Coyote Creek recorded significant high flow events in the southwestern part of the burned area in 1963, 1969, and 2017 (USGS; Figure 4a). The 2017 flood event on Coyote Creek was the largest on record since 1963 with a peak discharge of 11,500 cfs. The Santa Clara County Hazard Mitigation Plan (2017) records additional flood events occurring in the vicinity of the burned area, with widespread regional flooding events in 1982 and 1997 and localized flash flooding on Coyote Creek in 2000. The storms in 2017 brought flooding and reservoir spill events to Coyote and Anderson reservoirs. Uncontrolled spilling from Anderson Reservoir was the largest on record since dam construction and caused significant flooding downstream on Coyote Creek, including the flooding of residential streets, homes, and US-101 northbound lanes (Santa Clara County, 2017). The Santa Clara County Hazards Mitigation Plan lists the North Fork Dam at Pacheco Lake as a high hazard dam. A gage on Pacheco Creek, downstream from the dam, recorded flood events in 1956, 1963, 1969, and 2017 (USGS, Figure 4b). The 2017 flood event on Pacheco Creek was the largest since 1956, with a peak discharge of 11,700 cfs. The North Fork Dam spillway sustained damage as a result of the 2017 storm and excessive spill over which caused the National Weather Service to issue a flood advisory for a dam floodgate release in January 2017.

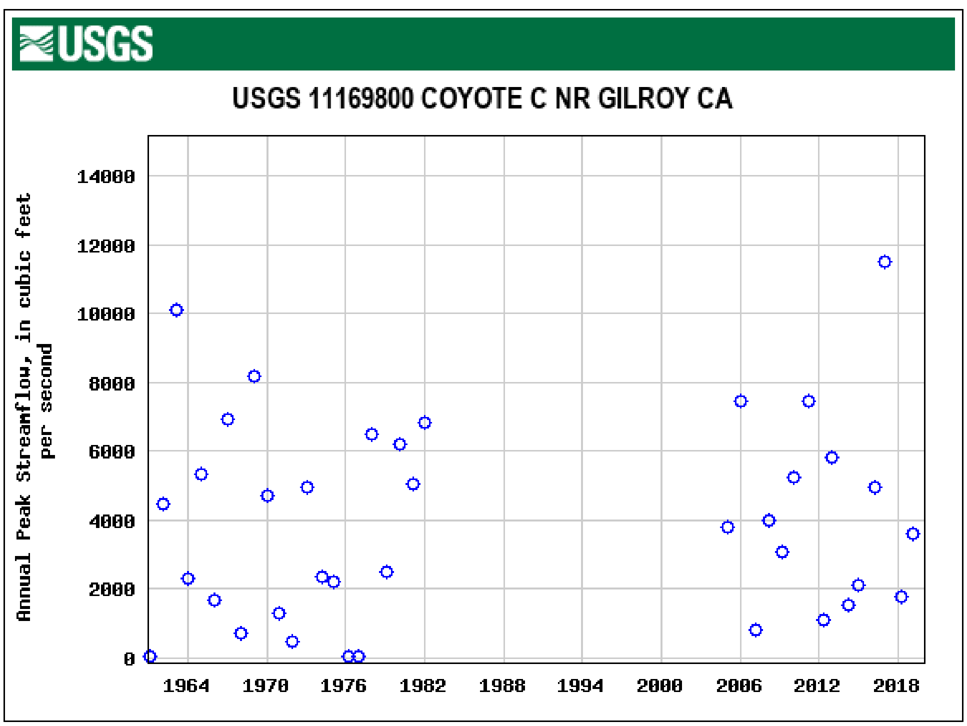


Figure 4a. Annual peak stream flow for Coyote Creek near Gilroy, CA.

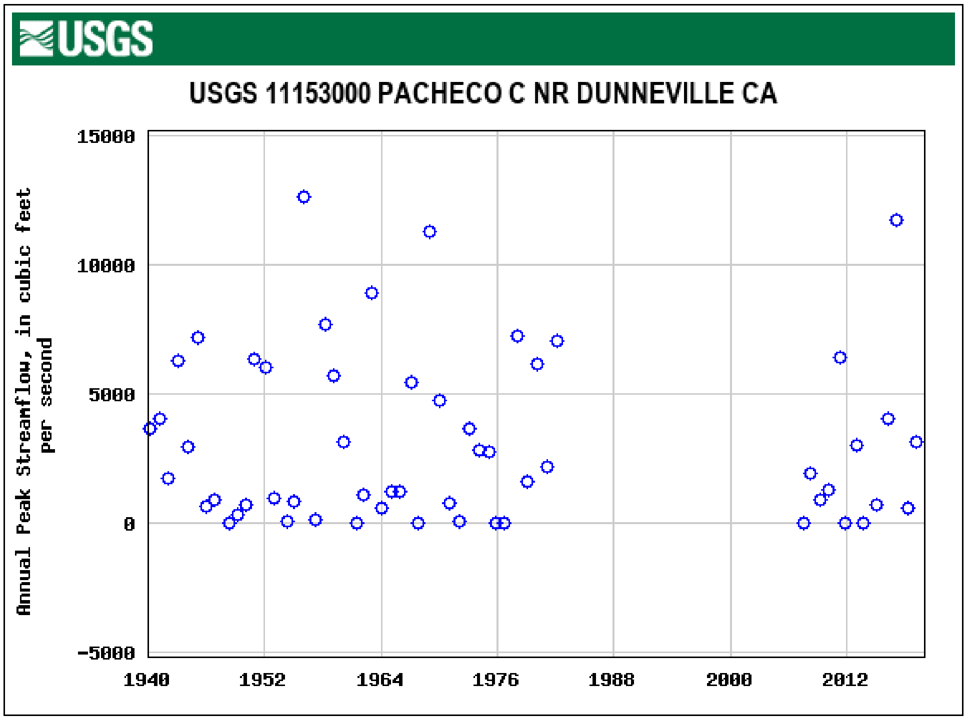


Figure 4b. Annual peak stream flow for Pacheco Creek near Dunneville, CA.

Historical occurrences of debris flows are documented in the burned area. In January 1982, a large storm initiated a number of debris flows across the San Francisco Bay Region, including on the slopes above Alameda Creek, Indian Creek, La Costa Creek, and Trout Creek in the northwestern part of the burned area (Ellen et al., 1997). Nearly 12 years later, in the winter of 1997-1998, El Niño-driven rainfall triggered many landslides and debris flows in the San Francisco Bay Area. Many of these landslides and debris flows occurred on tributaries that drain the northwestern part of the SCU Lightning Complex burned area (Coe et al., 1998; Godt, 1999).

Vegetation and Fire History

Primary vegetation types within the burned area include oak woodland, chaparral, cismontane forest, and grasslands (Figure 5). The western portions of the burned area have mixed oak woodland with a small portion of conifer forest at high elevations (Mt. Hamilton). The central portions of the burned area contain predominantly oak woodland and chaparral that becomes less densely vegetated prairie oak woodland and grassland to the east. Areas of low vegetation density, such as grassland and prairie oak woodland, are expected to have less post-fire change in soil hydrologic properties and yield a lower watershed response than areas burned with equal severity in denser vegetation.

The most recent fires within the fire perimeter occurred in 2003, 2006, and 2007 (Figure 6). These fires primarily overlapped the central and southern portions of the SCU Lightning Complex. The northern portions of SCU Lightning Complex do not have an extensive recent fire history, with large portions not have a recorded fire occurring in the last 70 years.

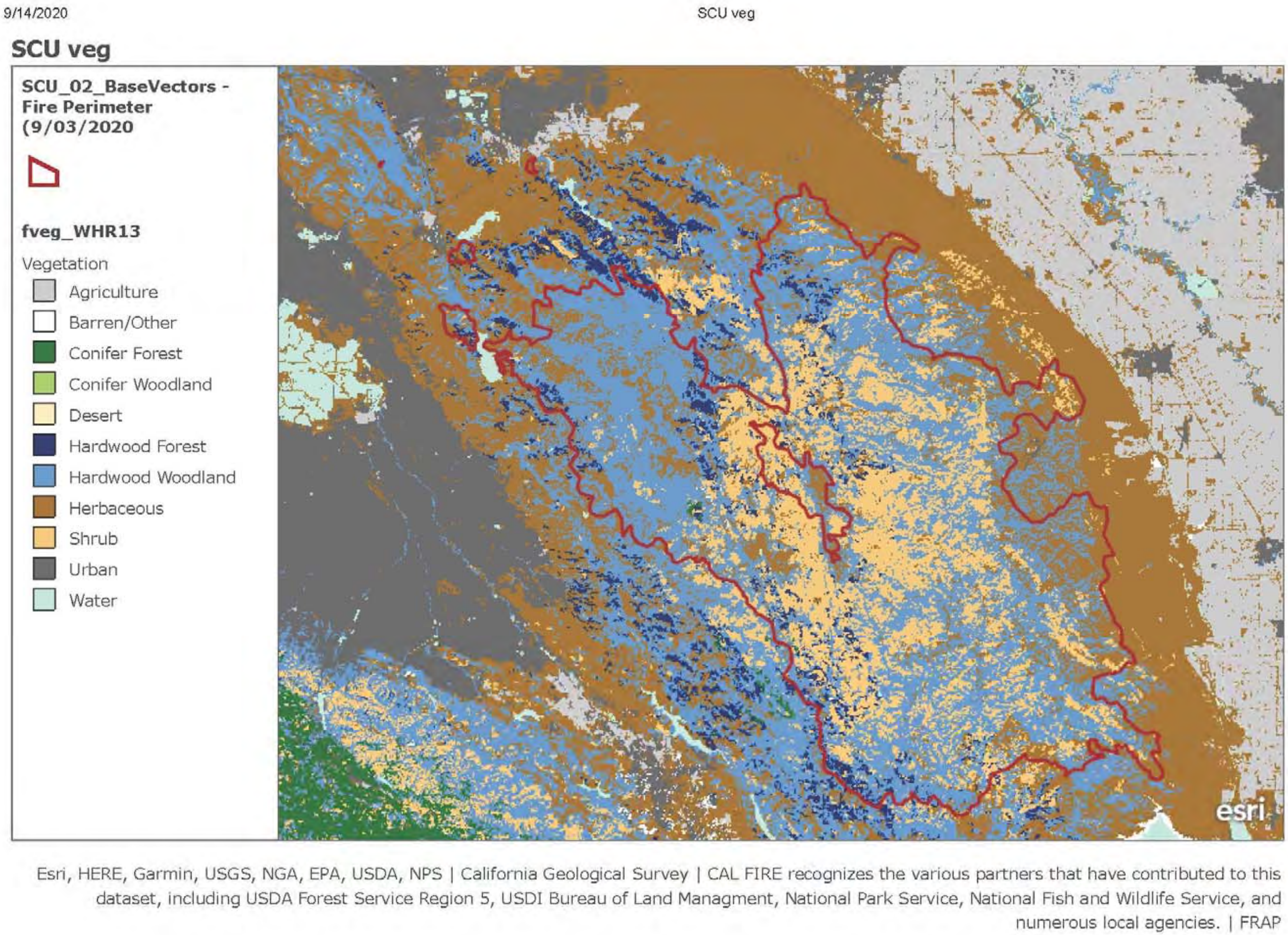


Figure 5. Vegetation map for the SCU Lightning Complex and surrounding area.

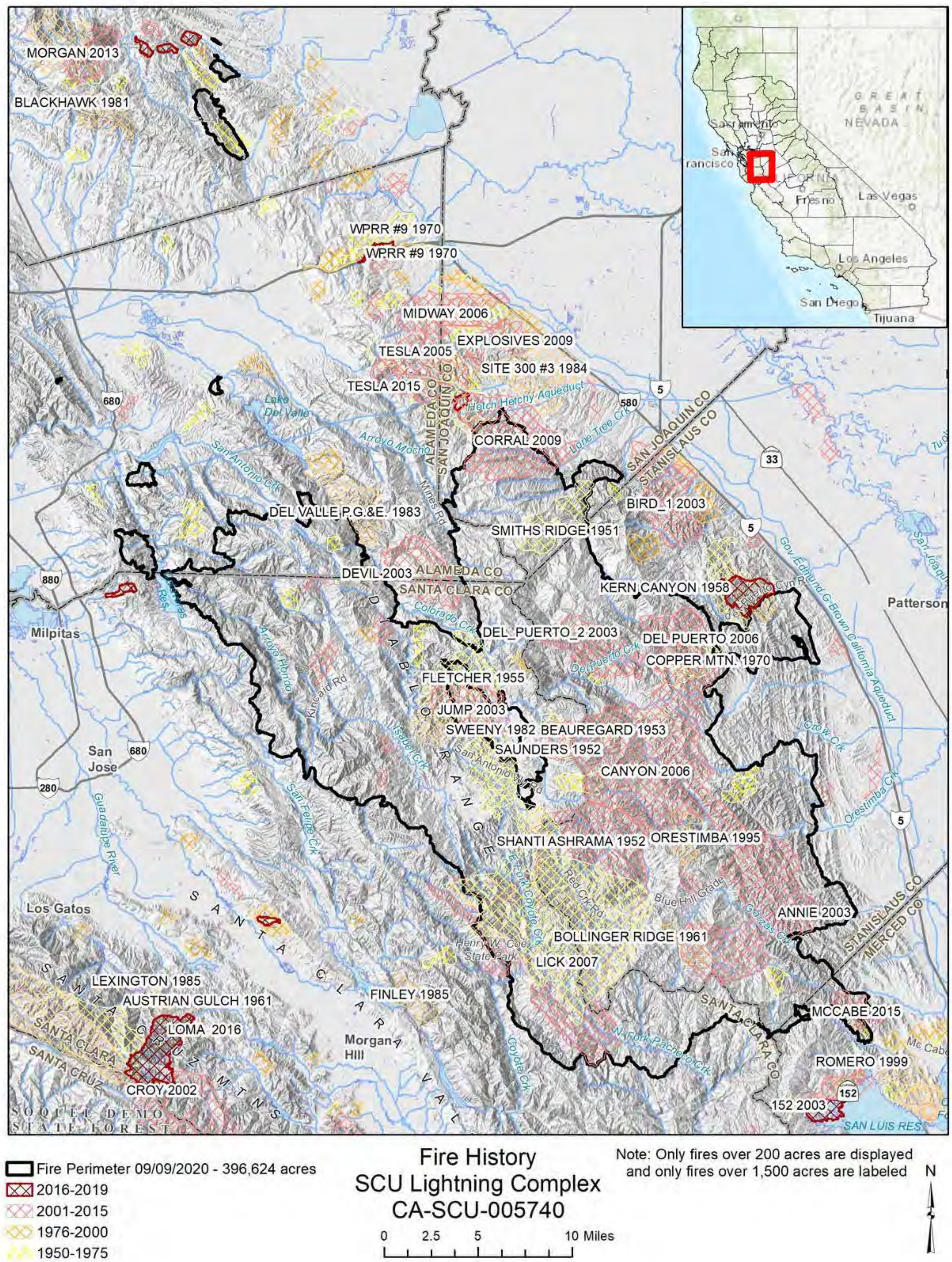


Figure 6. Fire history map for the SCU Lightning Complex and surrounding area.

Geology and Landslides

The SCU Lightning Complex occurred within the central portion of the Coast Ranges geomorphic province in central California (CGS, 2002). The Coast Ranges Geomorphic Province consists of a series of northwest-trending mountain ranges and valleys that trend subparallel to the San Andreas Fault. Strata generally dip beneath the alluvium of the Great Valley Geomorphic Province to the east and are bound to the west by the Pacific Ocean. The central portion of the Coast Ranges Geomorphic Province contains thick Mesozoic and Cenozoic sedimentary strata, dominated by irregular knobby, landslide topography of the Central Belt of the Franciscan Complex and an eastern border composed of strike-ridge and valleys in Upper Mesozoic strata.

Regional geologic mapping at 1:250,000 scale by Wagner et al. (1991) and at 1:100,000 scale by Wentworth et al. (1999) indicates the following geologic units are exposed in the SCU Lightning Complex burned area: 1) Cretaceous Franciscan Complex rocks comprised of metagraywacke, sandstone, shale, conglomerate, chert, and serpentinized ultramafic rocks; 2) Upper Cretaceous marine sedimentary rocks of the Panoche Formations, consisting of sandstone, shale, siltstone, and local conglomerate lenses; 3) Jurassic volcanic rocks of the Coast Range Ophiolite, including basalt and keratophyre; and 4) recent alluvium and colluvium containing unconsolidated gravel, sand, silt, and clay (Figure 7a and b).

The Franciscan Complex rocks underlie the majority of the burned area. These rocks are typically fractured and heavily sheared at the outcrop-scale, break down into smaller fragment readily, and are landslide prone. In the southwest part of the burned area, the Franciscan Complex is in fault contact with the Upper Cretaceous marine sedimentary rocks of the Panoche Formation. A dramatic change in geomorphology and slope gradient occurs across the contact. To the west of the contact, the Franciscan Complex rocks form variably oriented ridges with subdued slopes, and to the east the Panoche Formation rocks form a series of sub-parallel north-south oriented ridges and steep side-slopes (Figure 7a). The Panoche Formation rocks are generally more stable than the Franciscan Complex rocks; however, landslides occur within the shale and mudstone units (Martin, 2016), and where adversely oriented bedding planes are exposed in natural and man-made cuts.

Older and younger alluvium have been deposited in low-lying areas within and adjacent to the burned area. Large older fan deposits flank the northern margin of the burned area. Drainages issuing from this part of the burned area typically incise through the older fans at the mountain front and flow towards the Livermore Valley. On the eastern side of the burned area is a northwest-trending belt of coalescing alluvial fans that range from 15 to 25 km (~9 to 16 mi) wide (Lettis, 1982a). These alluvial fans were built principally by flood and debris flow events on the major drainages of Orestimba, Crow, Garzas, Del Puerto, Salado, Hospital, and Lone Tree creeks (Lettis, 1982a, b). Most of these drainages are deeply incised into the older fan deposits and are constrained to relatively wide alluvial floodplains. Several small debris fans were observed at the mouths of small drainages across the burned area but have not been identified by regional mapping within the fire perimeter. Recent alluvium and colluvium in the burned area range from moderately consolidated to unconsolidated. The erosion potential generally increases with lack of consolidation and clay interbeds can be planes of weakness that are conducive to landsliding when adversely oriented to natural exposures and excavated slopes. Clay soils can also be expansive and form aquitards that reduce slope stability. Young unconsolidated deposits can erode easily and contribute to bed load in flood flows or debris in hyperconcentrated flows.

The distribution of soils in the burned area is dependent on the underlying bedrock type or parent material (see USDA-NRCS Web Soil Survey). In general, soils developed on the Franciscan Complex rocks range from fine clayey loams (CL-CH) where slopes are gentle and underlain by finer grained metasedimentary units, to gravelly loams (ML-GW) where slopes are steeper and underlain by more resistant, coarser grained materials. The Panoche Formation sandstone units in the southeastern part of the burned area weathers predominantly to sandy loams (SM/SC) on steeper slopes, and to clay and clay loam (CL/CH) where slopes are gentle and underlain by finer grained lithologic units.

Published landslide mapping in the burned area is sparse although landslide processes are clearly active in the region. Most of the landslides within the burned area occur on steep to very steep slopes underlain by the Franciscan Formation as rockfalls, earthflows, and deep-seated landslides. Hazards from debris flows and hyperconcentrated flows are present in the burned area, as evidenced by alluvial fan landforms on eastern side of burned area and small debris fan deposits observed in exposure across the burned area. Debris flows and hyperconcentrated flows are generally initiated by intense or long-duration rainfall events common in the winter months in the San Francisco Bay Area. Historical occurrences of debris flows are documented in the northern part of the burned area after significant storm events in January 1982, and along the western and northern fire perimeter after the 1997/1998 El Niño-driven rainfall events. The 1982 debris flows in the northern part of the burned area initiated on slopes underlain by Franciscan Complex rocks and occurred primarily on slopes that face south to west-southwest, with fewer than one-quarter initiated on slopes with a northerly aspect (Pike and Sobieszczyk, 2008). The distribution of debris flows primarily on south-facing slopes within the burned area was controlled by wind-driven rainfall from the south, which focused increased rainfall on the south-facing slopes. The increased rainfall, coupled with steep converging catchments on landslide prone geologic units, resulted in the debris flows documented in the northern part of the burned area (Pike and Sobieszczyk, 2008).

The structural framework of the Diablo Range is governed by a series of sub-parallel, generally northwest-trending faults ranging in age from Mesozoic to present time (Wentworth et al., 1999). There are numerous active earthquake fault systems in and adjacent to the burned area. The burned area is within the active San Andreas Fault system, which distributes shearing across a complex system of primarily northwest-trending, right lateral, strike-slip faults. The dominant faults of the San Andreas system in the vicinity of burned area are the Calaveras and Greenville faults. The Holocene active Calaveras Fault parallels the western fire perimeter and trends northwest-southeast through Coyote, Anderson, and Calaveras reservoirs, and crosses through the communities of Morgan Hill, Mt. Hamilton and Sunol. Notably, movement along the Calaveras Fault in 1984 produced the magnitude 6.2 Morgan Hill Earthquake. The epicenter of this event was located approximately one mile from the west-central fire perimeter in Joseph D. Grant County Park.

The Greenville Fault trends northwest-southeast through the central part of the burned area, movement along the fault in 1980 resulted in a magnitude 5.8 Livermore Earthquake. This Late Quaternary fault extends into the burned area from the north-central border and continues along Mines Road until it feathers out in San Antonio Valley in the central part of the burned area. The eastern side of the burned area is bound by the Quaternary-aged San Joaquin Fault, an east-verging, shallow dipping blind thrust fault (Lettis, 1982b). There are numerous other regional seismic sources that are capable of producing strong ground motions in the burned area. Ground shaking from nearby active faults is an important process in preparing slopes for landsliding and initiating landslides (Keefer, 1984). Earthquakes and subsequent landsliding during the 3- to 5-year recovery period that burned slopes are susceptible to post-fire response flood flows can be further increased by bulking with sediment and debris delivered to the channel networks by coseismic landsliding. The material delivered to streams can also be mobilized in debris flow events, increasing their magnitude and destructive power. The landslide prone materials of the Franciscan Complex can add to the increased erosion and runoff expected because of post-fire soil hydrology changes.

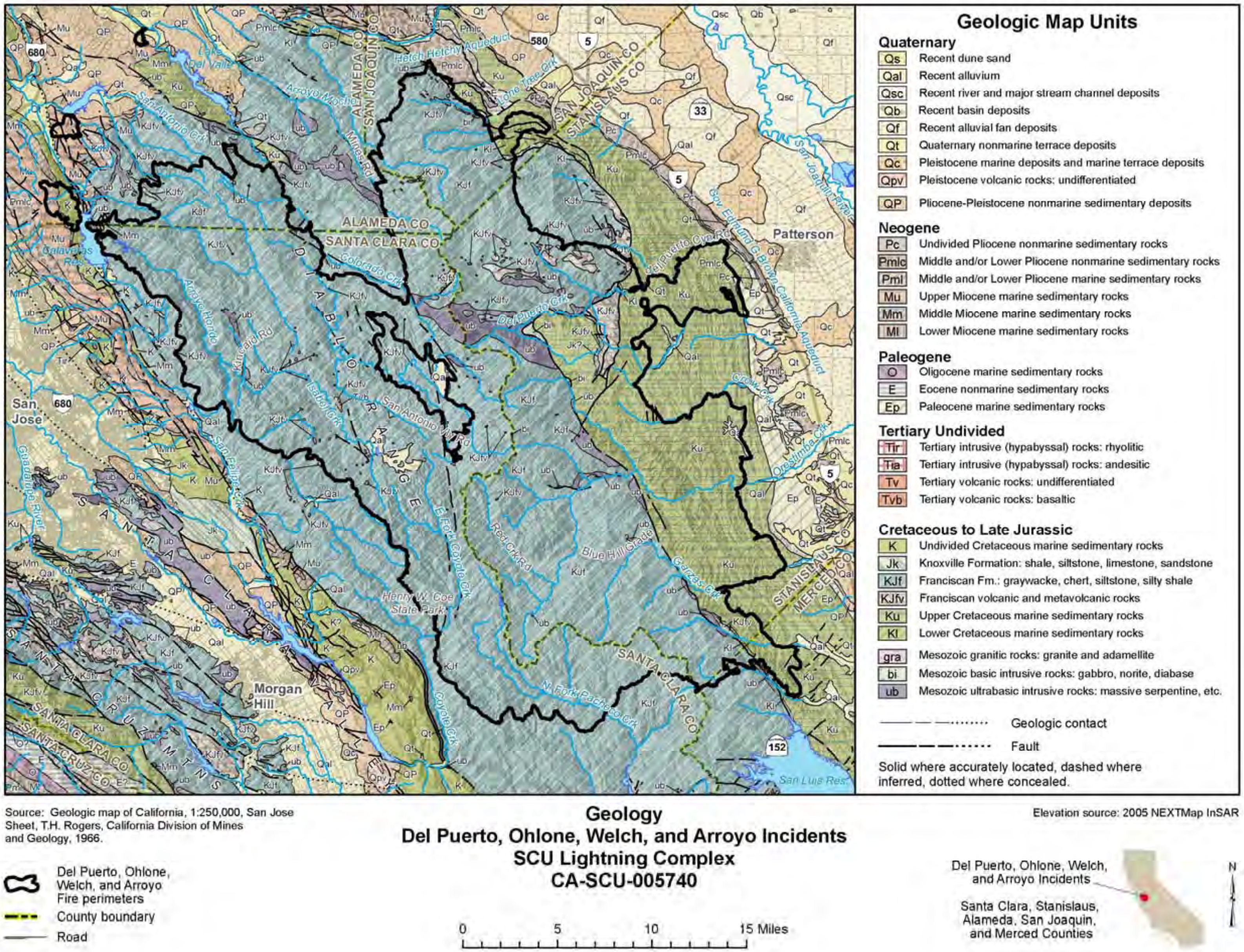


Figure 7a. Geologic map and legend for the southern SCU Lightning Complex burned area.

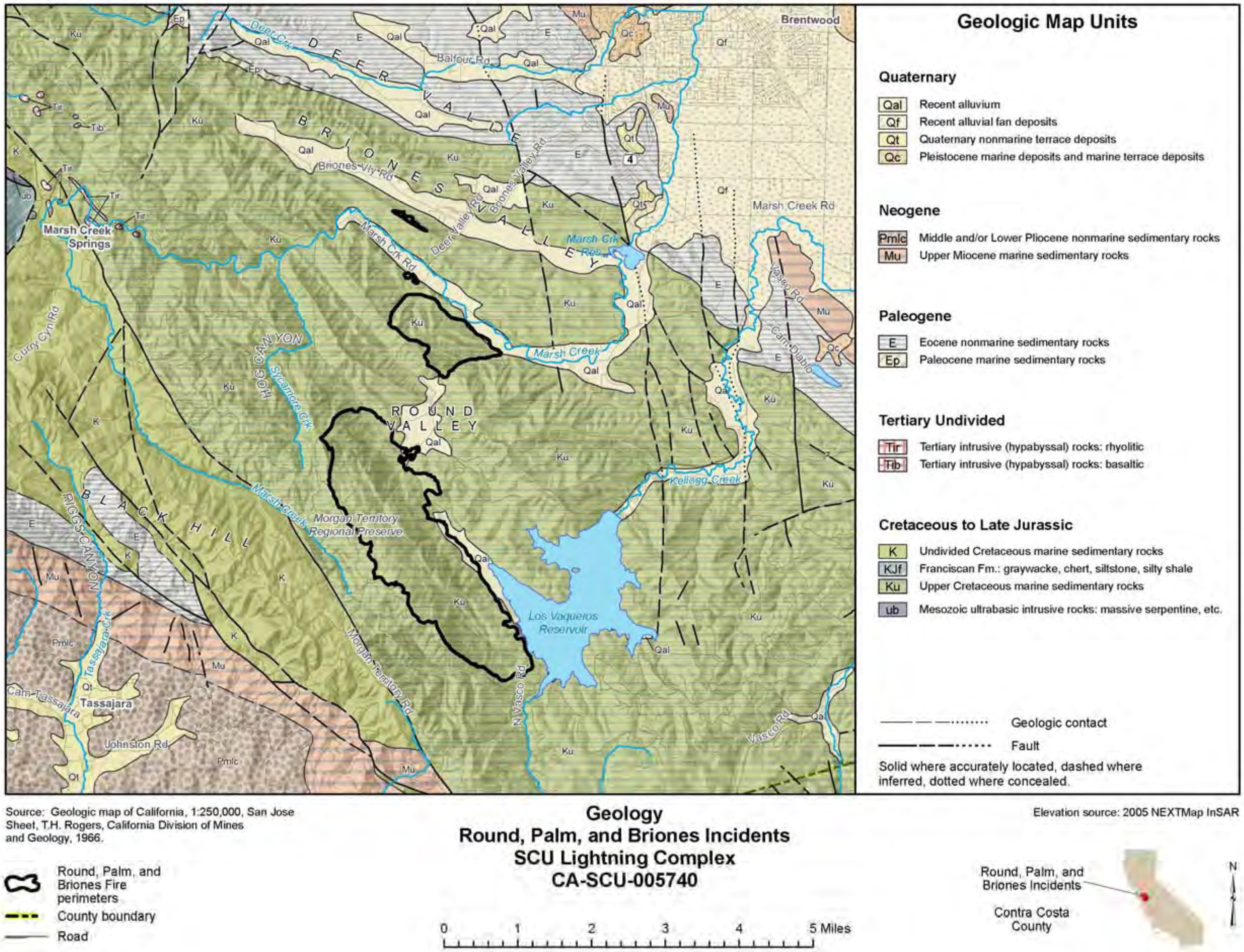


Figure 7b. Geologic map and legend for the northern SCU Lightning Complex burned area.

Hazardous Minerals

Figure 8 shows the distribution of rocks and mines that potentially contain hazardous minerals and elements in the vicinity of the SCU Lightning Complex. The map shows that the burned area is underlain predominantly by various metamorphic, igneous, and serpentinite/ultramafic rocks that have the potential for locally elevated concentrations of asbestos, chromium, cobalt, copper, manganese, mercury, and nickel. Landslide deposits dispersed throughout the burned area may have potential for locally elevated concentrations of metals. The eastern edge of the burned area is underlain by Mesozoic and Cenozoic sedimentary rocks that have the potential for elevated concentrations of cadmium, selenium, uranium, and possibly other CAM-17 metals. State and federal health officials consider these minerals to be hazardous to human health at certain levels. Mining prospects are located throughout the burned area, including chromium, copper, manganese, mercury, and silver. Some surface prospects for mercury are located in the vicinity but outside the boundaries of the Round Fire and Palm Fire burned areas which are not depicted on this figure. No active oil or gas wells were located within the burned area of the SCU Lightning Complex. Some decommissioned oil and gas wells are located on the eastern end of the burned area in Del Puerto Canyon, but are not included on this figure.

For general review information on hazardous minerals, see:

California Office of Environmental Health Hazard Assessment
https://oehha.ca.gov/chemicals/

For additional information on the noted naturally occurring hazardous minerals, see:

https://www.who.int/ipcs/assessment/public_health/asbestos/en/

https://www.who.int/ipcs/assessment/public_health/mercury/en/

http://www.who.int/mediacentre/factsheets/fs361/en/

http://www.who.int/ipcs/assessment/public_health/cadmium/en/

http://www.who.int/water_sanitation_health/dwq/chemicals/selenium.pdf

http://www.who.int/water_sanitation_health/water-quality/guidelines/chemicals/background_uranium.pdf?ua=1

For the Department of Conservations well finder see:

https://www.conservation.ca.gov/calgem/Pages/WellFinder.aspx

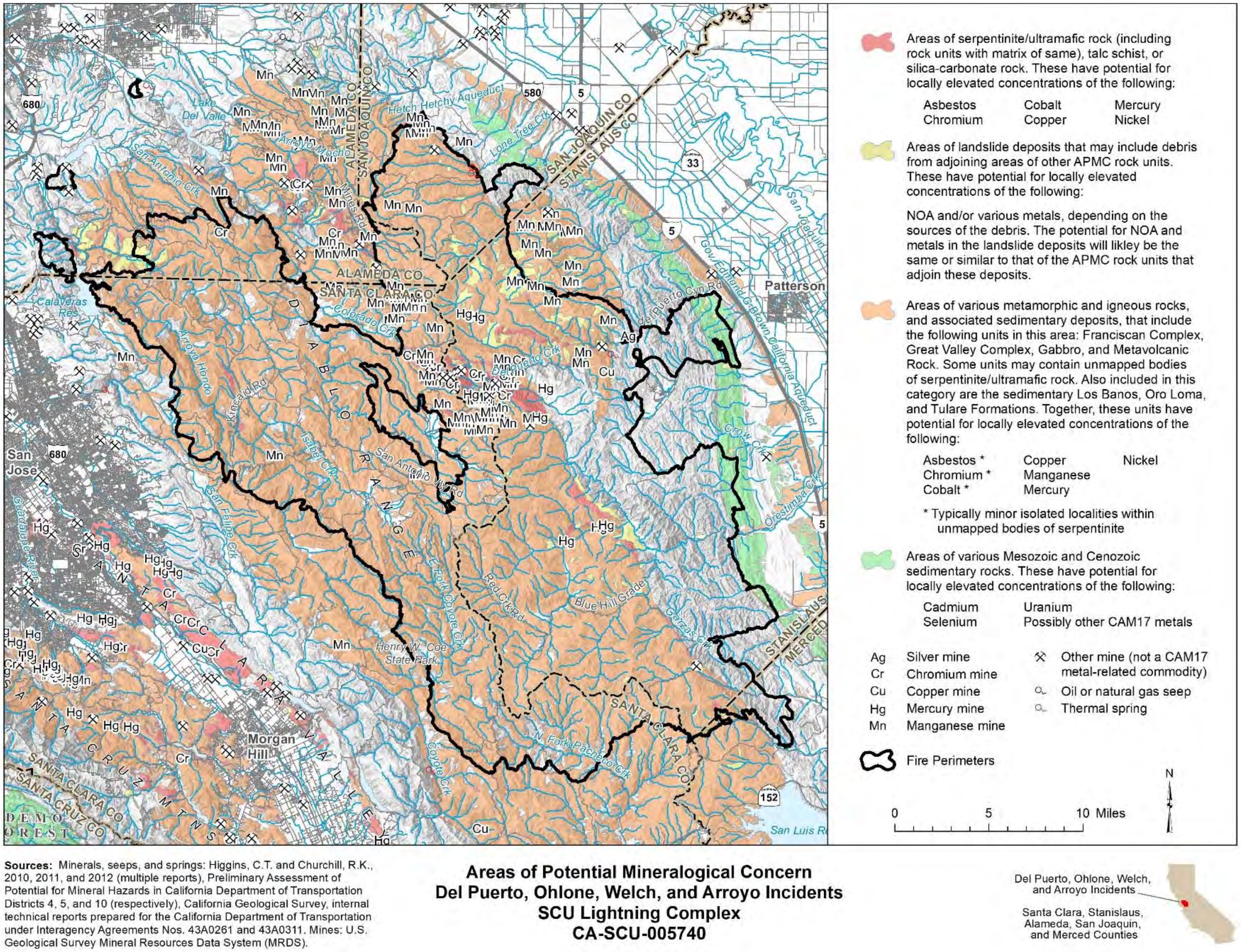


Figure 8. Map of areas and mines of potential mineralogical concern for the SCU Lightning Complex.

3. REMOTE SENSING AND MODELING RESULTS

Soil Burn Severity

The degree to which fire affects soil properties, along with other controlling factors, is important for predicting the potential for increased runoff and sedimentation (Keeley, 2009). Soil burn severity mapping reflects the spatial distribution of the fire's effects on the ground surface and soil conditions and is needed to rapidly assess fire effects, identify potential Values-at-Risk, and prioritize field assessment (Parsons et al., 2010; CAL FIRE and CGS, 2020).

USDA analysts at the Remote Sensing Applications Center (RSAC) used Sentinel-2 satellite derived spectral reflectance data to characterize post-burn conditions The USGS EROS Center compared post-fire satellite imagery with pre-fire imagery to generate a Burned Area Reflectance Classification (BARC) map. The BARC map shows changes in reflectance values that approximate the spatial distribution and the degree of change in vegetation in the burned area. CAL FIRE and CGS staff made soil burn severity (SBS) maps for the SCU Lightning Complex through a combination of remote sensing and field soil tests. The WERT made field observations on September 5 and 6, 2020 to assess the correlation between the satellite derived BARC map and observed soil burn severity (Parsons et al., 2010).

The WERT found the observed soil burn severity was generally lower than the BARC map classification for moderate and high burn severities. A CAL FIRE watershed scientist/GIS analyst adjusted the BARC map to match observed soil burn severity and vegetation type to produce a SBS map. The USGS Landslide Hazards Program used the SBS map as one input for the USGS post-wildfire debris flow hazard model (Figure 9).

The SCU Lightning Complex burned area is dominated by unburned/very low and low soil burn severity (Figure 9) (Table 3). Over 92% of the fire area burned at low severity or less. Soil burn severity was limited because of the type of fuels present (chaparral, oak woodland with grass understory, and grassland) and the rate of fire spread. The denser the vegetative cover and the slower the rate of fire spread typically results in higher soil burn severity.

Table 3: Soil Burn Severity Class by Percent and Area

SBS Classification	Percent Burned Area	Area (acres)*
Very Low/Unburned	22.1	89,899
Low	70.6	286,805
Moderate	7.3	29,782
High	<0.1%	8

* - RSAC satellite derived acreage

Based on the soil burn severity map, some of the slopes on the west-central portions of the SCU Lightning Complex that drain north towards Livermore and Pleasanton experienced moderate soil burn severity within larger areas of low soil burn severity. An area of steep slopes on the North Fork of Orestimba Creek burned at moderate SBS. Additionally, small, isolated areas of the North Fork of Pacheco Creek burned at moderate SBS.

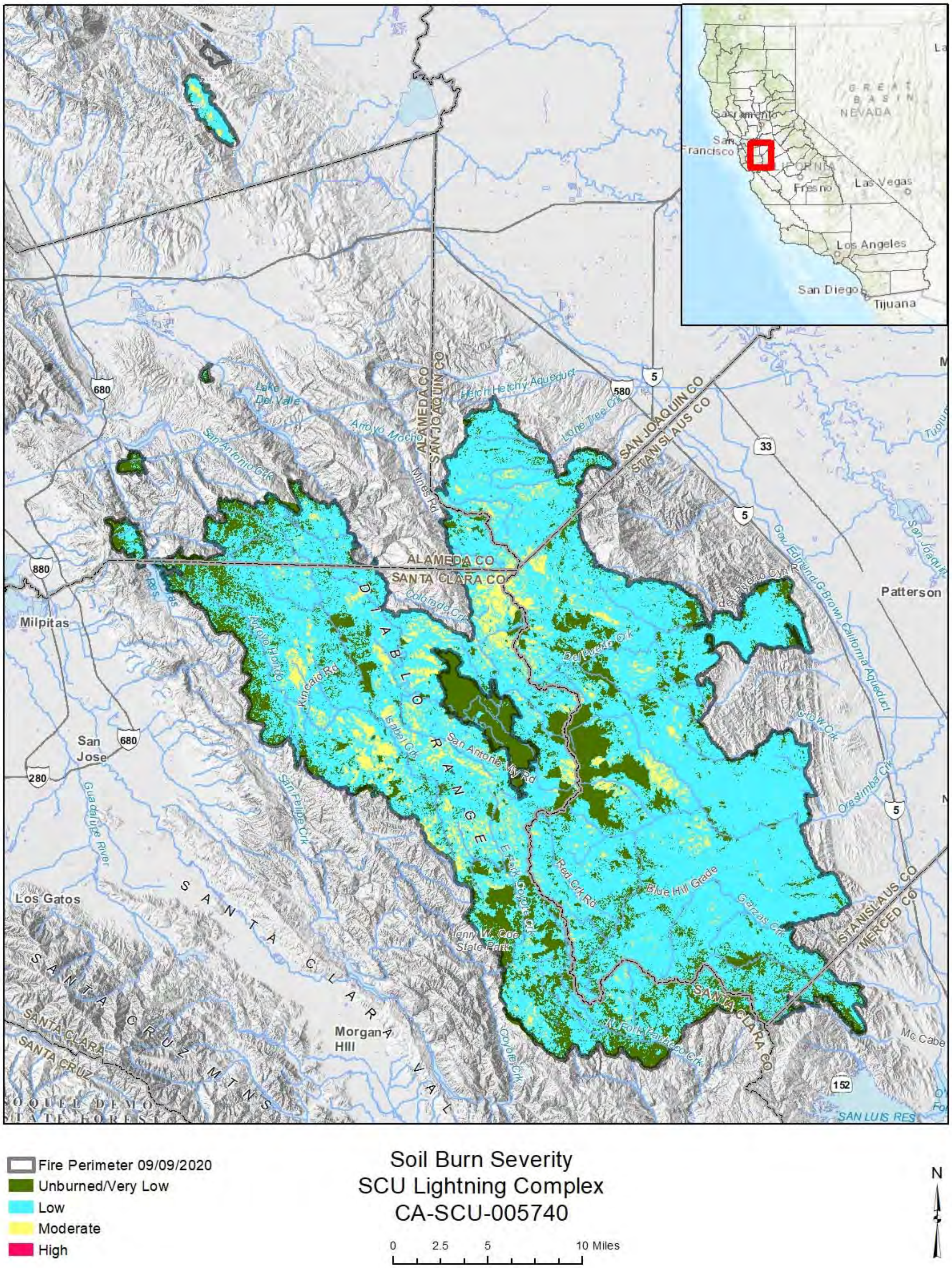


Figure 9. Soil burn severity map for the SCU Lightning Complex.

Post-Fire Hydrology

Peak flows increase following wildfire as a result of reduced vegetation and surface cover, and the formation of water repellent soils. The largest peaks occur during intense, short duration rainfall events on watersheds with steep slopes (Neary et al., 2005). Post-fire peak streamflows can exceed three orders of magnitude compared to peak flows during similar pre-fire events (Moody and Martin, 2001; Wagenbrenner, 2013; Wohlgemuth, 2016). Kinoshita et al. (2014) reported that commonly used flood flow prediction methods have lower confidence with larger recurrence interval events (25- and 50-year); therefore, we analyzed pre- and post-fire flows using a 2-year and a 10-year storm event.

The WERT selected nine watersheds, or “pour points”, to estimate potential post-fire peak flow increases to Values-at-Risk from flooding and sediment-laden flood hazard. Figure 10 shows the pour point locations. Pour points for sub-watersheds are established to obtain a better understanding of hydrologic response for specific areas, especially those that are related to areas at risk from flooding. Pour points represent a sampling of the fire and are not established for all of the Values-at-Risk. The selected pour points represent elevated post-fire flood/sediment laden flow hazard to reservoirs and/or impacts to public safety and property. Pour points located close to the fire perimeter and burned at higher soil burn severity yield larger post-fire flow increases than those far below the fire perimeter and those burned at lower severity.

The pre-fire peak flows were estimated for each pour point using the flow transference method (Waananen and Crippen, 1977). A design flood flow can be calculated using flow transference by adjusting for the difference in drainage areas between a gaged station and an ungaged station in a nearby hydrologically similar watershed. USGS stream gaging station 11169800, Coyote Creek near Gilroy, California was selected due to its unregulated condition and 37 annual peak flow records (Figure 4a), and its location partially within the fire perimeter (immediately above pour point #1). The flow transference method is superior to the more general USGS Magnitude and Frequency Method regional regression equations (Gotvald et al., 2012) if a hydrologically similar watershed with a stream gaging station is nearby and available stream gaging annual peak discharge records are adequate (Waananen and Crippen, 1977; Cafferata et al., 2017). Pre-fire peak flow estimates were produced for the nine pour point watersheds for 2-year and 10-year recurrence interval discharges.

Changes in post-fire peak flows were estimated using two methods. The first method uses a flow modifier adapted from Foltz et al. (2009) to calculate post-fire clearwater flows. The flow modifier is the ratio of post-fire to pre-fire runoff, and a 100% flow increase (doubling of pre-fire flows) is assumed for high and moderate burn severity areas (Table 4). These flows are then bulked to account for entrained sediment and debris (Gusman, 2011). The Foltz et al. (2009) and Gusman (2011) methods are described in greater detail in the 2020 WERT Draft Procedural Guide (CALFIRE and CGS, 2020).

The second method estimates peak flow using Moody’s level 2 empirical model (Moody, 2012) that calculates a post-fire runoff coefficient for a burned watershed as a function of mean difference in normalized burn ratio (dNBR), 30-minute rainfall intensities above 7.6 mm/hr (0.3 in/hr), and basin area in square kilometers. The post-fire peak flow is then compared to the pre-fire peak flow derived from the adjusted flows using the Coyote Creek USGS gaging station annual peak flow data to calculate a flow multiplier.

Field experience shows that the Foltz et al. (2009) method generally underestimates peak flows in central and northern California, particularly for short return period storms (<10-year RI) and for small watersheds that respond quickly to high-intensity, short-duration (<30 min) rainfall. Conversely, Moody's (2012) empirical model, which is derived using data from geoclimatic unique regions along the front range of the Rocky Mountains and from southern California and northern Nevada, generally overestimates peak flows in central California. Data on post-fire runoff from the 2015 Valley Fire that burned primarily in Lake County; however, indicate similar post-fire rainfall-runoff relationships to those documented in the western half of the United States by Moody (2012). Furthermore, these data indicate that runoff is generated on burned hillslopes and small catchments when 30-minute rainfall intensities exceed approximately 0.2 inches per hour (5 mm/hr).[1]

To account for the range in model results, the average of the two modeled multipliers was used to estimate peak post-fire flow responses at the nine pour points (Table 5). The predicted peak flow from 2- and 10-year rainfall events were then compared to flow frequencies derived for each modeled watershed from flood frequency analyses conducted for local USGS gaging station data. Predicted recurrence intervals were matched with a recurrence interval flow from gaging station data.

Results indicate that the 2-year storm is modeled to result in peak bulked flows that have flow multipliers between 1.0 to 1.8 and result in flow responses equivalent to <10-year recurrence interval floods. The 10-year storm is modeled to result in peak flow multipliers between 1.0 to 1.8 and produce flow responses equivalent to approximately 10 to 100-year RI floods. The largest changes are expected to occur for the Arroyo Valle and Arroyo Hondo pour point watersheds.

These estimates are intended for emergency response planning purposes only and are not to be used for design. Moreover, they are to be applied to flows within the first year following the fire. As knowledge is obtained through monitoring the runoff response of stressing storms in the first wet season after fire, or as the slopes in the watersheds become revegetated, it is likely these flow multipliers can be adjusted down to reduce conservatism.

[1] Research conducted on the Boggs Mountain Demonstration State Forest located in Lake County, performed by the USDA Forest Service Pacific Southwest Research Station, Oregon State University, and CAL FIRE.

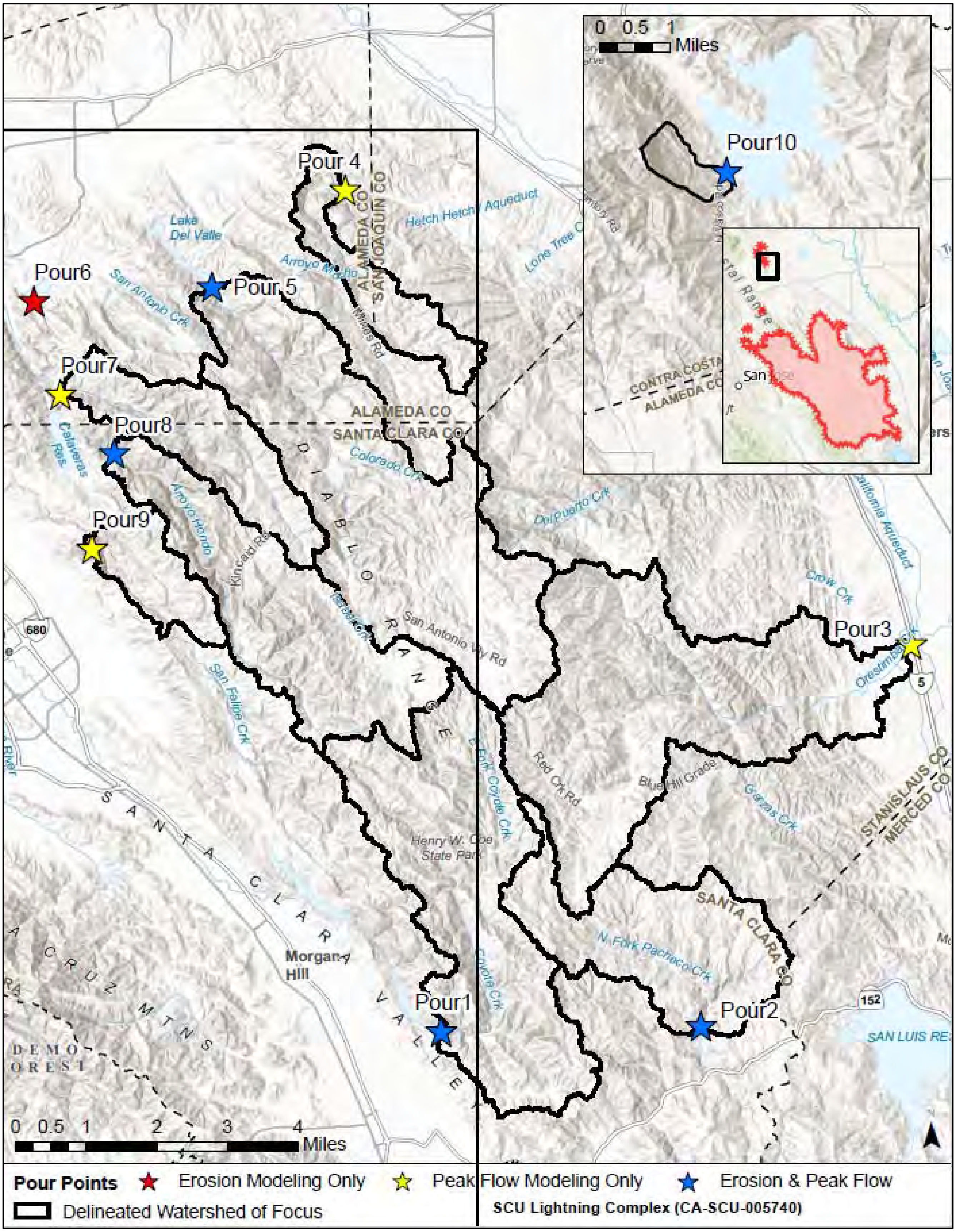


Figure 10. SCU Lightning Complex pour point watersheds.

Table 4. SCU Lightning Complex pour point watersheds and soil burn severity data.

Pour Point Number	Pour Point Name	Drainage Area (ac)	% of WS Burned	% Unburned/ Very Low	% Low	% Mod	% High
PPT 1	Coyote	71,260	35.6	76.4	19.6	4.0	0.0
PPT 2	Pacheco	40,635	62.7	62.2	36.8	1.0	0.0
PPT 3	Orestimba	86,932	90	26.6	69.0	4.4	0.0
PPT 4	Corral Hollow	15,962	41.8	59.0	36.8	4.2	0.0
PPT 5	Arroyo Valle	85,693	72	45.1	45.1	9.8	0.0
PPT 7	Alameda	25,465	84.6	35.6	62.1	2.3	0.0
PPT 8	Arroyo Hondo	50,130	87.9	27.4	60.8	11.8	0.0
PPT 9	Upper Penitencia	12,338	23.3	90.3	9.7	0.0	0.0
PPT 10	Los Vaqueros	428	97.9	7.2	79.6	13.1	0.0

Table 5. Estimated bulked post-fire flow multipliers and post-fire equivalent recurrence intervals (RI) for the pour point watersheds shown in Figure 10.

Pour Point Number	Pour Point Name	2-yr RI, Post-Fire Post-Fire Multiplier (Bulked Flows)	Post-Fire Equivalent RI	10-yr RI, Post-Fire Post-Fire Multiplier (Bulked Flows)	Post-Fire Equivalent RI
PPT 1	Coyote	1.2	3	1.1	14
PPT 2	Pacheco	1.1	2	1.1	12
PPT 3	Orestimba	1.4	3	1.5	57
PPT 4	Corral Hollow	1.1	2	1.1	12
PPT 5	Arroyo Valle	1.6	5	1.6	113
PPT 7	Alameda	1.4	3	1.6	30
PPT 8	Arroyo Hondo	1.8	6	1.8	91
PPT 9	Upper Penitencia	1.0	2	1.0	11
PPT 10	Los Vaqueros	1.4	2	1.4	24

Post-Fire Debris Flows

USGS Debris Flow Hazard Model

To help assess the locations of hazards to life-safety and property in and adjacent to the SCU Lightning Complex burned area, the WERT used the USGS postfire debris-flow hazard model (Staley et al., 2016). The model defined 2,972 catchments within the burned area with a maximum basin size of less than 8 km^2 (~2,000 acres). Segments that drain an area greater than 8 km^2 are modeled as USGS watch streams. Flooding is a greater concern in basins greater than 8 km^2; however, debris flow hazards are less likely but still present. The USGS Debris Flow Model also does not model hazards for basins that are less than 0.02 km^2 (~5 acres) in area.

These results give an indication of potential post-fire watershed response. It is important to note that the USGS probability and volume models provide debris flow hazards results for a single precipitation event. The USGS model was developed for rapid post-fire response and results do not constitute a site-specific analysis of debris flow hazards. Additional on-the-ground evaluation should be conducted by qualified and licensed professionals where necessary and appropriate. Additionally, other hillslope processes such as rockfalls and debris slides are not included in the model results and the volume estimates do not consider potential other sources of debris yield bulking.

Table 6: Conversion from metric to U.S. standard measure for rainfall intensities.

Rainfall Intensity ($mmhr^{-1}$)	Inch hr^{-1}	Inch at 15-min duration
24	0.94	0.24
28	1.10	0.28
32	1.26	0.32
40	1.57	0.39

USGS Post-Fire Debris Flow Basin Probability

The USGS Debris Flow Model indicates that with a 15-minute duration at 24 mm hr^{-1} precipitation event (Table 6), less than 3% of the modeled basins have a likelihood of 50% or greater to produce debris flows P50) (Figure 11, Table). This rainfall event represents about a 1-year recurrence interval (RI) (NOAA Atlas 14) (Figure 11, Table). Almost 27 percent of the basins model greater than 50% probability (P50) for debris flow initiation for the 15-min at 40 mm hr^{-1} storm, a 5- to 10-year RI storm (Figure 11C, Table). The Table in Figure 11 also shows the percentage modeled basins with P>50 for the 15-minute, 24 mm hr^{-1} and 32 mm hr^{-1} storms. Figure 11B and 11C, show basin probability for debris flow initiation of the 15-minute duration 32 mm hr^{-1} and 40 mm hr^{-1} events, respectively, compared with the locations of VARs with observed debris flow potential. Fifty-four (54) percent (7 of 13) and 69 percent (9 of 13) of VAR locations are modeled moderate to high hazard for the 32 mm hr^{-1} and 40 mm hr^{-1} storms, respectively.

The data indicate a low to moderate hazard to VARs identified with debris flow potential at the 1-2 year 15-min duration recurrence interval rainfall intensity that increases to moderate to high hazard at the 5-to 10-year recurrence interval storm intensity (NOAA Atlas 14) (Figure 11, Table). At the lower 24 mm hr^{-1} intensities, all the catchments modeled greater than P50 are small, steeply convergent side tributary catchments. At the higher rainfall intensities, larger catchments capable of producing larger amounts of debris are included and present a greater risk to downstream resources. Figure 11 shows catchments that model yielding debris volumes greater than 10,000 m^3 (~13,000 yd^3)) for different rainfall intensities. The results of the USGS debris flow modeling also indicate that most hillslope catchments may be sensitive to rainfall rates exceeding 32 mm hr^{-1}, as the model indicates that about 25 percent of the catchments and about 61 percent of the modeled area have a moderate or greater combined hazard for that event.

Debris Flow Volumes

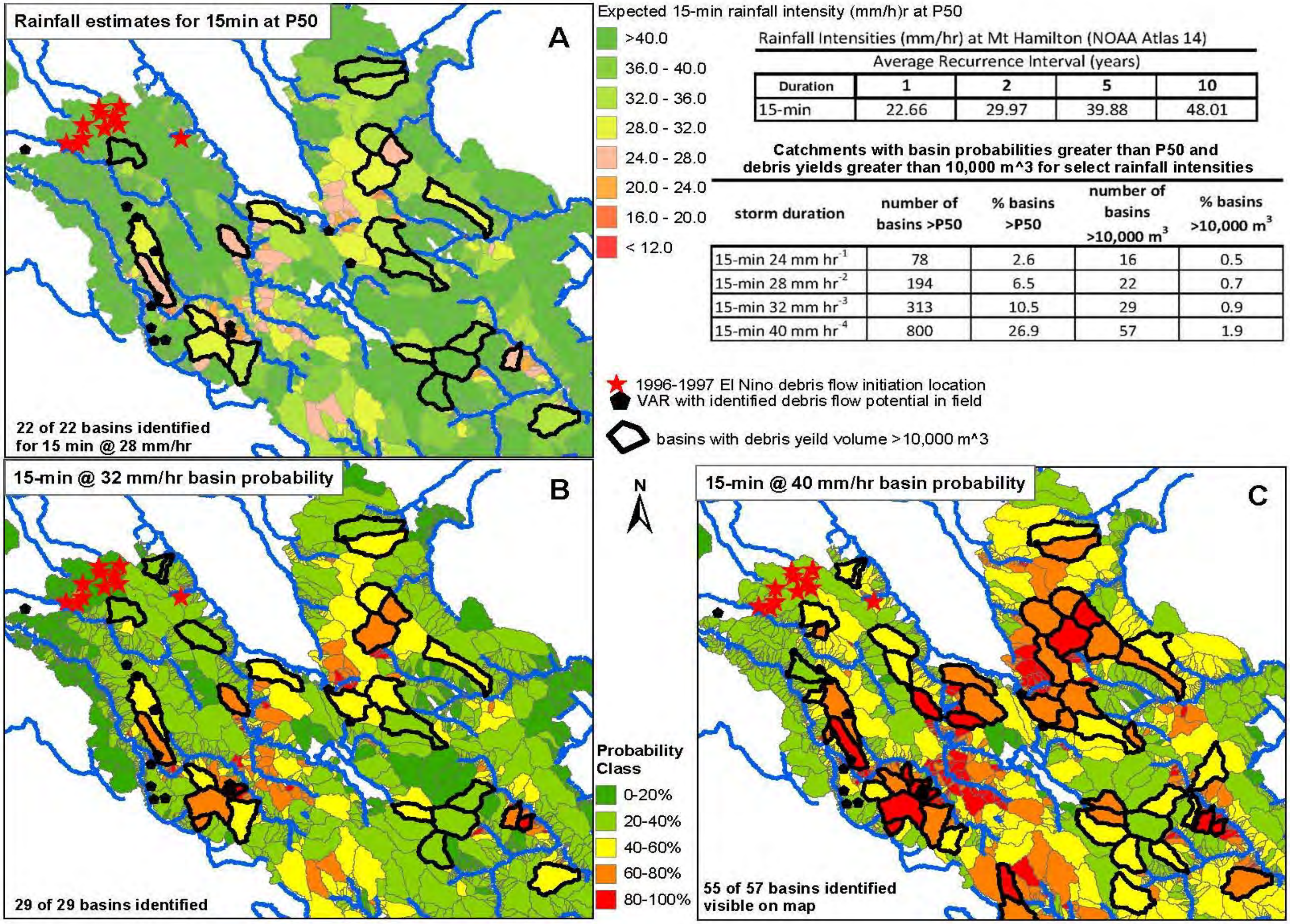
The USGS post-fire debris flow model calculates the volume of post-fire debris flows (Gartner et al., 2014). The results are provided as the total volume in cubic meters generated from the modeled burned watershed during a design storm. The basin volume analyses indicate that with a 15-minute rainfall intensity of 24 mm hr^{-1} (0.94 in hr^{-1}), debris flow volume yields for the 2,972 basins modeled for the SCU Lightning Complex include: 16 basins ranging between approximately10,000-100,000 (actual range 10,126 to 16,282) cubic meters (m^3), 449 basins between 1,000 to 10,000 m^3, and 2,507 basins with less than 1,000 m^3. Figure 11a highlights in black basins that predict yields greater than 10,000 m^3 for the 15-minute duration storm at the 28 mm hr^{-1}, 32 mm hr^{-1}, and 40 mm hr^{-1} rainfall intensities.

Combined Hazard

Figure 11b shows the combined hazard derived from both estimated debris flow probability and volume based on a peak 15-minute rainfall intensity of 28 mm hr^{-1}, which correlates with a storm event that has a 1- to 2-year average recurrence interval at Mount Hamilton (NOAA Atlas 14) (Figure 11a). The model indicates a moderate combined hazard for 18 percent of the modeled catchments that account for about 46 percent of the modeled area in the fire perimeter. The USGS Debris Flow Model predicts that about 25 percent of basins are moderate or higher for the combined hazard class at the 15-min at 32 mm hr^{-1} depth, which covers about 61 percent of the modeled area.

Historical Debris Flow Locations

The locations of historical debris flows initiated during the winter of 1996-1997 are plotted on Figure 11a. They are clustered in the northwestern corner of the SCU Lightning Complex burned area. Figure 11a, panel A illustrates that basins underlying the 1997 debris flow locations require a greater than 40 $mmhr^{-1}$ rainfall intensity for the 15-minute duration event for a P50 probability to generate debris flows. The clustering of the 1996-1997 debris flow locations to the northern portions of the burned area could be a result of a combination of rain shadow effect over the southern burned area and the debris flows that initiated were in an unburned condition and also likely initiated under different storm conditions than considered by the USGS Post-Fire Debris Flow Hazard Model.



Rainfall Intensities (mm/hr) at Mt Hamilton (NOAA Atlas 14)

	Average Recurrence Interval (years)			
Duration	1	2	5	10
15-min	22.66	29.97	39.88	48.01

Catchments with basin probabilities greater than P50 and debris yields greater than 10,000 m^3 for select rainfall intensities

storm duration	number of basins >P50	% basins >P50	number of basins >10,000 m^3	% basins >10,000 m^3
15-min 24 mm hr[1]	78	2.6	16	0.5
15-min 28 mm hr[2]	194	6.5	22	0.7
15-min 32 mm hr[3]	313	10.5	29	0.9
15-min 40 mm hr[4]	800	26.9	57	1.9

Figure 11. A) Rainfall estimates for catchments at the 50% probability (P50, moderate) of debris flow initiation. B) Basin probability of debris flow initiation for the 15-min at 32 mm/hr event C) Basin probability of debris flow initiation at the 15-min at 40 mm/hr event. Highlighted catchments have >10,000 m^3 predicted debris yields. VARs observed with geomorphic evidence of debris flows and historic debris flow locations are plotted.

Post-Fire Erosion

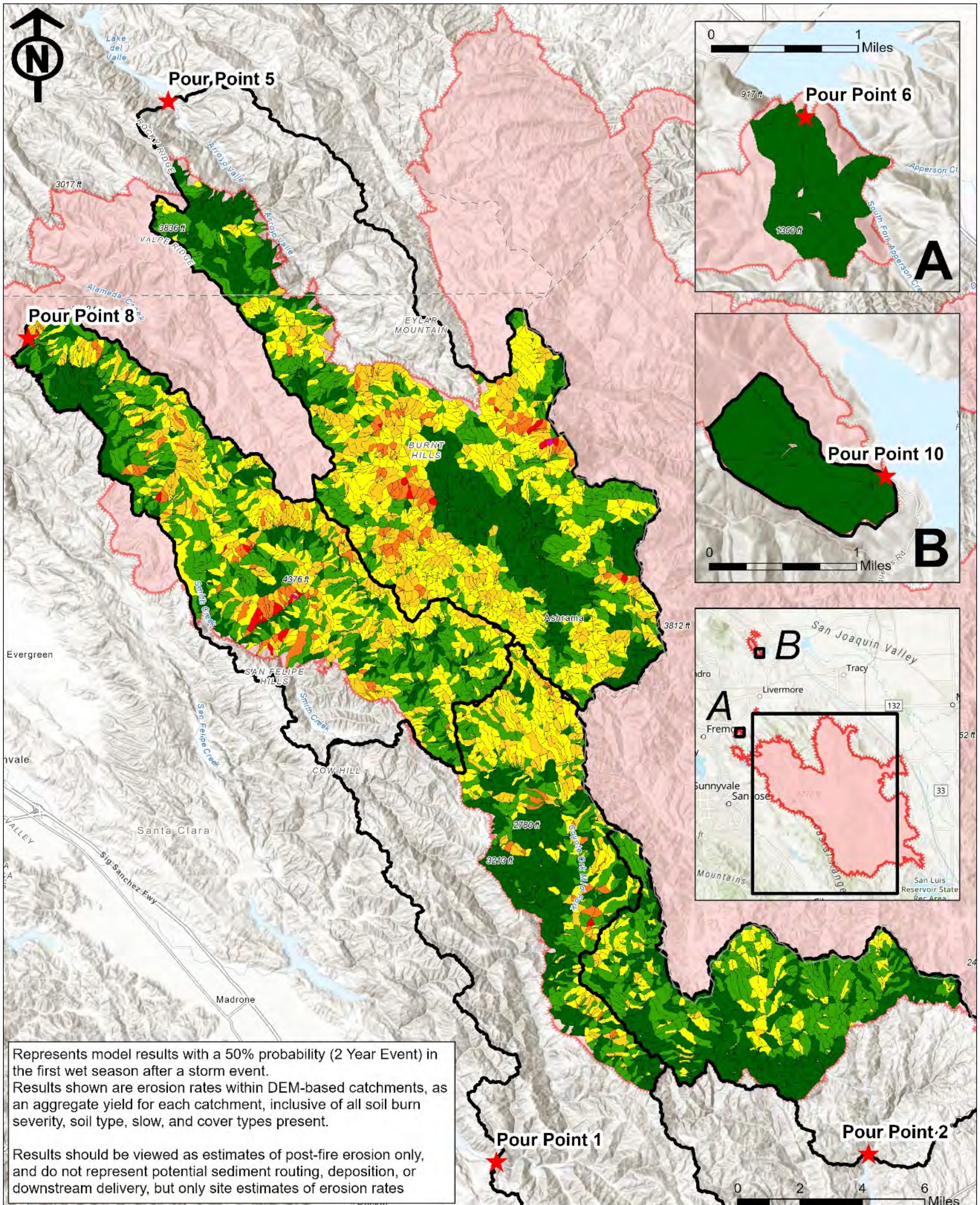
Post-fire erosion rates for the SCU Lightning Complex burned area was modeled using Batch ERMiT (Erosion Risk Management Tool)[2] by CAL FIRE Watershed Scientist Will Olsen. ERMiT is a web-based tool developed to predict surface erosion from pre- and post-fire hillslopes, and to evaluate the potential effectiveness of various erosion mitigation practices (Robichaud et al., 2011). ERMiT requires input for climate and physical parameters based on 1) location, 2) vegetation type (forest, range, chaparral, grassland), 3) soil type (USDA textures and rock content), 4) topography (slope length and gradient), and 5) soil burn severity class (low, moderate, high). This model provides probabilistic estimates of single-storm, post-fire hillslope erosion by incorporating variability in rainfall characteristics, soil burn severity, and soil characteristics into each prediction (Robichaud et al., 2011).

Pre-fire erosion rates in an unburned watershed are generally less than 1 ton/acre. Field investigations found water repellent soils to be relatively uncommon and weakly hydrophobic in the burned area. Because of the low soil burn severity the modeled erosion rates are relatively moderate. Table 7 summarizes estimates of post-fire erosion rates for 2- and 10-year recurrence interval storms in the first year and second year following fire. Results demonstrate that erosion rates increase by about 4- to 7-fold going from a 2-year storm to a 10-yr storm occurring in the first year following fire. Erosion rates are expected to drop quickly after the first year. Plots showing the spatial distribution of relative erosion rates from minimum to maximum are shown for the 2-year storm in Figure 12. Table 7 also gives the ratio of the post-fire erosion rate to the pre-fire erosion rate and shows for the 2-year storm within the first year of the burn erosion rates will increase 7- to 32-times the pre-fire erosion rates. The increase in post-fire erosion rate for the 10-year storm ranges from 2- to 11 –times the pre-fire erosion rate.

Table 7. Batch ERMiT surface erosion estimates.

Location	Pour Point	% Area Burned	2 Year, Year 1 Mean (Ton/Ac)	2 Year, Pre-Fire (Ton/Ac)	2 Year, Year 1 Post/ Pre Inc	10 Year, Year 1 Mean (Ton/Ac)	10 Year, Pre-Fire (Ton/Ac)	10 Yr, Yr 1 Post/ Pre Inc
Coyote Creek	1	35.6	2.41	0.09	27	10.14	1.43	7
Pacheco Reservoir	2	62.7	1.30	0.16	8	6.08	0.98	6
Lake del Valle	5	72	2.52	0.10	25	9.33	0.85	11
San Antonio Reservoir	6	100	0.76	0.1	8	3.37	0.64	5
Calaveras Reservoir	8	87.9	2.53	0.08	32	10.10	1.19	8
Los Vaqueros Reservoir	10	98	0.69	0.10	7	4.51	1.87	2

[2] http://forest.moscowfsl.wsu.edu/fswepp/batch/bERMiT.html



Pour Points for Erosion Modeling

ERMiT Model Results (Catchments)

2 Year (50% Probability) Year 1

- Minimal Surface Erosion
- Moderate Surface Erosion
- Maximum Surface Erosion

Average results across all modeled basins is 2.5 Tons/Ac	Pour Point	% Area Burned	2 Year, Year 1 Mean (Ton/Ac)	2 Year, Pre-Fire (Ton/Ac)	2 Yr, Yr 1 Post/Pre Inc
Coyote Creek at Coyote Reservoir	1	35.6	2.41	0.09	27
North Fork Pacheco Creek at Pache	2	62.7	1.30	0.16	8
Arroyo Valle at Lake del Valle	5	72	2.52	0.10	25
San Antonio Reservoir South Hillslop	6	100	0.76	0.1	8
Arroyo Hondo at Calaveras Reservoi	8	87.9	2.53	0.08	32
Los Vaqueros Reservoir Western Hill	10	98	0.69	0.10	7

Figure 12. SCU Lightning Complex ERMiT predicted surface erosion rates for the 2-year storm event.

Sedimentation

Pre-fire sedimentation rates were investigated using bathymetric data for Coyote Reservoir. Bathymetric data were available from an Excel spreadsheet provided by Dr. Toby Minear, USGS, in 2009; data from the spreadsheet were used to publish Minear and Kondolf (2009).[3] Bathymetric data for Coyote Reservoir revealed that approximately 2,017,560 m^3 (1,636 acre-feet) of sediment accumulated over 43 years between surveys. Assuming a conversion factor of 0.81 short tons per cubic yard (Minear and Kondolf (2009),[4] this equates to 511 $yd^3/mi^2/yr$ or 414 $t/mi^2/yr$ (0.6 t/ac/yr).

Post-fire surface erosion rates are expected to be 4- to 7-times higher than pre-fire rates for the SCU Lightning Complex. Past post-fire studies in the California Coast Ranges suggest a considerable level of increased sedimentation for watersheds burned at higher severities. For example, Ritter and Brown (1972) reported that sediment yields increased significantly in Williams Reservoir following a 1961 wildfire that burned in the nearby Los Gatos Creek watershed. Warrick et al. (2015) state that average sediment yields can increase by an order of magnitude within watersheds the first year following a wildfire in the Santa Ynez Mountain region, located to the south of this fire complex. Additionally, a post-fire sediment study conducted on Boggs Mountain Demonstration State Forest following the 2015 Valley Fire, primarily located in Lake County, has revealed sediment rates the first winter of 5-10 t/ac for intensely burned forest areas (D. Coe, CAL FIRE, Redding, unpublished data). Due to the lower level of soil burn severity for the watersheds draining to multiple reservoirs in the SCU Lightning Complex, post-fire surface erosion rates are expected to be lower than the examples above.

4. SUMMARY OF OBSERVATIONS AND RECOMMENDATIONS

The following are observations and preliminary recommendations for Values-at-Risk within and downslope/downstream of the SCU Lightning Complex. The SCU Lightning Complex burned in six counties: Alameda, Contra Costa, Santa Clara, San Joaquín, Stanislaus, and Merced. San Benito County is outside of the burned area but was identified as having postfire flooding impacts. Potential Values-at-Risk (VARs) are grouped by county. General observations and recommendations for each county are provided below. Observations and preliminary recommendations are summarized in tabular form in Appendix B (i.e., VAR Table) and VAR locations are displayed in Appendix C. VAR-specific maps and information are provided on information sheets in Appendix D. Furthermore, spatial data of Values-at-Risk can be requested in the form of shapefiles from the WERT team lead.

This evaluation is not intended to be comprehensive and/or conclusive, and additional VARs may be identified through more detailed evaluation by responsible agencies. Several limitations include:

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[3] Estimating reservoir sedimentation rates at large spatial and temporal scales: A case study of California.

[4] Minear and Kondolf (2009) assumed that reservoir sediments had a density of 960 kg/ m^3.

- Not all roadway culverts and bridges in and adjacent to the burned area were evaluated.
- Some potential VARs were not evaluated because of the lack of access.
- Some VARs were evaluated at a distance or using remote sensing imagery when access was limited.
- When evaluating a destroyed structure, the VAR designation was based on the assumption that the structure would be rebuilt in-place. See the General Recommendations section for recommendations on placement of rebuilt structures.
- VAR evaluation was not conducted within all mapped flood hazard areas that are downstream of the burn perimeter. Risk of flooding in these areas is preexisting and is anticipated to be increased by post-fire runoff. As such, local agencies should consider these mapped hazard areas in addition to the VARs identified in this report.

It is intended that responsible agencies will use the information presented in this report as a preliminary guide to complete their own more detailed evaluations and develop detailed emergency response plans and mitigations.

Alameda County

Summary of Observations

The SCU Lightning Complex burned 24,408 acres in Alameda County which represents 6% of the total burned area. Development within and downstream of the burned area consists primarily of parklands, rural homes, small ranch properties, hillside residences, and associated private access roads.

Soil burn severity within Alameda County is generally low to very low/unburned with small amounts of moderate. The debris flow model generally predicts a low probability of debris slides within this area. See Section 3 for a discussion of soil burn severity and debris flow model results.

The WERT identified 14 VARs within Alameda County. One VAR is a polygon that crosses the county line between Alameda County and San Joaquin County (SCU01) (Table 8).

Four VARs were determined to have moderate risk to life-safety or property associated with debris flows or combined flood and debris flow hazards (SCU43, SCU44, SCU45, SCU48).

All 14 VARs are associated with flood or combined debris flow / flood hazards. The majority of VARs are associated with residential structures, camp facilities, and recreational facilities built in mapped flood zones or are built on a low-lying surface with geomorphic evidence for flooding. SCU02 is a bridge across Arroyo Mocho that constricts flow and diverts the creek with a potential for flooding at the road and erosion of the abutments. This bridge is located relatively low on Arroyo Mocho and could restrict ingress and egress to a large part of Arroyo Mocho Road if compromised.

Table 8. Summary of VAR hazard calls for Alameda County.

Alameda County						
VAR type	Hazard Call					
	Life-Safety			Property		
	low	mod	high	low	mod	high
Flood	SCU02 SCU03 SCU05 SCU06 SCU07 SCU08 SCU09 SCU46 SCU47	SCU48		SCU48	SCU02 SCU03 SCU05 SCU06 SCU07 SCU08 SCU09 SCU46 SCU47	
Flood / Debris Flow		SCU43 SCU44 SCU45			SCU43 SCU44 SCU45	
Flood / Debris Flow / Rockfall	SCU01				SCU01	
total	10	4	0	1	13	0

In Alameda County, San Antonio Reservoir, Lake del Valle Reservoir, as well as part of Calaveras Reservoir, are downslope/downstream of watersheds impacted by the SCU Lightning Complex and are subject to sediment and water quality impacts.

Calaveras Reservoir is under the jurisdiction of the San Francisco Water Department and has a capacity of 30,000 acre-feet of water. Calaveras Creek and Arroyo Hondo flow into Calaveras Reservoir. San Antonio Reservoir is also under the jurisdiction of the San Francisco Water Department and has a capacity of 50,500 acre-feet of water and stores water from the Hetch Hetchy Aqueduct. San Antonio Creek, which originates in the San Antonio Valley, flows into San Antonio Reservoir. Lake del Valle is a California Department of Water Resources reservoir with a capacity of 77,100 acre-feet of water and Is part of the South Bay Aqueduct Complex. Arroyo Valle flows into Lake del Valle.

The WERT did not identify any specific VARs associated with these reservoirs; however, increased sediment and impacts to water quality are possible. See the Section 3 for a discussion of flow predictions and bulking factors for these watersheds, and past sedimentation rates at Coyote Reservoir.

Alameda County-Specific Recommendations:

- Residents are encouraged to sign up for ACAlert to receive emergency alerts for severe weather and flooding: https://www.acgov.org/emergencysite/
- Consider closing campground facilities at Del Valle Regional Park when severe storms are forecasted.
- Monitor water quality of reservoirs during and immediately after rain events.

Contra Costa County

Summary of Observations

The SCU Lightning Complex burned 3,104 acres in Contra Costa County within and adjacent to Morgan Territory Regional Preserve and Round Valley Regional Park, which represents less than 1% of the total burned area. The soil burn severity in this area is generally low to moderate. The debris flow model generally predicts a low probability of debris slides within this area. See Section 3 for a discussion of soil burn severity and debris flow model results.

One VAR was identified within Contra Costa County, associated with flood and combined debris flow hazards at the Los Vaqueros Reservoir (SCU50) (Table 9). Los Vaqueros Reservoir is under the jurisdiction of the Contra Costa Water District and has a capacity of 160,000 acre-feet of water. The WERT identified potential debris flow deposits in the channel suggesting processes that could impact water quality of the reservoir, additionally sediment impacts to the reservoir are possible. The debris flow model shows a low probably of debris flows in this area; however, it should be monitored. It is a low risk to life-safety, but moderate risk to property.

Table 9. Summary of VAR hazard calls for Contra Costa County

Contra Costa County						
VAR type	Hazard Call					
	Life-Safety			Property		
	low	mod	high	low	mod	high
Flood						
Flood / Debris Flow	SCU50				SCU50	
Rockfall						
total	1	0	0	0	1	0

Contra Costa County-Specific Recommendations:

- Monitor and maintain infrastructure at Los Vaqueros Reservoir.
- Consider installing a debris catchment if needed.

San Benito County

Summary of Observations

The SCU Lightning Complex did not burn in San Benito County; however, areas in the northeast corner of the county are downslope/downstream of watersheds impacted by the fire.

No VARs were identified in San Benito County. However, the spillway for the Pacheco Reservoir dam in Santa Clara County was identified as having a high risk to life-safety and property, and is upstream of agricultural communities in northern San Benito County. See the VAR description and recommendations for Pacheco Reservoir in the Santa Clara County VAR section.

San Benito County-Specific Recommendations:

- San Benito County Emergency Services should have an evacuation plan in place for a potential uncontrolled spill at the Pacheco Dam.
- Residents are encouraged to sign up for emergency alerts from San Benito County https://local.nixle.com/county/ca/san-benito/

Santa Clara County

Summary of Observations

The SCU Lightning Complex burned 165,205 acres in Santa Clara County which represents 42% of the total burned area. Mount Hamilton and Lick Observatory, parts of Highway 130 (San Antonio Mountain Road), parts of Henry W. Coe State Park, Isabel Valley, and parts of San Antonio Valley are within the burned area.

Calaveras Reservoir, Coyote Reservoir, Anderson Reservoir, Pacheco Reservoir, Lake del Valle Reservoir, and Highway 152 are outside of the burned area but are downstream of watersheds affected by the SCU Lightning Complex. Development within and immediately down-gradient of the burned area is generally low-density rural communities, many of which are accessed from San Antonio Mountain Road, Kincade Road, and Mines Road.

Soil burn severity within Santa Clara County was generally low, with some areas of moderate. The debris flow model predicts that the majority of the watersheds within the burned area in Santa Clara County have a low potential for debris flows; however, localized areas have moderate to high potential for debris flows. See Section 3 for a discussion of soil burn severity and debris flow model results.

The WERT identified 26 VARs within Santa Clara County. One VAR is a polygon that crosses the county line between Alameda County and Santa Clara County (SCU09). All 26 VARs identified by the WERT within Santa Clara County are associated with flood or combined debris flow / flood hazards (Table 10).

Twenty-four VARs are associated with residential and commercial structures built in mapped flood zones or are built on a low-lying surface with geomorphic evidence for flooding. The two other VARs are a road segmented subjected to combined debris flow and flood hazards, and the damaged spillway at Pacheco Reservoir. SCU27 through SCU29 are located on the floodplain for Jumpoff Creek. SCU33 through SCU35 are within the floodplain for Arroyo Bayo. SCU21 through SCU23 are within the floodplain of Beauregard Creek. SCU40 is a section of Kincade Road where crossings and culverts appear to be undersized and have the potential for clogging and overtopping. Debris flow potential was observed upslope from these crossings.

Numerous county roads, private roads, and driveways provide access to properties throughout the burned area. Many cross drainages susceptible to debris flows or flooding and culverts are commonly undersized or lacking for potential post-fire flow conditions. Specific VARs were not designated for most of these crossings, see the General Recommendations section.

Table 10. Summary of VAR hazard calls for Santa Clara County

Santa Clara County						
VAR type	**Hazard Call**					
	Life-Safety			Property		
	low	mod	high	low	mod	high
Flood	SCU09 SCU10 SCU20 SCU21 SCU25 SCU26 SCU27 SCU28 SCU29 SCU31 SCU32 SCU33 SCU34 SCU35 SCU36 SCU37 SCU41	SCU23 SCU24	SCU49		SCU09 SCU10 SCU20 SCU21 SCU23 SCU24 SCU25 SCU26 SCU27 SCU28 SCU29 SCU31 SCU32 SCU33 SCU34 SCU35 SCU36 SCU37 SCU41	SCU49
Flood / Debris Flow	SCU22 SCU30 SCU40	SCU38 SCU39 SCU42			SCU22 SCU30 SCU38 SCU39 SCU40 SCU42	
total	20	5	1		25	1

Four reservoirs are downstream/down gradient of the burned area in Santa Clara County: Anderson, Calaveras, Coyote, and Pacheco. Anderson Reservoir is under the jurisdiction of the Santa Clara Valley Water District and has a capacity of 91,280 acre-feet of water. The outflow of Coyote Reservoir flows into Anderson Reservoir along Coyote Creek. Calaveras Reservoir is under the jurisdiction of the San Francisco Water Department and has a capacity of 30,000 acre-feet of water. Calaveras Creek and Arroyo Hondo flow into Calaveras Reservoir. Coyote Reservoir on Coyote Creek is part of the Santa Clara Valley Water District and has a capacity of 22,925 acre-feet. The WERT did not identify any specific VARs associated with Anderson, Calaveras, or Coyote reservoirs, however increased sediment and impacts to water quality are possible. See the Hydrology Section 3 for a discussion of flow predictions and bulking factors for these watersheds, and past sedimentation rates at Coyote Reservoir.

Pacheco Dam was identified by the WERT as having a high risk to life-safety and property (SCU49). Pre-existing damage to the spillway from 2017 has not been repaired. California Division of Safety of Dams, Valley Water, San Benito County Water District, and Pacheco Pass Water District are stakeholders for the Pacheco Reservoir. It is currently not permitted to impound water but the reservoir has not fully emptied and water is flowing out of a 36-inch culvert below the current water level in the dam. The reservoir has a storage capacity of 6,150 acre-feet of water. During rain events the reservoir is anticipated to fill with water, and in extreme rain events, water may discharge through the spillway. Further damage to the spillway could potentially compromise the integrity of the dam. Failure of the Pacheco Dam would pose an immediate risk to life safety and property downstream, including Highway 152, residences in Pacheco Pass, and agricultural communities on the northeast side of the town of Hollister. It is recommended that the spillway be evaluated for potential risks to public safety before the rainy season.

Santa Clara County-Specific Recommendations:

- Residents are encouraged to sign up for AlertSCC to receive alerts for severe weather and flooding: https://www.sccgov.org/sites/oes/alertscc/Pages/home.aspx
- Consider placing signage along Highway 130 during storm events to alert drivers of possible flooding or debris on the road. Consider closing the highway to incoming traffic during severe storm events.
- Monitor water quality of reservoirs during and immediately after rain events.
- Santa Clara County should have or develop an evacuation plan in place for a possible breach of the Pacheco Dam.
- Due to high risk to life-safety and property, public risks posed by damage to the spillway of Pacheco Dam should be evaluated prior to the winter 2020-2021 season.
- A licensed engineer should evaluate if Pacheco Dam is at risk of failure based on predicted flows through the spillway.
- If the spillway is in use it should be monitored for any sign of additional deterioration or failure. Any change in the structure should be immediately reported.
- The California Division of Safety of Dams should inspect the spillway and dam structure based on the potential for increased flood flows into the reservoir and make necessary recommendations for the upcoming winter.

San Joaquin County

Summary of Observations

The SCU Lightning Complex burned 24,332 acres in San Joaquin County, which represents 6% of the total burned area. Development within and immediately down-gradient of the burned area is generally low-density rural communities. Soil burn severity is generally low with minor amounts of very low/unburned and moderate. The debris flow model generally predicts a low probability of debris flows in San Joaquin County. See Section 3 for a discussion of soil burn severity and debris flow model results.

Two VARs identified in San Joaquin County and both have a low risk to life-safety but moderate risk to property (Table 11). The WERT identified several residences, outbuildings, park faculties, and a county road along Hollow Corral Creek that are within the DWR Awareness floodplain and could be impacted by flooding (SCU01). Another residence built in a side drainage to Corral Hollow Creek appears to have flood risk (SCU09).

Table 11. Summary of VAR hazard calls for San Joaquin County

San Joaquin County						
VAR type	**Hazard Call**					
	Life-Safety			Property		
	low	mod	high	low	mod	high
Flood	SCU01 SCU04				SCU01 SCU04	
total	2	0	0	0	2	0

San Joaquin County-Specific Recommendations:

- Residents are encouraged to sign up for SJREADY to receive emergency alerts and receive important public safety notifications: https://member.everbridge.net/397890065268824/login
- Consider closing Carnegie State Vehicular Recreation Area during severe storm events.

Stanislaus County

Summary of Observations

The SCU Lightning Complex burned 175,804 acres in Stanislaus County which represents 44% of the total burned area. This area is dominated by ranch land. Development within and immediately down-gradient of the burned area is generally low-density rural communities, many of which are accessed from Highway 130 (Del Puerto Canyon Road), and ranches. Soil burn severity in the area is generally low, with some moderate. The debris flow model generally predicts low risk of debris flows. Some moderate to high debris flow potential exists on tributaries to Orestimba Creek and in Deer Park Canyon, a tributary to Del Puerto Creek. See Section 3 for a discussion of soil burn severity and debris flow model results.

The WERT identified nine VARs within Stanislaus County (SCU11-SCU19), all of which are accessed from Highway 130 (Del Puerto Canyon Road) and are considered to have a low risk to life-safety and a moderate risk to property (Table 12).

SCU14 is a section of Highway 130 down-gradient of a steep incised channel that appears to have debris flow potential. This location, as well as other crossings along Highway 130, should be monitored for debris that could affect motorist safety during storm events. SCU16 is a campground on a river terrace adjacent to Del Puerto Creek that is within the DWR Awareness flood zone. A local resident indicated that there may be chemical storage tanks in the vicinity of SCU19. The Adobe Canyon Water Plant is located within Adobe Canyon. Other buildings and facilities for the Adobe Canyon Water Plant were not identified as VARs, however potential impacts to water quality in Adobe Canyon were not considered as part of this assessment.

Table 12. Summary of VAR hazard calls for Stanislaus County

Stanislaus County						
VAR type	**Hazard Call**					
	Life-Safety			Property		
	low	mod	high	low	mod	high
Flood	SCU11 SCU12 SCU13 SCU15 SCU17 SCU18 SCU19				SCU11 SCU12 SCU13 SCU15 SCU17 SCU18 SCU19	
Flood / Debris Flow	SCU16				SCU16	
Debris Flow	SCU14				SCU14	
total	9	0	0	0		0

Locked gates prevented access up Garzas Creek, Orestimba Creek, and Quinto Creek, and structures upstream were not evaluated. Based on signage in the area and a discussion with a local ranch owner, Orestimba Creek is prone to flooding.

Numerous county roads, private roads, and driveways provide access to properties throughout the burned area. Many cross drainages are susceptible to debris flows or flooding and culverts are commonly undersized or lacking for potential post-fire flow conditions. Specific VARs were not designated for most of these crossings; see the General Recommendations section.

Stanislaus County-Specific Recommendations:

- Residents are encouraged to sign up for StanAware to receive emergency alerts. The Stanislaus County Office of Emergency Services can send a message regarding a situation to residences and businesses within a certain geographical area(s) that will contain special notice and instructions to be followed by citizens in the area. http://www.stanaware.com/
- Consider placing signage along Highway 130 during storm events to alert drivers of possible flooding or debris on the road.
- Consider closing Deer Creek Campground during severe storm events.
- Adobe Canyon Water Plant should prepare for a possible influx of sediment or flooding of Adobe Creek
- Prepare for potential flooding on Garzas, Quinto, and where Orestimba Creek crosses the California Aqueduct, passes under I-5, and around the town of Newman.

Merced County

Summary of Observations

The SCU Lightning Complex burned 3,769 acres in Merced County, which represents less than 1% of the total burned area. The soil burn severity within Merced County is generally low to very low/unburned. The debris flow model generally predicts a low probability of debris flows in Merced County. See Section 3 for a discussion of soil burn severity and debris flow model results.

No VARs were identified in Merced County, however a locked gate prevented access up Quinto Creek. Quinto Creek and Romero Creek flow through, and downstream of, the burned area and may experience increased flooding in high-intensity storm events.

Merced County-Specific Recommendations:

- Residents are encouraged to sign up for Merced County Emergency Notification System which issues critical notifications to citizens county-wide. https://www.co.merced.ca.us/1922/Merced-County-Emergency-Notification-Sys

General Recommendations for All Affected Counties

• Early warning systems; residents should monitor forecasts and sign up for emergency notifications from their county of residence. Residents at VARs identified by the WERT should consider evacuation during significant storm events and follow County recommendations.

• Storm watch; motorists and pedestrians should not use low water crossings during flood events. Residents should monitor storm forecasts and emergency notifications and consider that access may not be feasible during and following significant storm events. Educate the public about potential flood hazards at these crossings during storms; consider additional warning signs and potential weather-related closures.

• Culverts for drainages down gradient of the burned area should be cleared of debris, monitored during storms, and maintained as needed following each storm event. Motorists and responsible agencies should be aware of the potential for flooding along these roads during large storm events.

• Temporary drainage diversion improvements such as sand bags or K-rails may be effective mitigation on a limited basis to protect structures and other improvements outside of main channel areas from debris flows or sediment-laden flows; diversion measures should consider potential downstream paths and potential impacts. Permanent diversion measures such as impact walls may also be viable, but design of such measures is beyond the scope of the WERT assessment.

• Use licensed professionals to properly locate temporary and permanent housing when rebuilding. Appendix E provides building and rebuilding guidelines to consider when locating temporary and permanent housing structures.

• Burned debris from structures and vehicles should either be properly disposed of, or mitigations put in place to prevent runoff from burned sites from entering watercourses. Areas with the highest density of burned structures near watercourses or with storm drainage systems that drain directly to watercourses should be the priority.

• Utilize experts in geotechnical engineering, flood hazards, soil erosion, and engineering geology to develop mitigation for specific hazards identified above or additional mitigation activities.

Early Warning Systems

Existing early warning systems should be used and improved such that residents can be alerted to incoming storms, allowing enough time to safely vacate hazard areas. In areas where cellular reception is poor or non-existent, methods should be developed to effectively contact residents. For example, installation of temporary mobile cellular towers should be considered.

National Weather Service Forecasting

Flash flood and debris flow warnings with practical lead times of several hours must come from a combination of weather forecasts, rainfall measurements of approaching storms, and knowledge of triggering thresholds. The following information is from the National Weather Service (NWS); they provide flash flood and post-fire debris flow “watch” and “warning” notifications in burned areas:

The NWS provides 24/7 information on watches, warnings and advisories for California. For additional information, see:

NWS – San Francisco Bay Area Forecast Office: https://www.weather.gov/mtr/

NWS - Post-wildfire flash flood and debris flow guide

http://www.wrh.noaa.gov/lox/hydrology/files/DebrisFlowSurvivalGuide.pdf

Wireless Emergency Alerts (WEA)

WEA is an alert system originated by the NWS that can inform residents and businesses of flash flood warnings and other potential hazards. WEA alerts are emergency messages sent by authorized government alerting authorities through mobile carriers. Government partners include local and state public safety agencies, FEMA, the FCC, the Department of Homeland Security, and the National Weather Service. No signup is required, and alerts are automatically sent to WEA-capable phones during an emergency. Residents and businesses interested in this function must turn on the emergency alert setting for their phone.

https://www.weather.gov/wrn/wea

Emergency Alert System (EAS)

EAS is a national public warning system that may also be used by state and local authorities to delivery important emergency information, such as weather information, to targeted specific areas.

https://www.fcc.gov/general/emergency-alert-system-eas

Integrated Public Alert and Warning System (IPAWS)

IPAWs is a FEMA-originated system that integrates federal, state, and local emergency warning systems (e.g., WEA, EAS) into a single interface.

https://www.fema.gov/integrated-public-alert-warning-system

Education for Residents and the General Public

First and foremost, it is critical that residents heed evacuation warnings from local officials. In the absence of an official notice, residents should pay attention to evolving conditions around their homes.

Suzanne Perry, disaster scientist from the USGS, suggests the following:

- Be ready for debris flows for 2-5 years after a wildfire. Don't worry about every storm, as it takes more intense rain (typically about ½ inch per hour – like being in a thunderstorm) on a recently burned slope to trigger a debris flow.
- Follow all evacuation orders. Debris flows can destroy everything in their path.
- Pay attention to official weather forecasts. The National Weather Service will issue a Flash Flood "Watch" or "Warning" for your area when rainfall is anticipated to be intense. Also – and this is important - the rain back in the mountains can be different than where you are. It's the rain in the mountains that will start the debris flow.
- Don't rely on what you've seen in past debris flows. Debris flows can hit new areas or return to previous areas; they might be smaller - or larger - the next time. Whatever happened before, the next time could be different.
- If you must shelter in place, choose your spot in advance and stay alert. Find the highest point nearby (such as a 2nd story or roof) and be ready to get there with a moment's notice. Listen and watch for rushing water, mud, unusual sounds. Survivors describe sounds of cracking, breaking, roaring, or a freight train.
- Never underestimate a debris flow. Unlike other landslides, debris flows can start in places they've never been before. They can leave stream channels and plow through neighborhoods. When a debris flow is small, people can control it with walls, K-rails, and sand bags. When a debris flow is big enough, nothing can stop it.
- Expect other flood dangers. Storms that can cause debris flows can also cause more common flooding dangers.
- Turn Around, Don't Drown!® Never drive, walk, or bicycle through a flooded road or path. Even a few inches of water can hide currents that can sweep you away. Also, the water level can rise before you finish crossing.

Signage

Place temporary signage in areas of potential post-fire rockfall and flooding hazards. Place signage along roads, bridges, and other types of crossings identified at risk of flooding, rockfalls and debris flows. The WERT suggests responsible agencies consider installing gates, warning signs, or other measures to alert and keep people out of areas of identified risk.

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Appendix A: SCU Lightning Complex Contacts

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Austin Roundtree	CA Division of Safety of Dams	916-565-7822

Appendix B: Values-at-Risk Table

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Shaded rows = polygons
White rows = points

SCU Lightning Complex

Values at Risk Table

Alameda County

Site	Community / Local area	County	Latitude	Longitude	Potential hazard / Field observation	Hazard Category	Specific at-risk feature	Potential hazard to life	Potential hazard to property	Preliminary EMP
SCU02	Mines Road	Alameda	37.5533	-121.5728	Bridge crossing on Arroyo Macho at oblique angle to channel forcing a bend in the creek and impeding flow. Creek confined upstream of crossing and widens at bend in crossing. Aggradation under bridge. Abundant vegetation in channel above and below crossing.	flood	Bridge	low	mod	Monitor and maintain
SCU03	Mines Road	Alameda	37.5412	-121.5660	House situated on low terrace above creek. Slight bend in creek upstream from structure, could cause erosion and flooding issues. Lower terrace noted on other side of stream.	flood	Home	low	mod	Early Warning
SCU05	Mines Road	Alameda	37.5203	-121.5239	Home situated above channel in floodplain. However, a stock pond impoundment is just upstream from house across creek. Unclear where creek drains through. Possible diversion channel on north side of property.	flood	Home	low	mod	Early Warning
SCU06	Mines Road	Alameda			Multiple structures located in floodplain adjacent to channel. One structure located across channel from steep sidehill drainage.	flood	Homes	low	mod	Early Warning
SCU07	Mines Road	Alameda	37.5033	-121.5401	RV on building pad 5 ft above stream channel	flood	RV	low	mod	Early Warning
SCU08	Mines Road	Alameda	37.4930	-121.5121	Burned structure located adjacent to channel on old fan. Upstream culvert looks new, indicating possible prior issues at sites. Sharp bend in main channel near structure could cause flood waters could jump out of channel during flood and impact structure.	flood	Home	low	mod	Early Warning
SCU43	Sunol Alameda Creek	Alameda	37.4896	-121.7455	Cabin built at mouth of catchment. Debris at mouth of catchment. Deflection wall and berm adjacent cabin. Rockfall hazards present too.	debris flow / flood	Cabin	mod	mod	Early Warning, Deflection structure

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White rows = points

SCU Lightning Complex

Values at Risk Table

Site	Community / Local area	County	Latitude	Longitude	Potential hazard / Field observation	Hazard Category	Specific at-risk feature	Potential hazard to life	Potential hazard to property	Preliminary EMP
SCU44	Valpe Ridge	Alameda			Multiple structures located the base of steep drainages. One structure is in a channel, and two others are adjacent to and slightly above main channels. Blocky debris noted in gullies, indicating debris flows previously.	debris flow / flood	Homes and buildings	mod	mod	Early Warning
SCU45	Shafer Creek	Alameda			Multiple homes located on graded (?) valley bottom below 4 converging steep drainages. Berms constructed at base of one channel to divert flow and between another channel and adjacent structures, indicating past flood issues. Blocky debris in drainages.	debris flow / flood	Homes	mod	mod	Early Warning
SCU46	Arroyo Valle	Alameda	37.5484	-121.6726	Structure situated adjacent to incised channel and downstream from crossing that is undersized. Lots of woody debris in channel above crossing. If water flows over crossing, will go down road and into barn.	debris flow / flood	Barn	low	mod	Early Warning
SCU47	Arroyo Valle	Alameda	37.5621	-121.6843	Multiple structures located on older flood terrace above channel. Local said flood waters reach the bottom of adjacent bridge during bad weather years, which is same elevation as structures, indicating possible flood hazard.	flood	Ranch buildings	low	mod	Early Warning
SCU48	Del Valle Regional Park	Alameda			Campground located on floodplain terrace, with young geomorphic features. Mainstream channel on northeast side of campground, overflow channel on southwest side of terrace. Restroom buildings and other structures on terrace as well.	flood	Campers	mod	low	Early Warning, restrict camping during rain events
SCU09	Smith Gulch	Alameda and Santa Clara			Structures located at the mouth of two converging drainages and adjacent to stream channel. Two crossings near structures are undersized or have abundant debris in upstream side of channel.	flood	Structures	low	mod	Early Warning

General Recommendations (see dicussion in report)

1	Communicate the risks associated with post-fire debris flows and flooding to residents and the general public
2	Utilize early warning systems to warn residents of hazards
3	Close parks/trails during predicted intense storms
4	Monitor and maintain drainage and storm water control infrastructure
5	Place signage and stage equipent on public roads that may be impacted by flooding and/or debris flows

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SCU Lightning Complex

Values at Risk Table

Site	Community / Local area	County	Latitude	Longitude	Potential hazard / Field observation	Hazard Category	Specific at-risk feature	Potential hazard to life	Potential hazard to property	Preliminary EMP
Contra Costa County										
SCU50	Los Vaqueros Reservoir	Contra Costa	37.8097	-121.7545	394 ac. catchment drains through narrow channel to reservoir forebay. Large transported boulders in channel and plastered to sidewalks of channel. Up to 3-4 feet on long axis. Boulders appear be source from geologic unit incised through.	debris flow / flood	Drinking water quality.	low	mod	Monitor and maintain

General Recommendations (see dicussion in report)

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SCU Lightning Complex

Values at Risk Table

Site	Community / Local area	County	Latitude	Longitude	Potential hazard / Field observation	Hazard Category	Specific at-risk feature	Potential hazard to life	Potential hazard to property	Preliminary EMP
San Joaquin County										
SCU01	Corral Hollow Creek	San Joaquin and Alameda			Residences, outbuildings, park facilities and County road in FEMA floodplain.	flood	Residences, road and OHV park facilities	low	mod	Early Warning
SCU04	Mines Road	San Joaquin	37.5312	-121.5236	Home situated at mouth of 2 steep sidehill drainages. Owners say one of the drainages flows in the winter, but goes down driveway, which is very close to house.	flood	Home	low	mod	Early Warning

General Recommendations (see dicussion in report)

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2	Utilize early warning systems to warn residents of hazards
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SCU Lightning Complex
Values at Risk Table

Site	Community / Local area	County	Latitude	Longitude	Potential hazard / Field observation	Hazard Category	Specific at-risk feature	Potential hazard to life	Potential hazard to property	Preliminary EMP
Santa Clara County										
SCU10	Mines Road	Santa Clara	37.4355	-121.4871	Several mobile homes located at mouth of drainage. Erosion/rilling present on driveway from prior flow out of catchment.	flood	Homes	low	mod	Early Warning
SCU20	Sweetwater Creek	Santa Clara	37.4065	-121.4894	Business, outbuilding on low surface next to creek.	flood	Building	low	mod	Early Warning, Sandbags
SCU21	Del Puerto Canyon	Santa Clara	37.3875	-121.4659	House on a terrace near the channel. Two large culverts under driveway across channel have the potential to clog.	flood	House	low	mod	Early Warning
SCU22	Beauregard Creek	Santa Clara	37.3777	-121.4547	Trailers and ranch buildings on low lying surface near channel	debris flow / flood	Trailers and ranch buildings	low	mod	Early Warning
SCU23	Beauregard Creek	Santa Clara	37.3657	-121.4434	House on low lying surface near a channel	flood	Residential structure	mod	mod	Early Warning
SCU24	Isabel Valley	Santa Clara	37.3218	-121.5543	Destroyed residential structure in flood plain, not much higher than active channel	flood	House, if rebuilt	mod	mod	Early Warning
SCU25	Arroyo Bayo	Santa Clara	37.3307	-121.5005	Destroyed house near channel. Shed and excavator Nearby	flood	House, if rebuilt	low	mod	Early Warning
SCU26	Bollinger Canyon	Santa Clara	37.3447	-121.5156	House in potential flood plain, on low lying surface near channel	flood	House	low	mod	Early Warning
SCU27	San Antonio Valley	Santa Clara	37.3469	-121.4826	House on low lying surface near channel	flood	House	low	mod	Early Warning
SCU28	San Antonio Valley	Santa Clara	37.3511	-121.4896	House on low lying surface near channel	flood	House	low	mod	Early Warning
SCU29	San Antonio Valley	Santa Clara	37.3534	-121.4914	House on low lying surface near channel	flood	House	low	mod	Early Warning
SCU30	Arroyo Bayo	Santa Clara	37.3551	-121.5582	Destroyed house in flood plain	debris flow / flood	House, if rebuilt	low	mod	Early Warning

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White rows = points

SCU Lightning Complex

Values at Risk Table

Site	Community / Local area	County	Latitude	Longitude	Potential hazard / Field observation	Hazard Category	Specific at-risk feature	Potential hazard to life	Potential hazard to property	Preliminary EMP
SCU31	Arroyo Bayo	Santa Clara	37.3606	-121.5507	Destroyed residential structure and ranch buildings on low lying surface near channel. Earthen dams up canyon.	flood	Structures. Possible habitation	low	mod	Early Warning
SCU32	Arroyo Bayo	Santa Clara	37.3659	-121.5523	Long culvert runs under building pad. Culvert is 60 in, half full of sediment. Has elbow in it somewhere under the building pad. If it clogs it could flood house.	flood	House	low	mod	Early Warning
SCU33	Arroyo Valle	Santa Clara	37.3612	-121.5775	Houses, barns, and livestock areas in low lying flood plain. Main house on building pad upslope. Talked to homeowner, said they haven't had flood issues in the 30 yrs she's lived there. Trailers near creek are storage only.	flood	House	low	mod	Early Warning
SCU34	Arroyo Valle	Santa Clara	37.3642	-121.5790	House and barn in floodplain	flood	House	low	mod	Early Warning
SCU35	Arroyo Valle	Santa Clara	37.3837	-121.5811	Cabins in flood plain	flood	Houses	low	mod	Early Warning
SCU36	Kincaid Road	Santa Clara			Multiple mobile homes located across or adjacent to creek at mouth of narrow drainage. Appears to be on active floodplain.	flood	Residences	low	mod	Early Warning
SCU37	Kincaid Road	Santa Clara			Multiple single-story residences located in or adjacent to channel at mouth of narrow drainage.	flood	Homes	low	mod	Early Warning
SCU38	Kincaid Road	Santa Clara			Home located in floodplain adjacent to shallow channel. A number of tents set up around property as well. Site is located just downstream from a confluence of 3 drainages. Large boulder noted on floodplain adjacent to house.	debris flow / flood	Homes and tents	mod	mod	Early Warning
SCU39	Kincaid Road	Santa Clara	37.3705	-121.6697	Burned structure situated on colluvium adjacent to channel. Large blocky debris noted in channel. Possible flood and debris flow hazard.	debris flow / flood	Home	mod	mod	Early Warning

Shaded rows = polygons
White rows = points

SCU Lightning Complex

Values at Risk Table

Site	Community / Local area	County	Latitude	Longitude	Potential hazard / Field observation	Hazard Category	Specific at-risk feature	Potential hazard to life	Potential hazard to property	Preliminary EMP
SCU40	Kincaid Road	Santa Clara			Multiple crossings along this stretch of road that are undersized or non-existent. Potential for clogging and overtopping. Narrow gullies could pose debris flow hazard risk.	debris flow / flood	Road/crossings	low	mod	Monitor and maintain, Early Warning
SCU41	Kincaid Road	Santa Clara	37.3986	-121.6679	Single family home located on floodplain adjacent to channel.	flood	Home	low	mod	Early Warning
SCU42	Alameda Creek	Santa Clara	37.4618	-121.6810	Multiple structures located between 2 debris flow channels. Channels are incised and have blocky debris in them. Structures appear to be well above channels, but flows could jump if channels clog. Utility line crosses one of the channels	debris flow / flood	Home and buildings	mod	mod	Early Warning
SCU49	Pacheco Reservoir	Santa Clara	37.0513	-121.2907	Pre-existing damage to spillway from 2017 storm. May be impacted by future storm events. Concrete is missing from left wall and bank is eroded.	flood	Spillway and dam	high	high	Monitor and maintain, Early Warning

General Recommendations (see dicussion in report)

1	Communicate the risks associated with post-fire debris flows and flooding to residents and the general public
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SCU Lightning Complex

Values at Risk Table

Site	Community / Local area	County	Latitude	Longitude	Potential hazard / Field observation	Hazard Category	Specific at-risk feature	Potential hazard to life	Potential hazard to property	Preliminary EMP
Stanislaus County										
SCU11	Del Puerto Canyon	Stanislaus	37.4496	-121.2611	House and ranch buildings in flood plain	flood	House and ranch structure	low	mod	Early Warning
SCU12	Del Puerto Canyon	Stanislaus	37.4440	-121.2884	House and ranch structures in flood plain	flood	House and ranch buildings	low	mod	Early Warning
SCU13	Del Puerto Canyon	Stanislaus	37.4369	-121.3246	Structure on low lying surface near channel, possible residence. Could not access.	flood	House	low	mod	Early Warning
SCU14	Del Puerto Canyon	Stanislaus	37.4310	-121.3368	Debris slide potential onto road. Low burn severity.	debris flow	Highway 130	low	mod	Traffic control, Debris barrier
SCU15	Del Puerto Canyon	Stanislaus	37.4211	-121.3539	House and ranch buildings in flood plain	flood	House and ranch buildings	low	mod	Early Warning
SCU16	Deer Creek Campground	Stanislaus			Campground on river terrace, outbuilding near possible debris flow channel	debris flow / flood	Campground facilities	low	mod	Early Warning, restrict camping during rain events
SCU17	Del Puerto Canyon	Stanislaus			House on alluvial fan, ranch structures on low lying surface near the channel.	flood	House and ranch structure	low	mod	Early Warning
SCU18	Adobe Canyon	Stanislaus	37.4062	-121.4057	House on low lying surface near channel	flood	House and water storage tanks	low	mod	Early Warning
SCU19	Adobe Canyon	Stanislaus	37.4029	-121.3968	Residential structure and chemical storage infrastructure near channel. Long-time resident said water has never come above the channel banks.	flood	Home and chemical storage structures	low	mod	Early Warning

General Recommendations (see dicussion in report)

1	Communicate the risks associated with post-fire debris flows and flooding to residents and the general public
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Appendix C: VAR Maps

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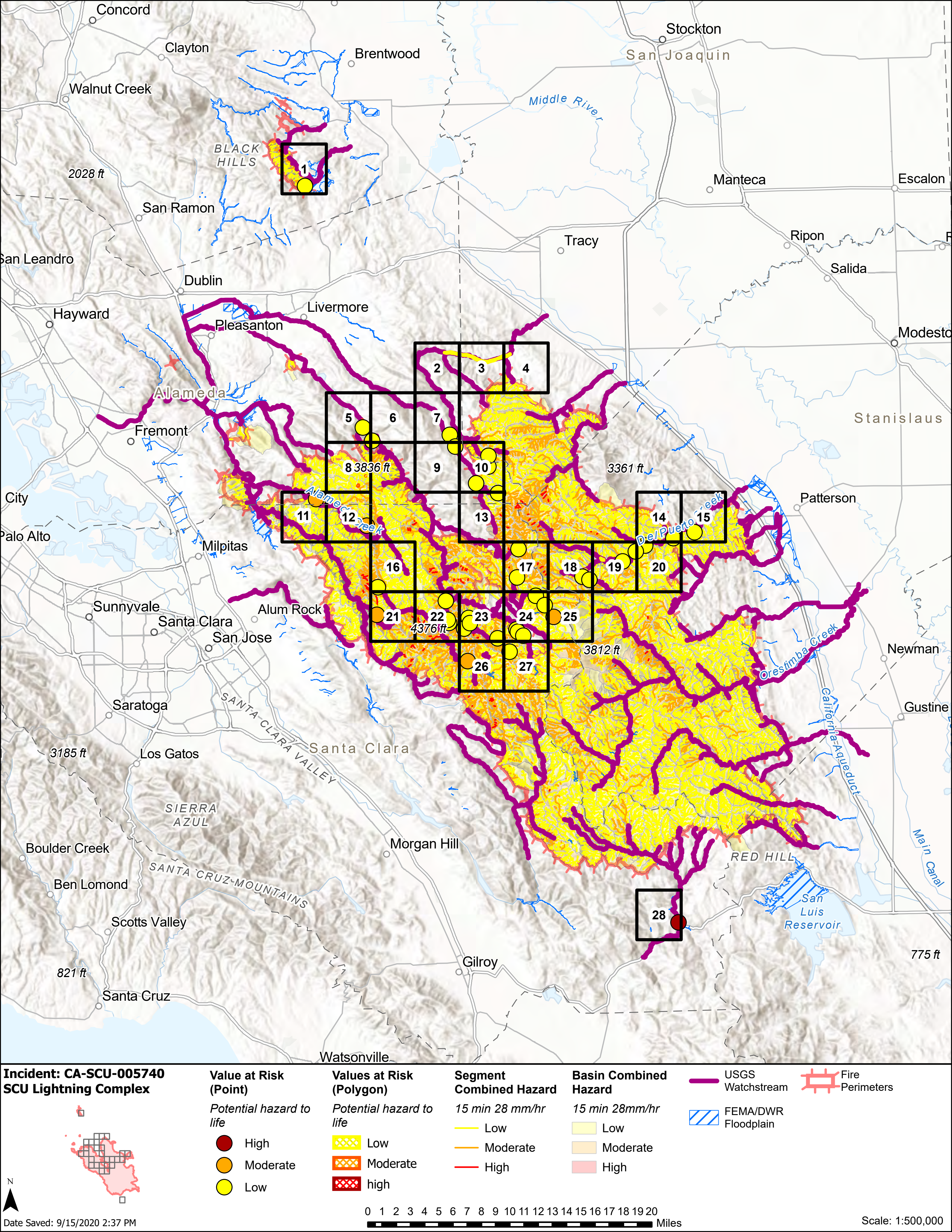
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Brentwood
Stockton
San Joaquin
Walnut Creek
Middle River
BLACK HILLS
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Manteca
Escalon
San Ramon
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Ripon
San Leandro
Salida
Dublin
Hayward
Livermore
Pleasanton
Modesto
Alameda
Fremont
Stanislaus
3836 ft
3361 ft
City
Alameda Creek
Del Puerto Creek
Patterson
Palo Alto
Milpitas
Sunnyvale
Alum Rock
Santa Clara
San Jose
4376 ft
3812 ft
Newman
Orestimba Creek
Saratoga
Gustine
SANTA CLARA VALLEY
Santa Clara
3185 ft
Los Gatos
California Aqueduct
SIERRA AZUL
Boulder Creek
Morgan Hill
RED HILL
Main Canal
SANTA CRUZ MOUNTAINS
Ben Lomond
San Luis Reservoir
Scotts Valley
775 ft
821 ft
Gilroy
Santa Cruz
Watsonville
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Incident: CA-SCU-005740
SCU Lightning Complex
Value at Risk (Point)
Potential hazard to life
High
Moderate
Low
Values at Risk (Polygon)
Potential hazard to life
Low
Moderate
high
Segment Combined Hazard
15 min 28 mm/hr
Low
Moderate
High
Basin Combined Hazard
15 min 28mm/hr
Low
Moderate
High
USGS Watchstream
FEMA/DWR Floodplain
Fire Perimeters
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Miles
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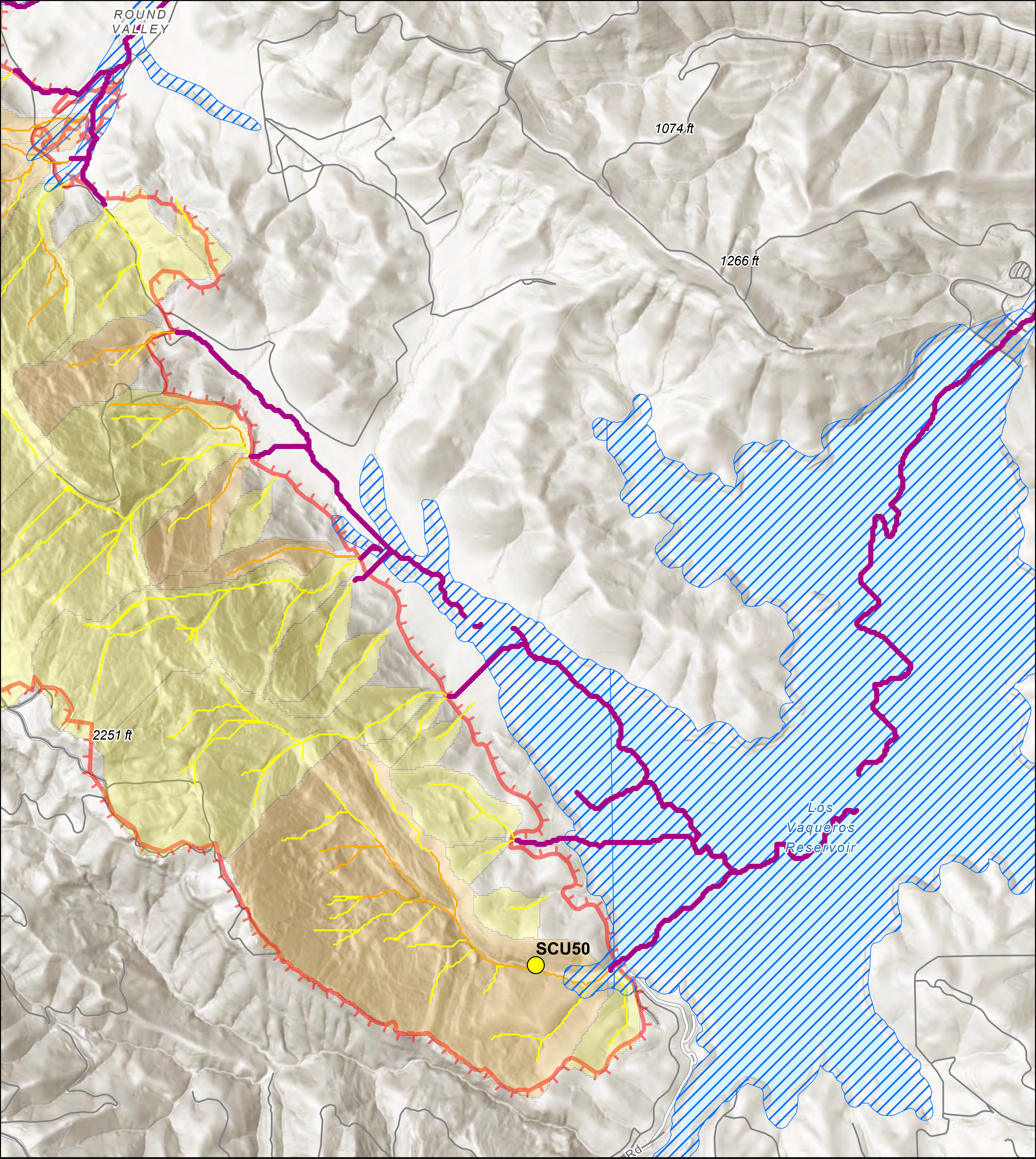

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SCU Lightning Complex

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USGS Watchstream

FEMA/DWR Floodplain

Fire Perimeters

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Scale: 1:24,000

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SCU Lightning Complex

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USGS Watchstream

FEMA/DWR Floodplain

Fire Perimeters

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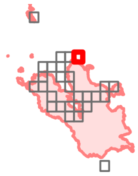
SCU Lightning Complex



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USGS Watchstream

FEMA/DWR Floodplain

Fire Perimeters

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0 1 Miles

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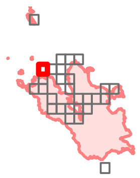
SCU Lightning Complex



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USGS Watchstream
Fire Perimeters
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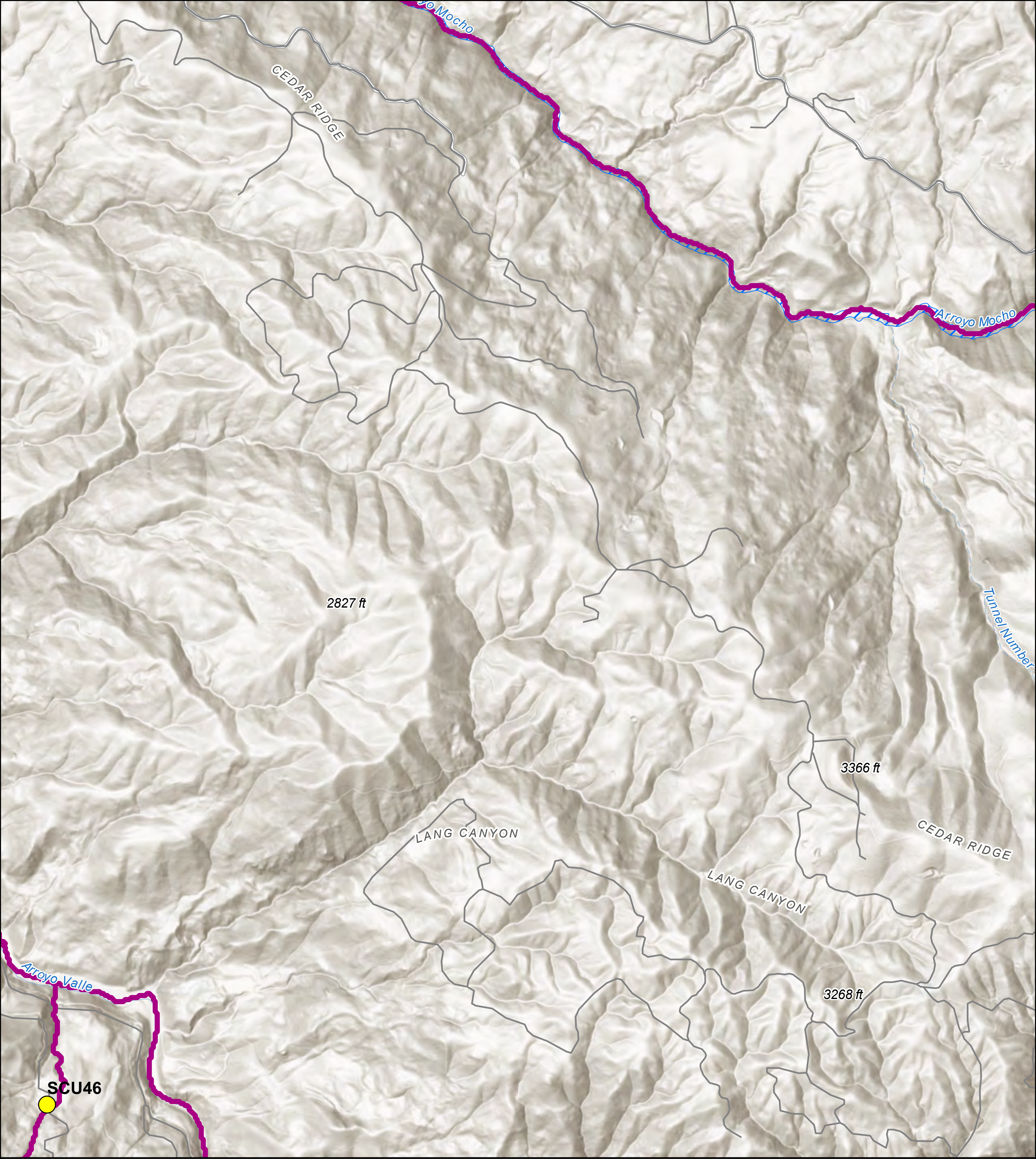

Incident: CA-SCU-005740
SCU Lightning Complex

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Value at Risk (Point)
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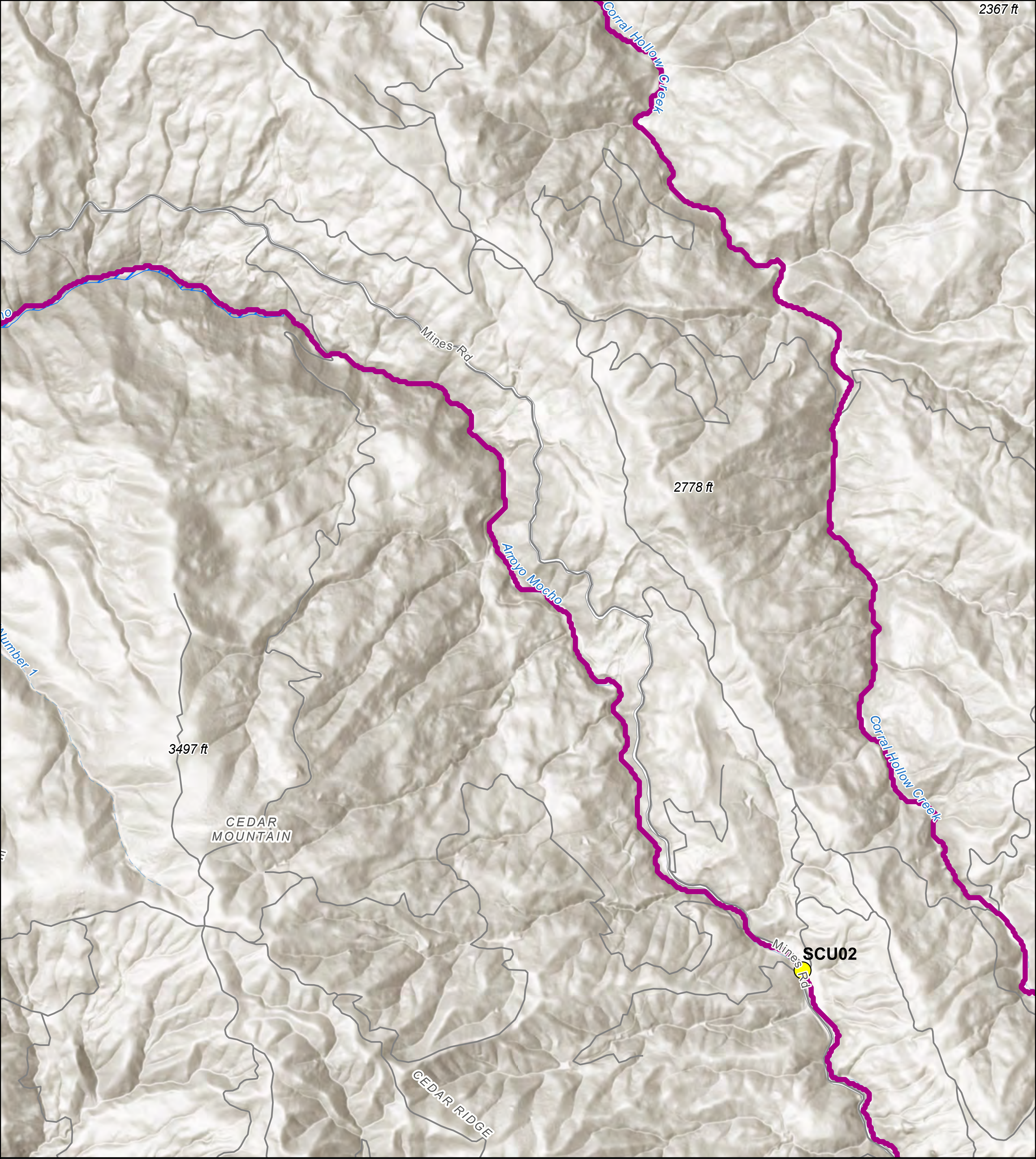
USGS Watchstream

FEMA/DWR Floodplain

Fire Perimeters

0 1 Miles

Scale: 1:24,000



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USGS Watchstream

FEMA/DWR Floodplain

Fire Perimeters

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0 1 Miles

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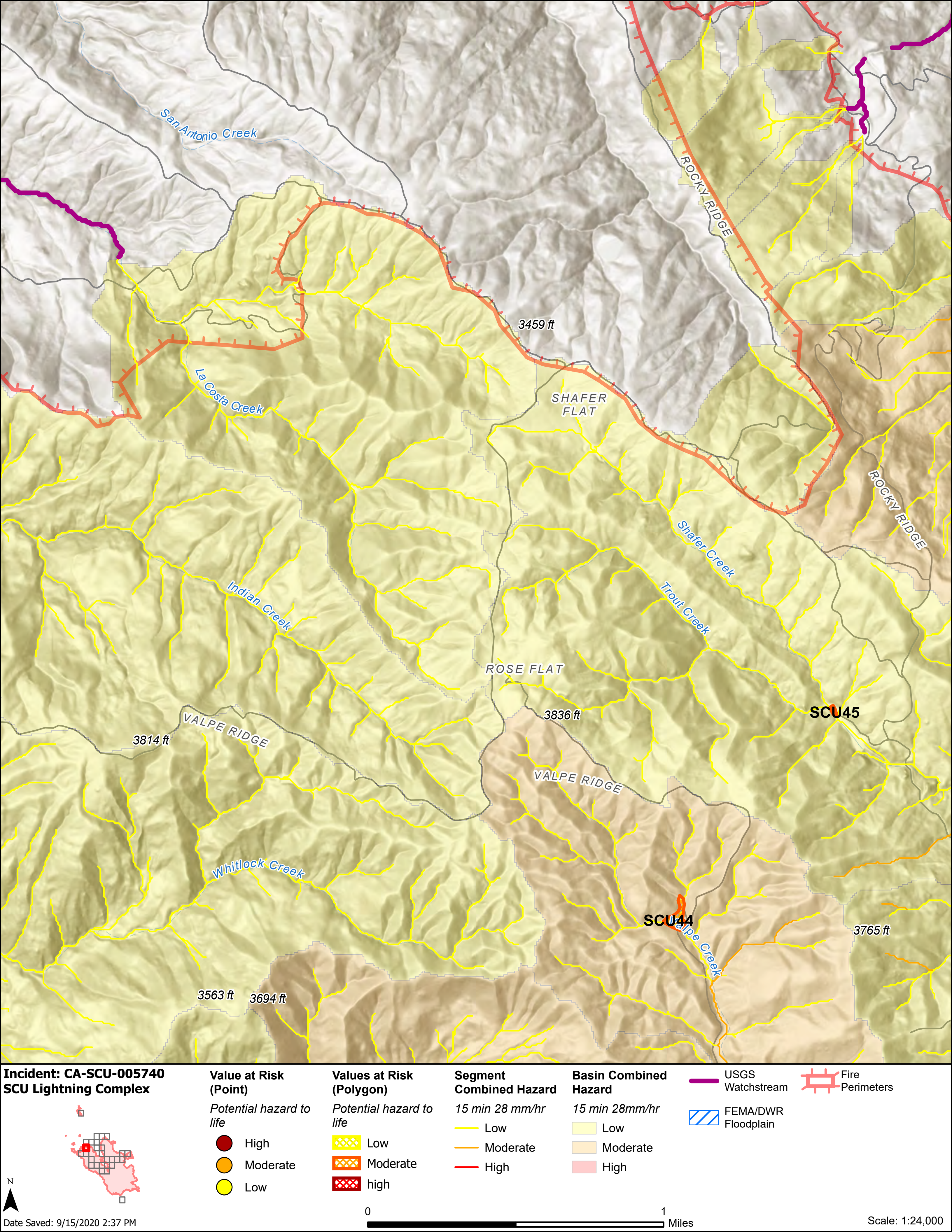
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VALPE RIDGE
3814 ft
VALPE RIDGE
Whitlock Creek
SCU44
Valpe Creek
3765 ft
3563 ft
3694 ft
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Fire Perimeters
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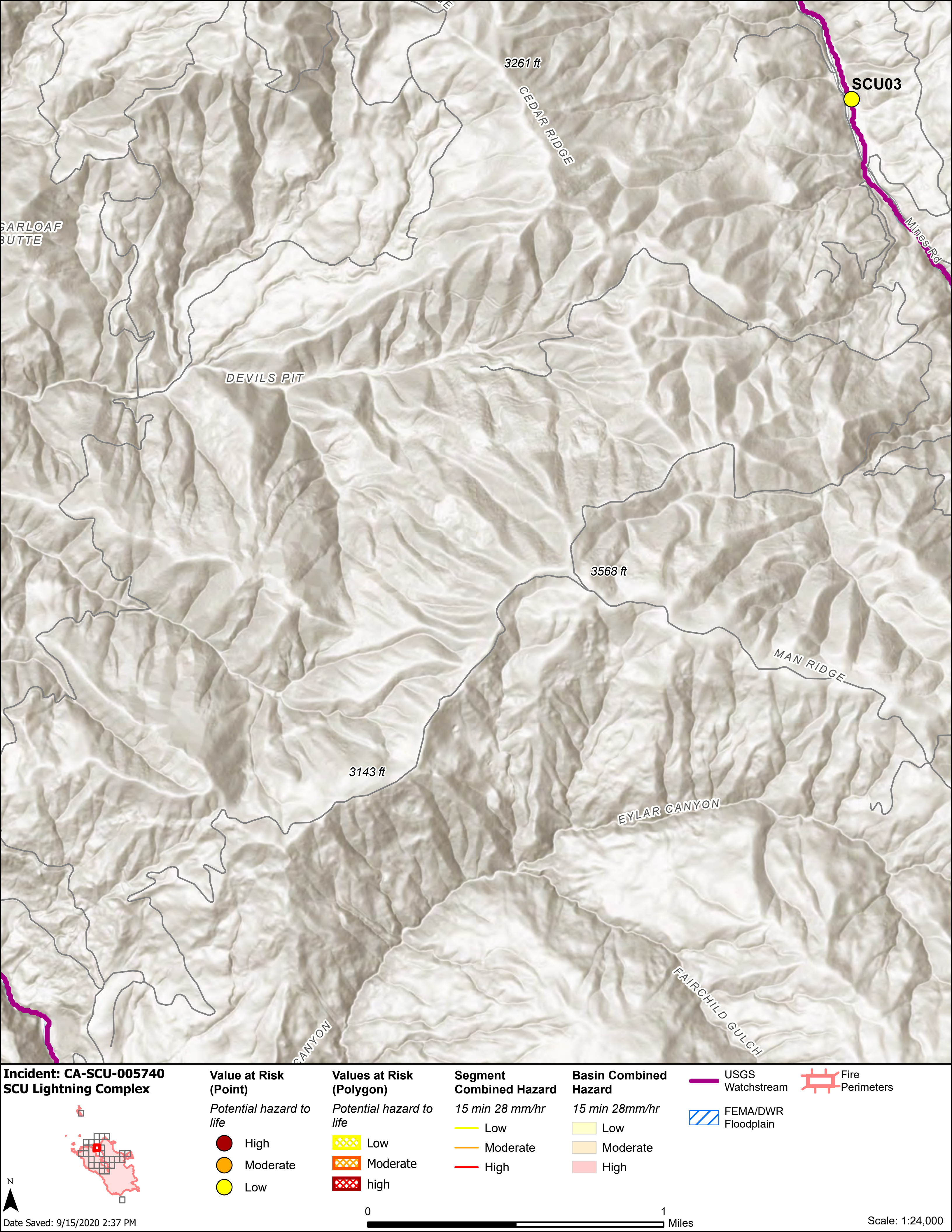

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GARLOAF
BUTTE
DEVILS PIT
3568 ft
MAN RIDGE
3143 ft
EYLAR CANYON
FAIRCHILD GULCH
CANYON
Incident: CA-SCU-005740
SCU Lightning Complex
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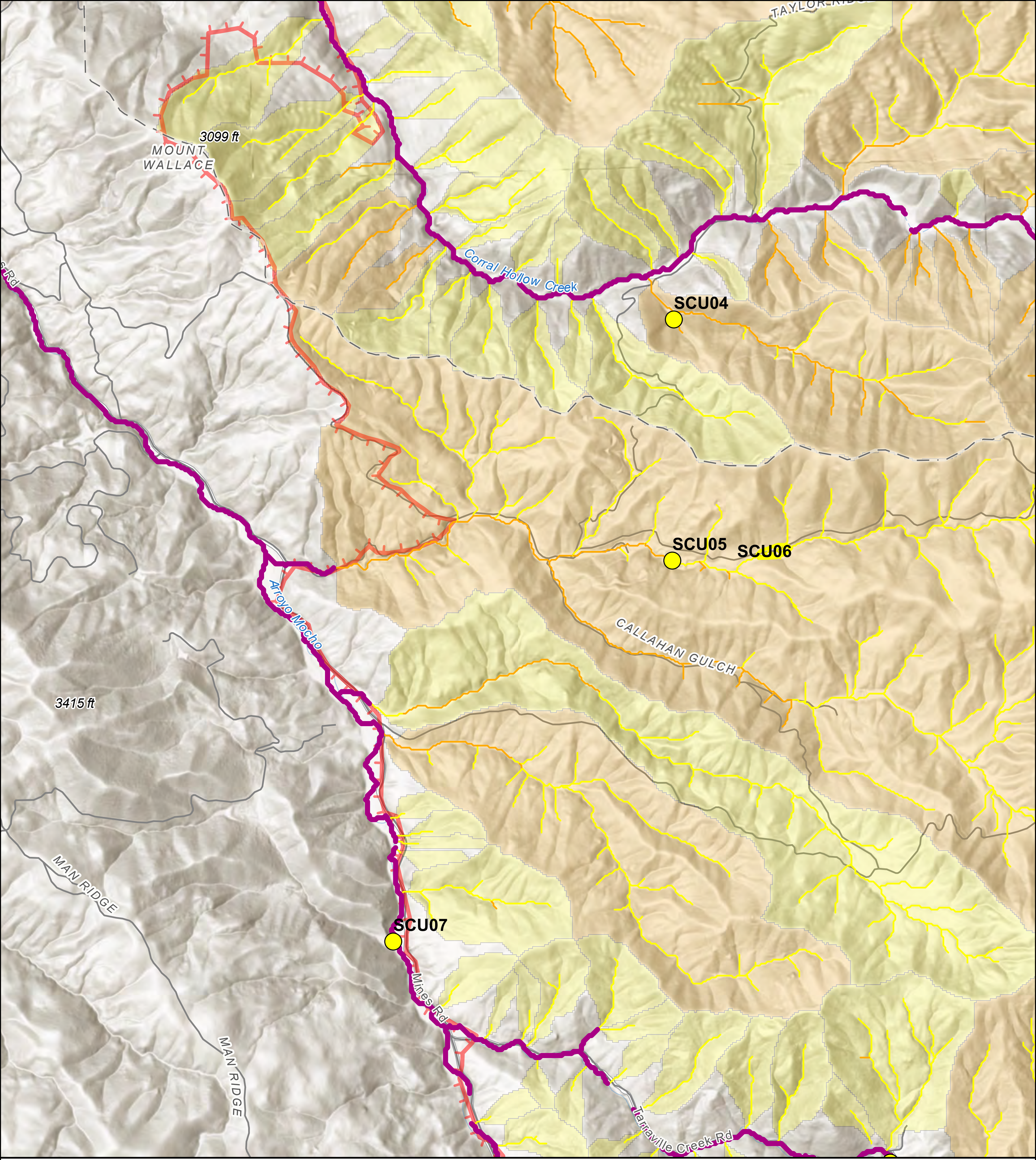
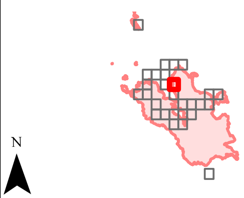


Incident: CA-SCU-005740
SCU Lightning Complex



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Value at Risk (Point)

Potential hazard to life

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Potential hazard to life

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Segment Combined Hazard

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Basin Combined Hazard

15 min 28mm/hr

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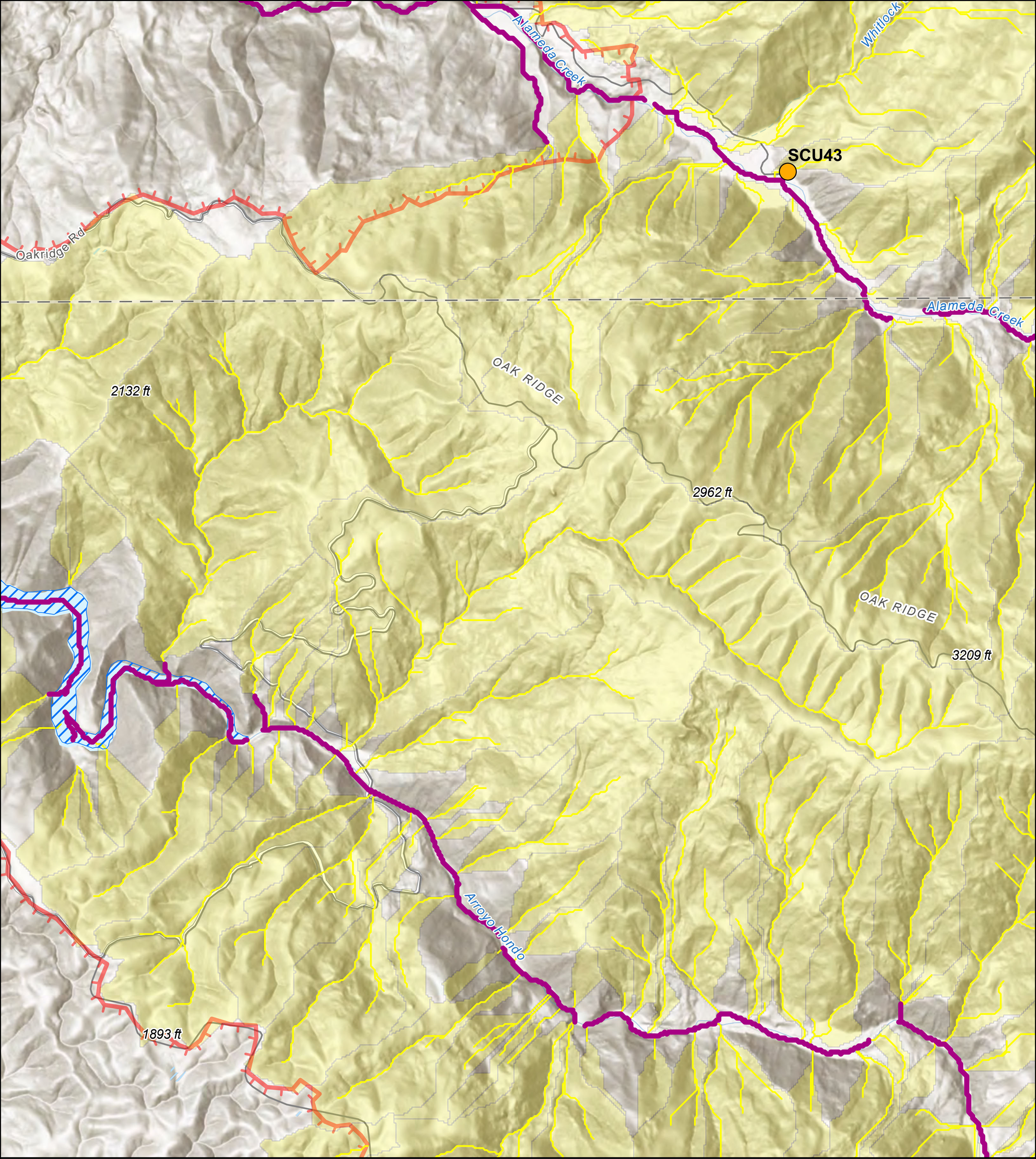
USGS Watchstream

FEMA/DWR Floodplain

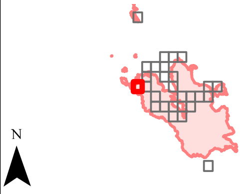
Fire Perimeters

0 1 Miles

Scale: 1:24,000



Incident: CA-SCU-005740
SCU Lightning Complex



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Value at Risk (Point)
Potential hazard to life
- High
- Moderate
- Low

Values at Risk (Polygon)
Potential hazard to life
- Low
- Moderate
- high

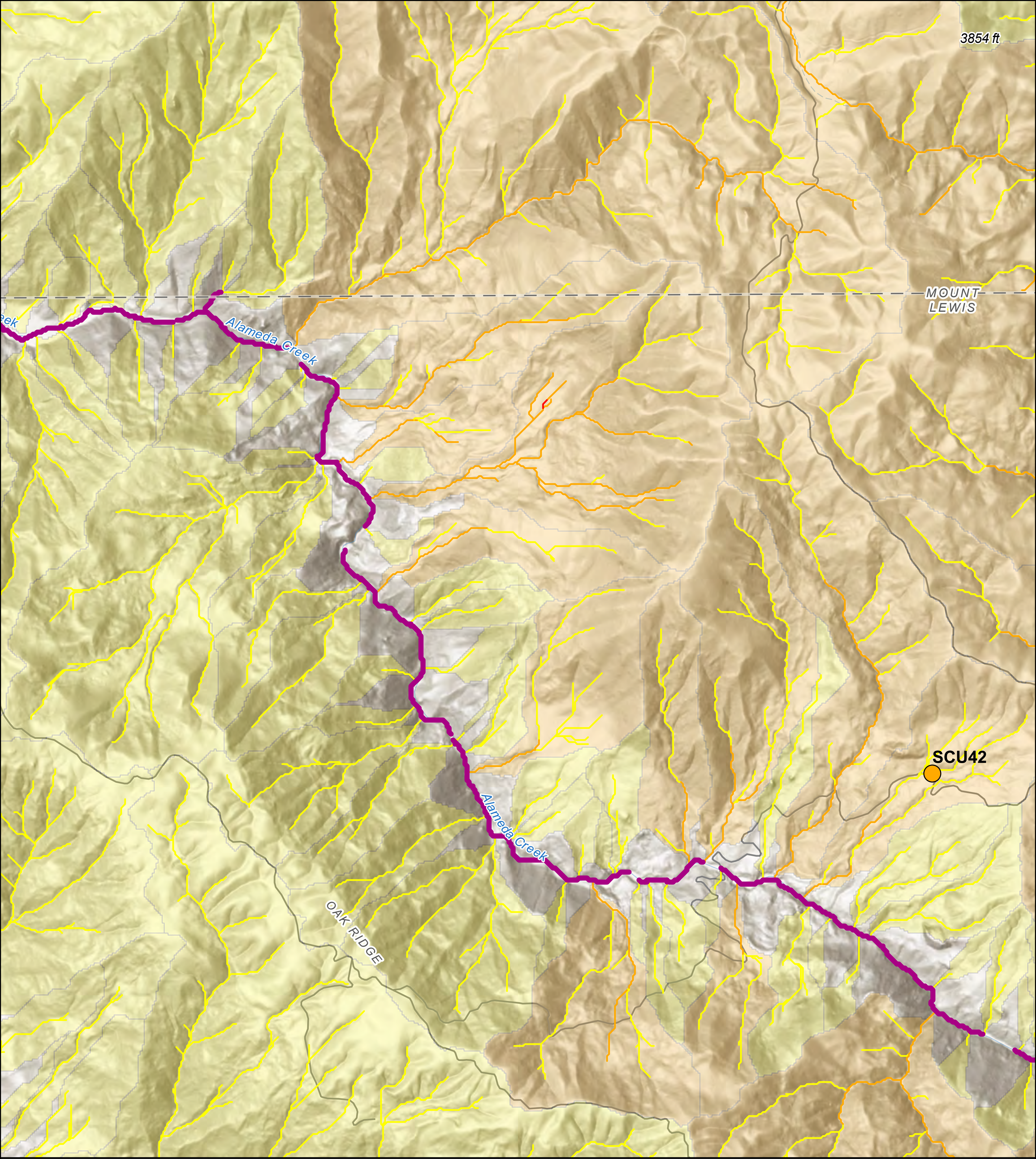
Segment Combined Hazard
15 min 28 mm/hr
- Low
- Moderate
- High

Basin Combined Hazard
15 min 28mm/hr
- Low
- Moderate
- High

USGS Watchstream
FEMA/DWR Floodplain
Fire Perimeters

0 — 1 Miles

Scale: 1:24,000



Incident: CA-SCU-005740
SCU Lightning Complex

Value at Risk (Point)

Potential hazard to life

- High
- Moderate
- Low

Values at Risk (Polygon)

Potential hazard to life

- Low
- Moderate
- high

Segment Combined Hazard

15 min 28 mm/hr

- Low
- Moderate
- High

Basin Combined Hazard

15 min 28mm/hr

- Low
- Moderate
- High

USGS Watchstream

FEMA/DWR Floodplain

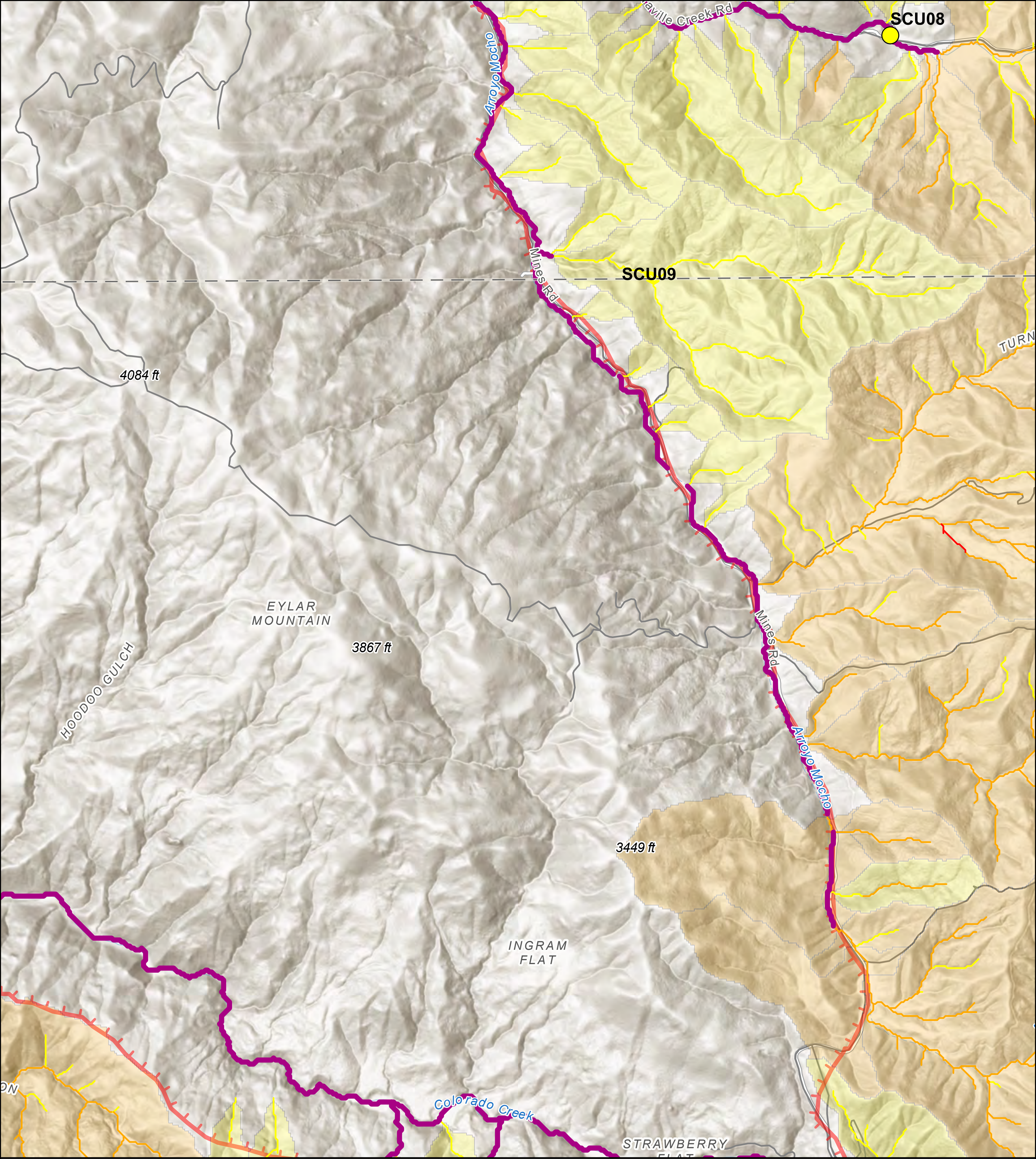
Fire Perimeters

N

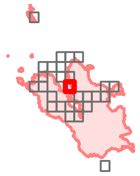
0 1 Miles

Date Saved: 9/15/2020 2:37 PM

Scale: 1:24,000



Incident: CA-SCU-005740
SCU Lightning Complex



Value at Risk (Point)

Potential hazard to life

- High
- Moderate
- Low

Values at Risk (Polygon)

Potential hazard to life

- Low
- Moderate
- high

Segment Combined Hazard

15 min 28 mm/hr

- Low
- Moderate
- High

Basin Combined Hazard

15 min 28mm/hr

- Low
- Moderate
- High

USGS Watchstream

FEMA/DWR Floodplain

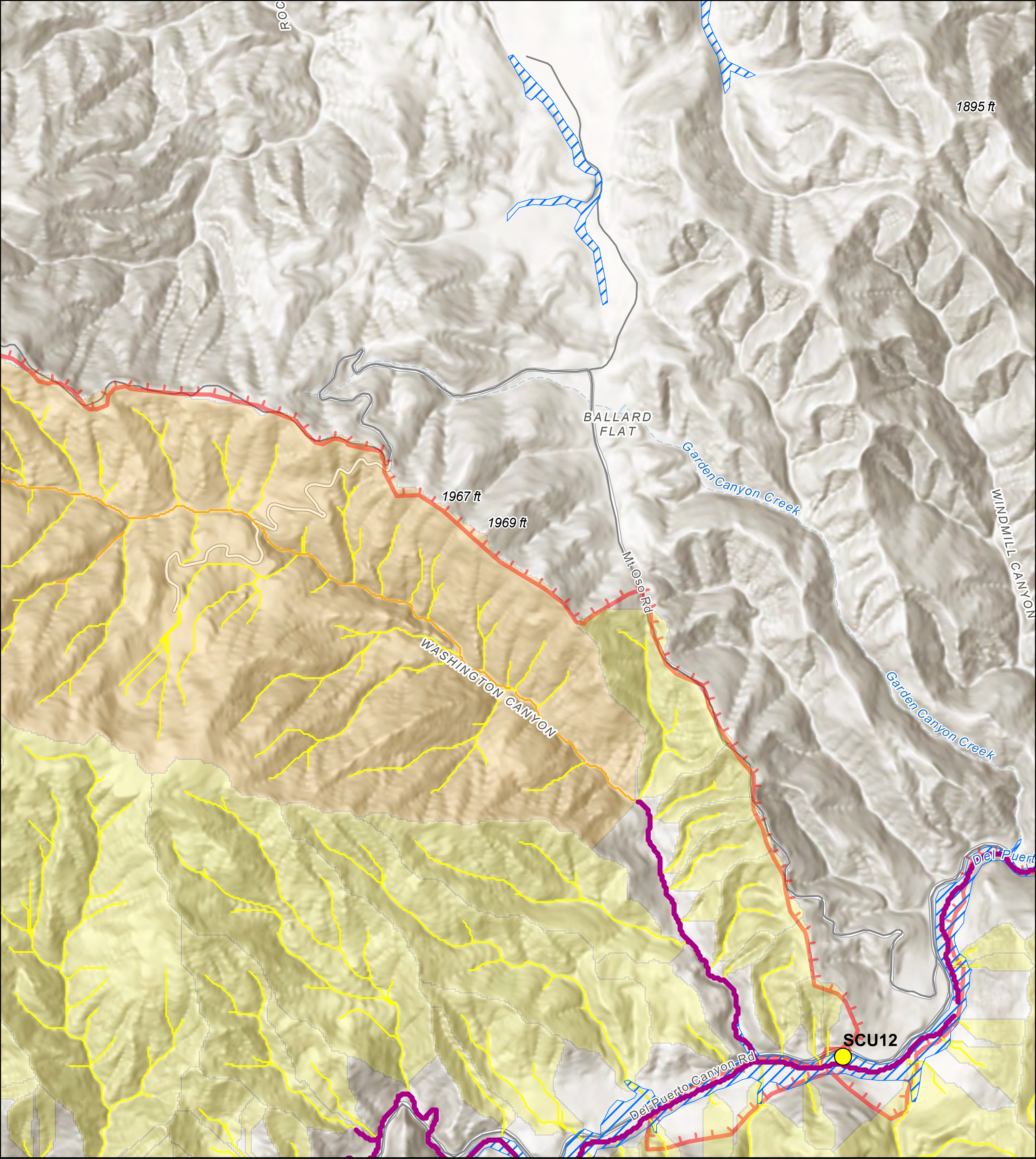
Fire Perimeters

N

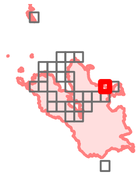
0 1 Miles

Date Saved: 9/15/2020 2:37 PM

Scale: 1:24,000



Incident: CA-SCU-005740
SCU Lightning Complex



N

Value at Risk (Point)

Potential hazard to life

- High
- Moderate
- Low

Values at Risk (Polygon)

Potential hazard to life

- Low
- Moderate
- high

Segment Combined Hazard

15 min 28 mm/hr

- Low
- Moderate
- High

Basin Combined Hazard

15 min 28mm/hr

- Low
- Moderate
- High

USGS Watchstream

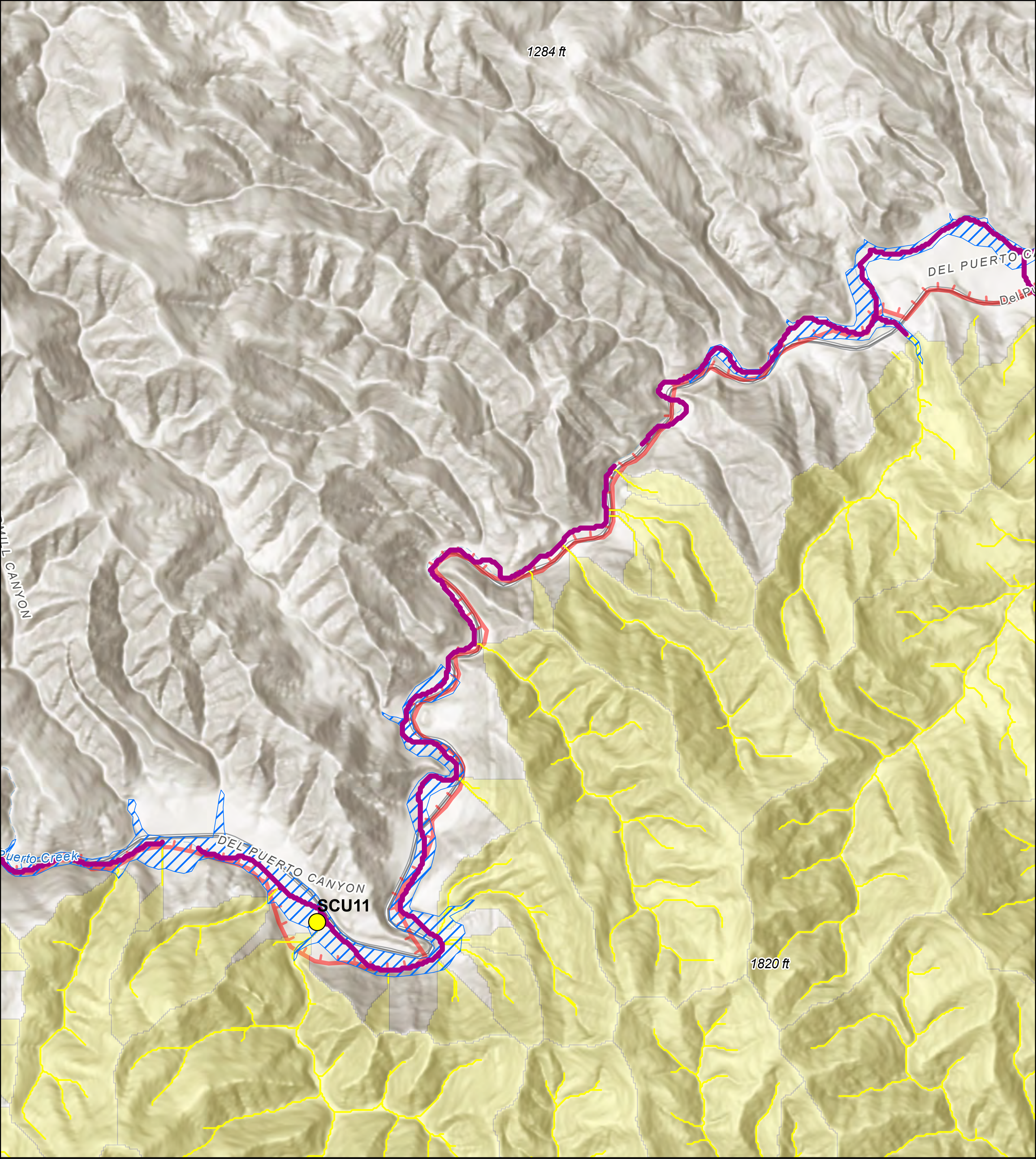
FEMA/DWR Floodplain

Fire Perimeters

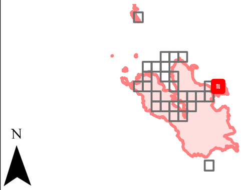
0 1 Miles

Scale: 1:24,000

Date Saved: 9/15/2020 2:37 PM



Incident: CA-SCU-005740
SCU Lightning Complex



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Value at Risk (Point)
Potential hazard to life
- High
- Moderate
- Low

Values at Risk (Polygon)
Potential hazard to life
- Low
- Moderate
- high

Segment Combined Hazard
15 min 28 mm/hr
- Low
- Moderate
- High

Basin Combined Hazard
15 min 28mm/hr
- Low
- Moderate
- High

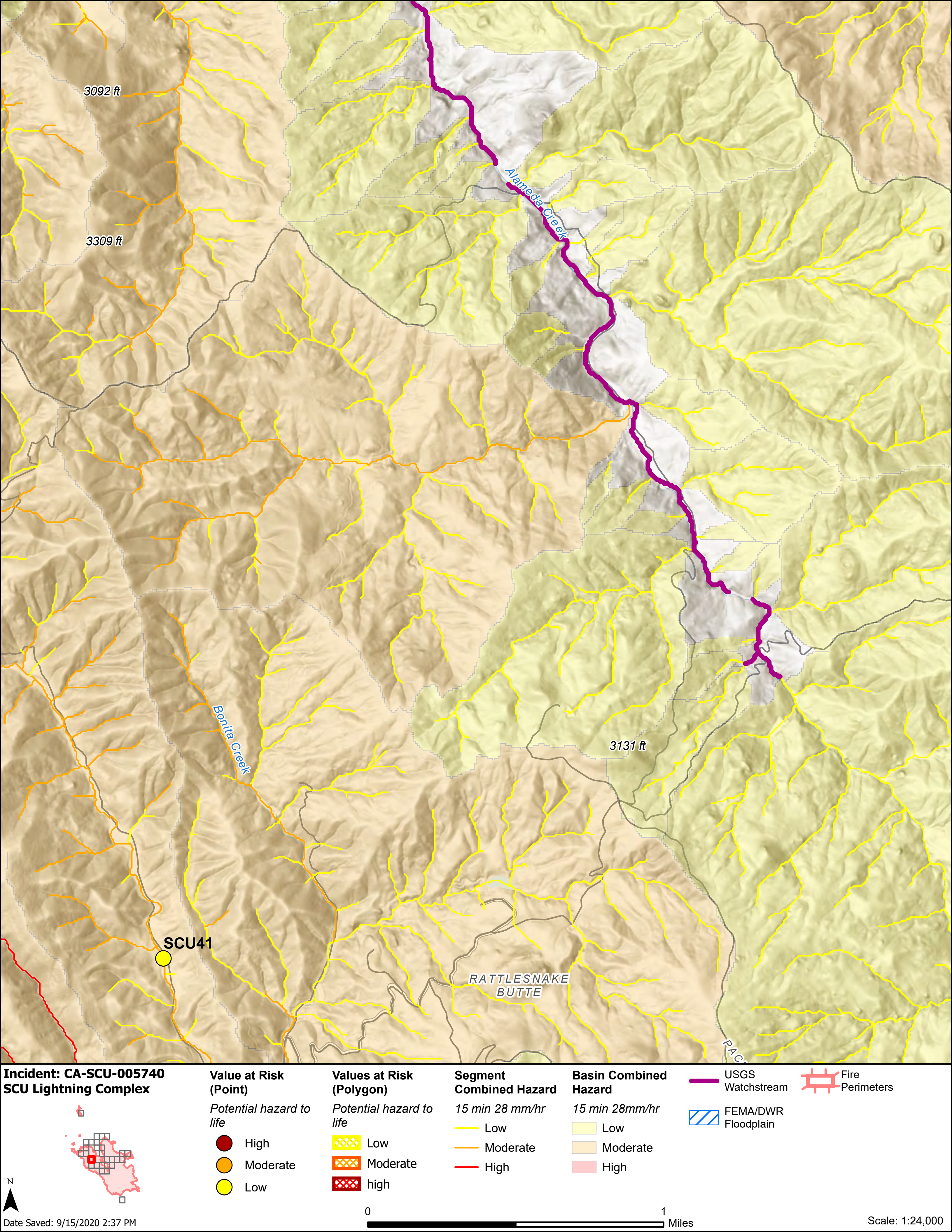
USGS Watchstream

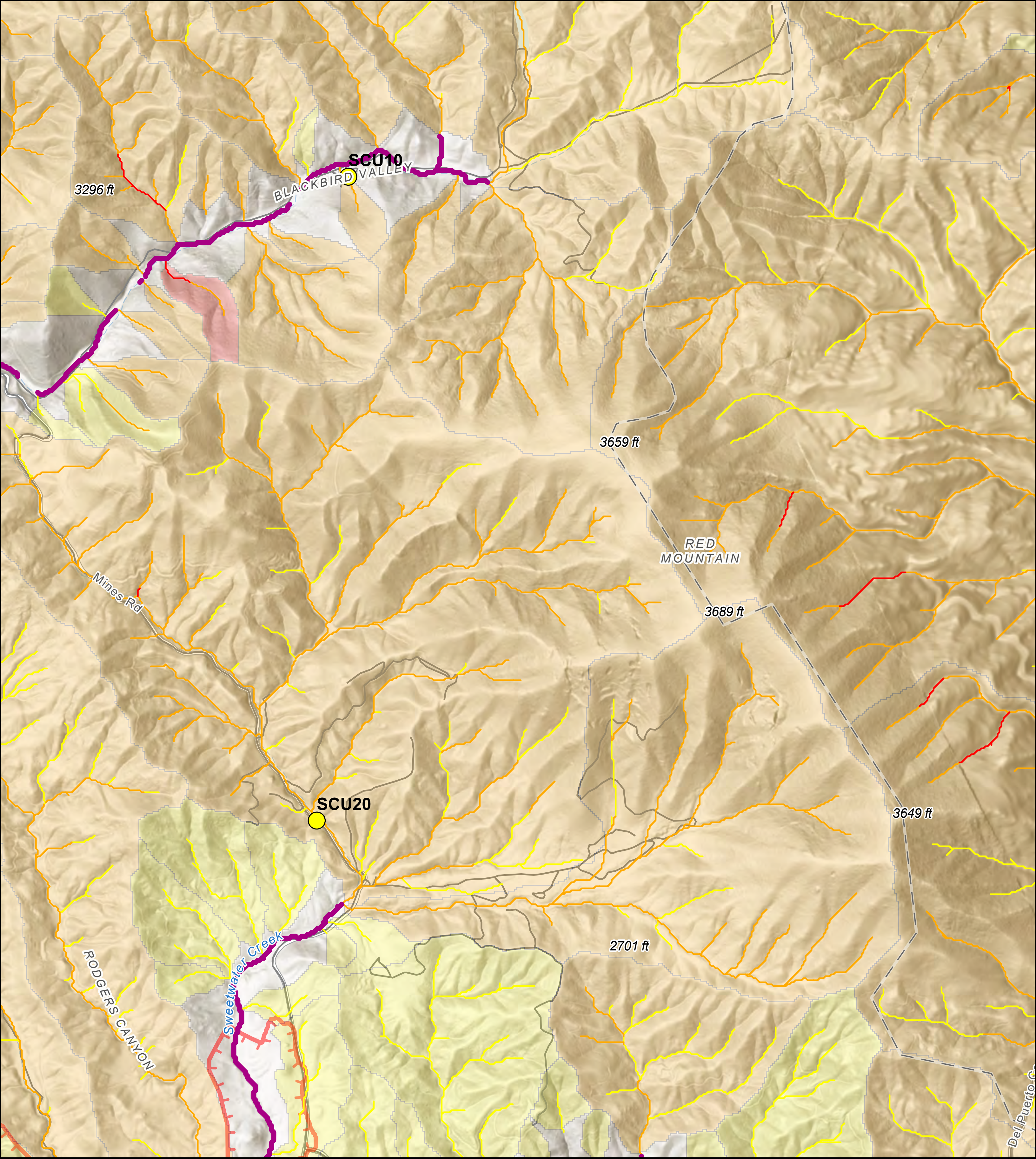
FEMA/DWR Floodplain

Fire Perimeters

0 1 Miles

Scale: 1:24,000


3092 ft
3309 ft
Alameda Creek
Bonita Creek
3131 ft
SCU41
RATTLESNAKE BUTTE
Incident: CA-SCU-005740
SCU Lightning Complex
Value at Risk (Point)
Potential hazard to life
High
Moderate
Low
Values at Risk (Polygon)
Potential hazard to life
Low
Moderate
high
Segment Combined Hazard
15 min 28 mm/hr
Low
Moderate
High
Basin Combined Hazard
15 min 28mm/hr
Low
Moderate
High
USGS Watchstream
FEMA/DWR Floodplain
Fire Perimeters
N
0
1
Miles
Date Saved: 9/15/2020 2:37 PM
Scale: 1:24,000



Incident: CA-SCU-005740
SCU Lightning Complex

Value at Risk (Point)
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Values at Risk (Polygon)
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Basin Combined Hazard
15 min 28mm/hr
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- High

USGS Watchstream

FEMA/DWR Floodplain

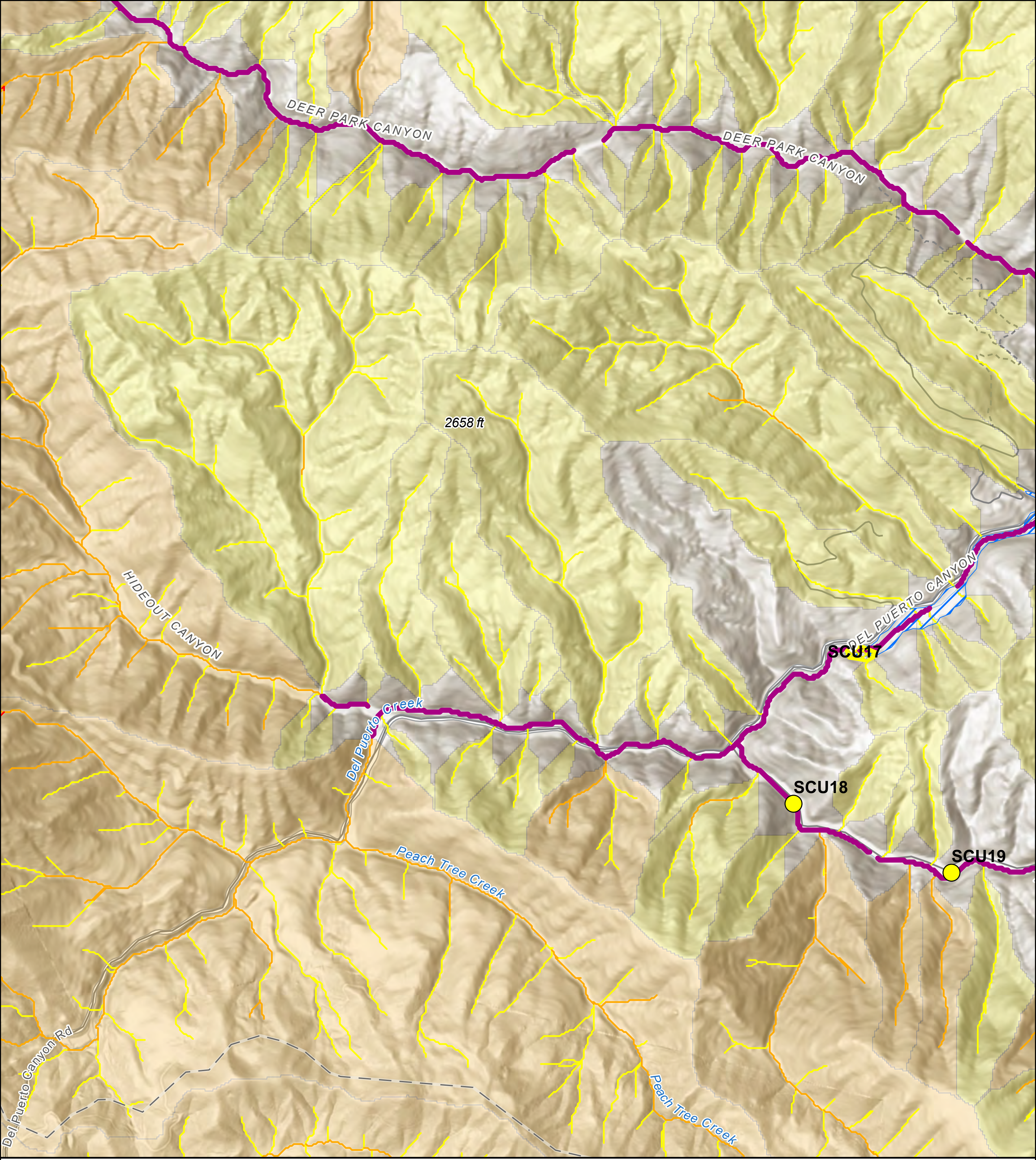
Fire Perimeters

N

0 1 Miles

Date Saved: 9/15/2020 2:37 PM

Scale: 1:24,000



Incident: CA-SCU-005740
SCU Lightning Complex

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USGS Watchstream

FEMA/DWR Floodplain

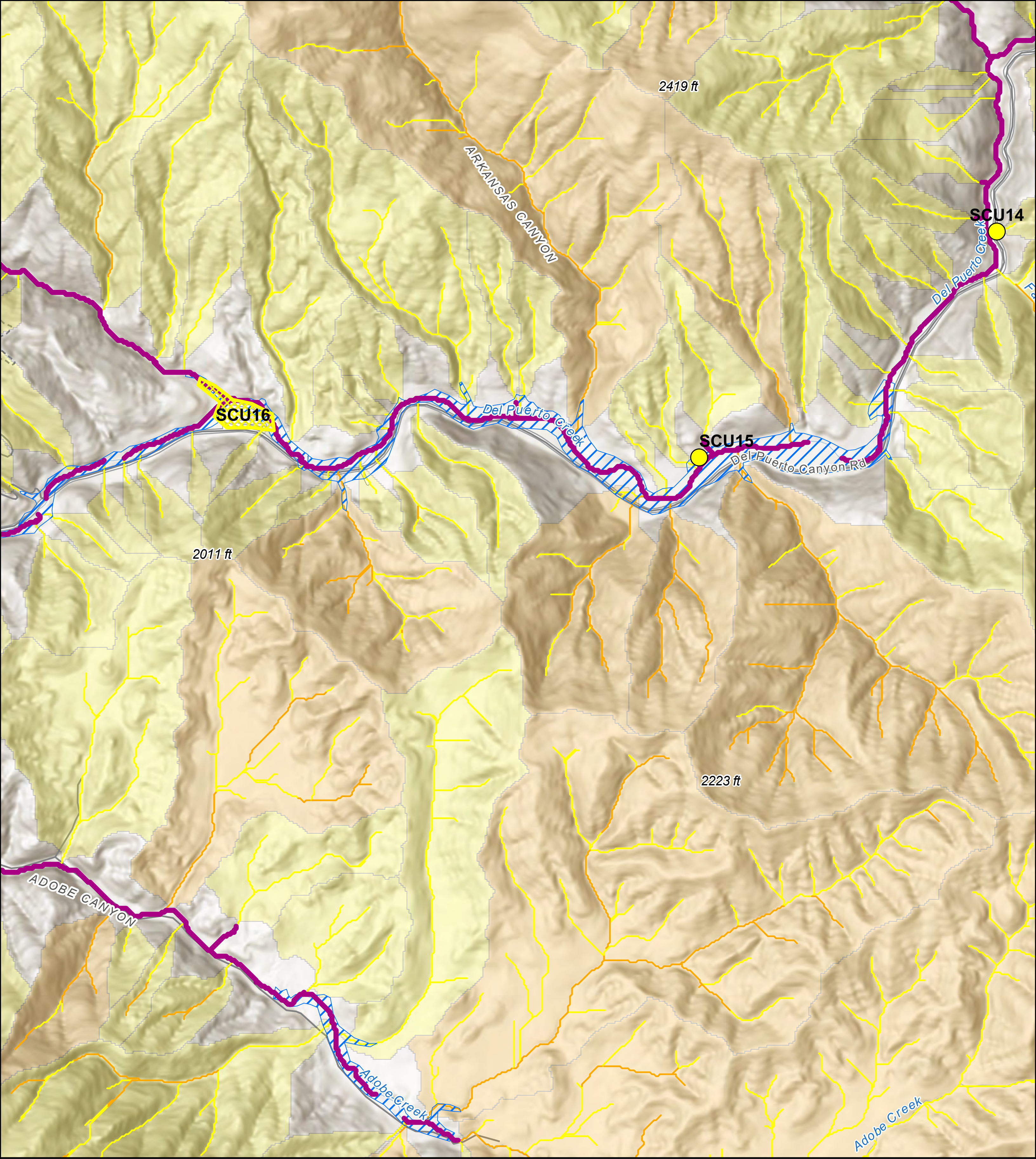
Fire Perimeters

N

Date Saved: 9/15/2020 2:37 PM

0 1 Miles

Scale: 1:24,000



Incident: CA-SCU-005740
SCU Lightning Complex

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Basin Combined Hazard
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- High

USGS Watchstream

FEMA/DWR Floodplain

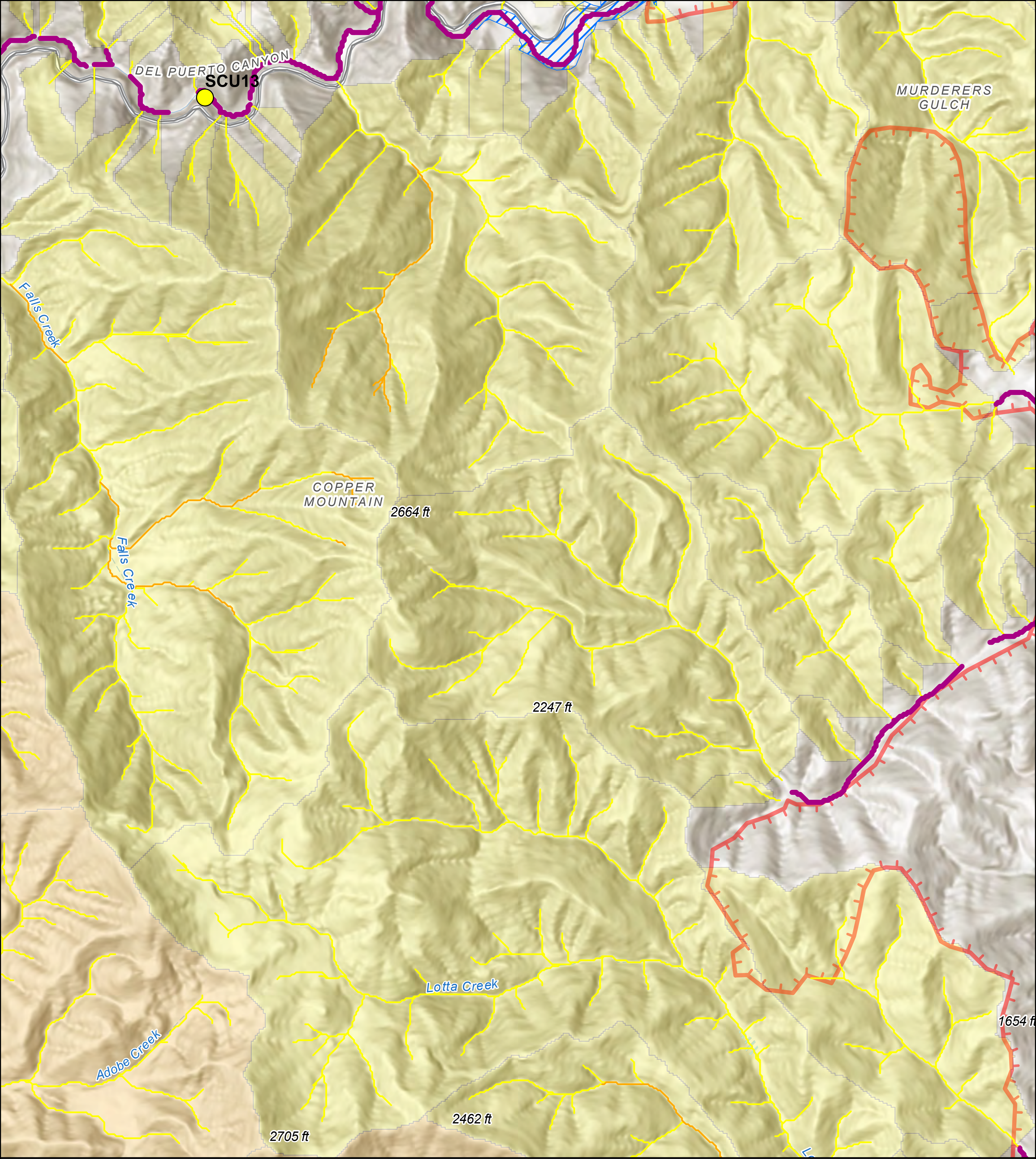
Fire Perimeters

N

0 1 Miles

Date Saved: 9/15/2020 2:37 PM

Scale: 1:24,000



Incident: CA-SCU-005740
SCU Lightning Complex

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USGS Watchstream

FEMA/DWR Floodplain

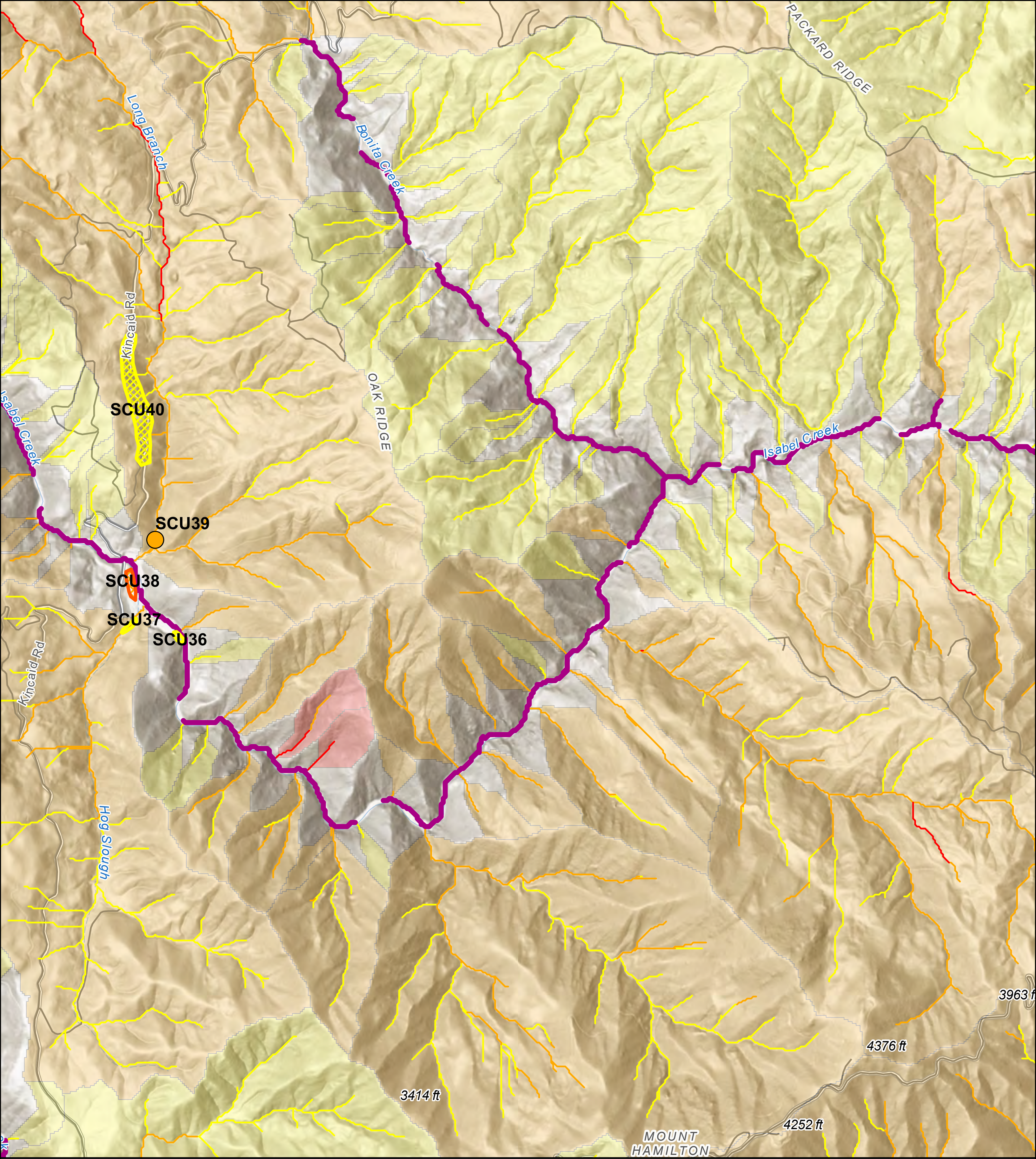
Fire Perimeters

N

0 1 Miles

Scale: 1:24,000

Date Saved: 9/15/2020 2:37 PM



Incident: CA-SCU-005740
SCU Lightning Complex

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Moderate
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USGS Watchstream
FEMA/DWR Floodplain
Fire Perimeters

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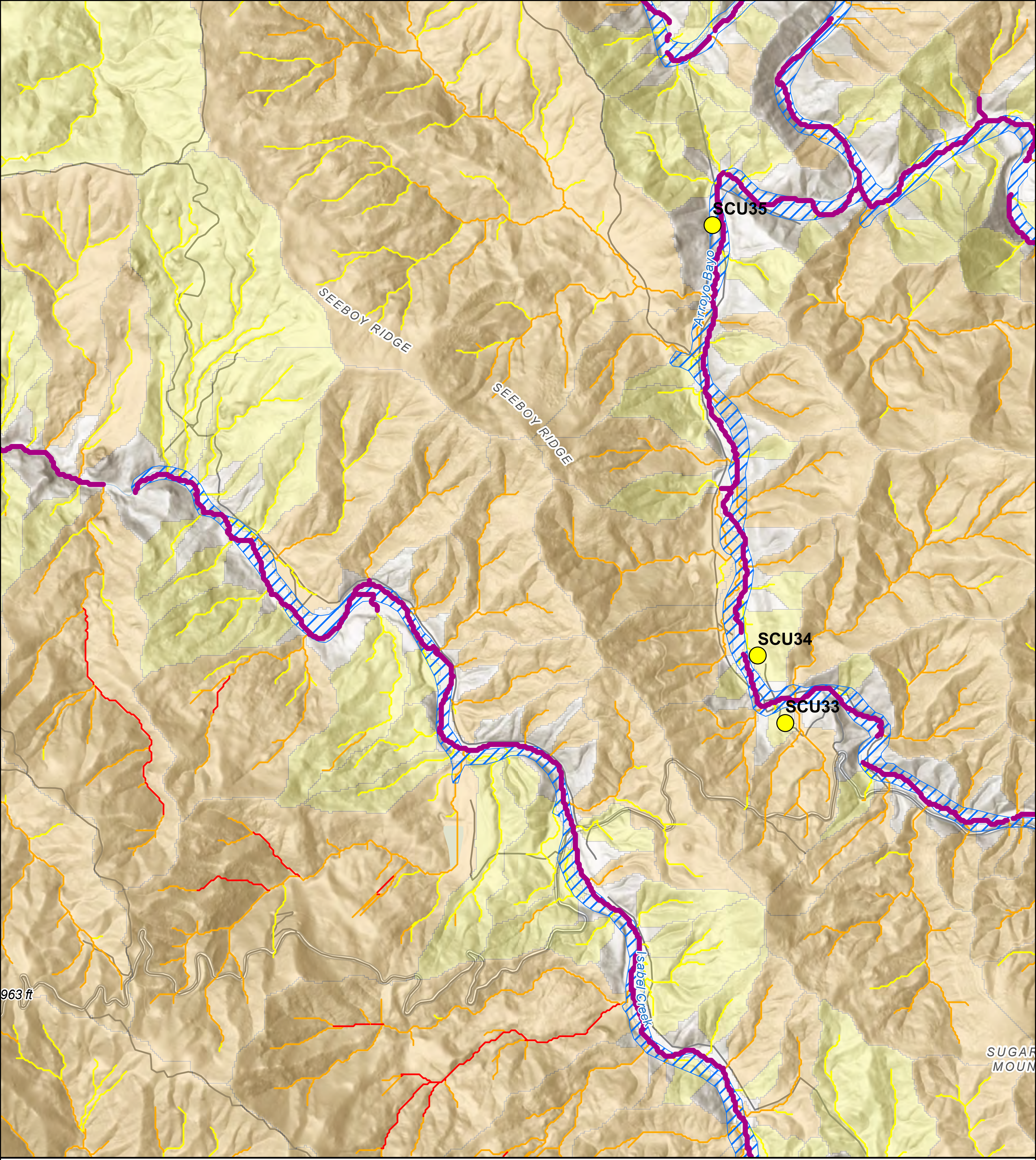
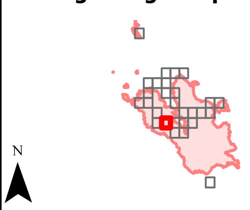
Scale: 1:24,000



Incident: CA-SCU-005740
SCU Lightning Complex



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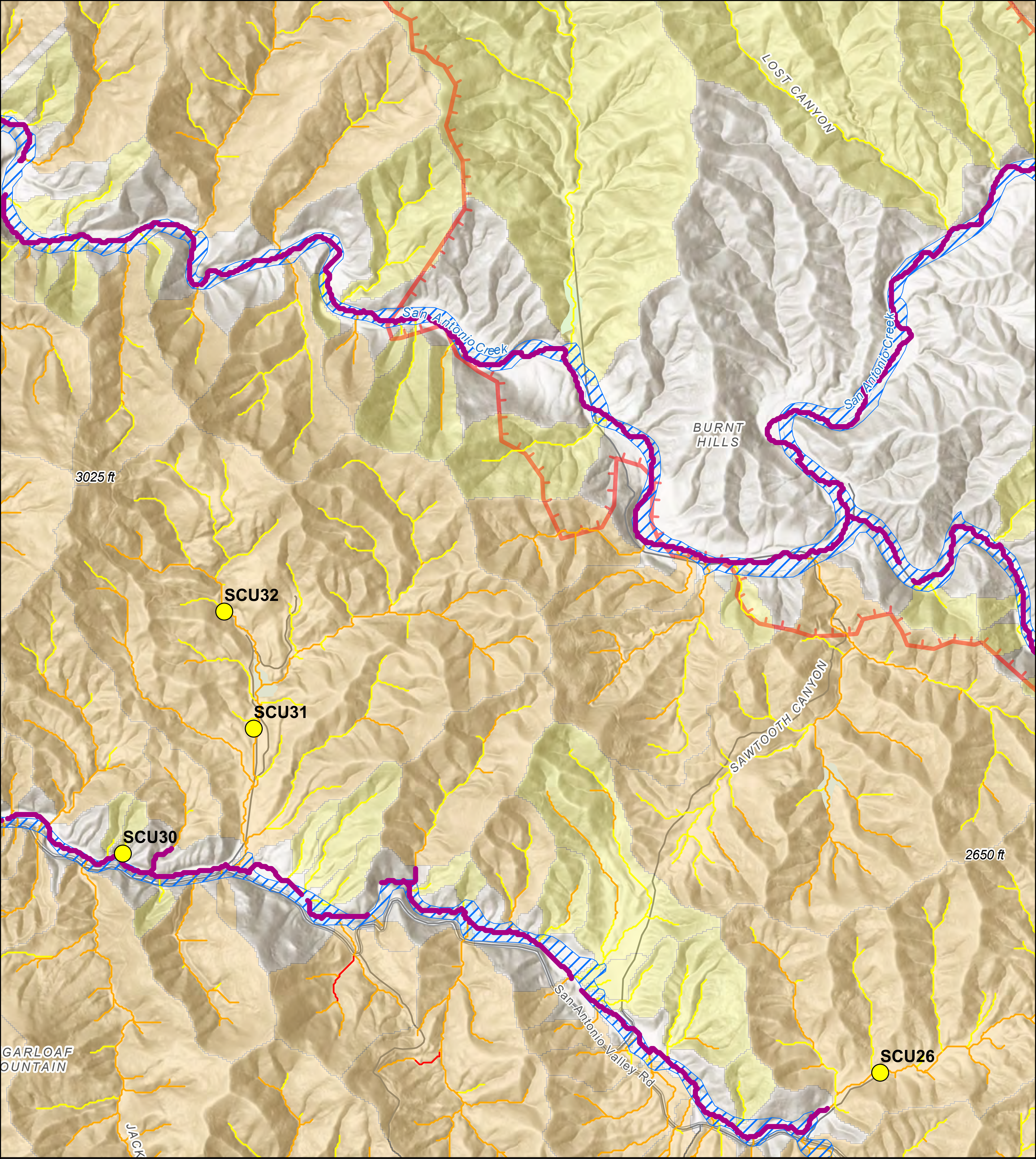
USGS Watchstream

FEMA/DWR Floodplain

Fire Perimeters

0 1 Miles

Scale: 1:24,000



Incident: CA-SCU-005740
SCU Lightning Complex

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USGS Watchstream

FEMA/DWR Floodplain

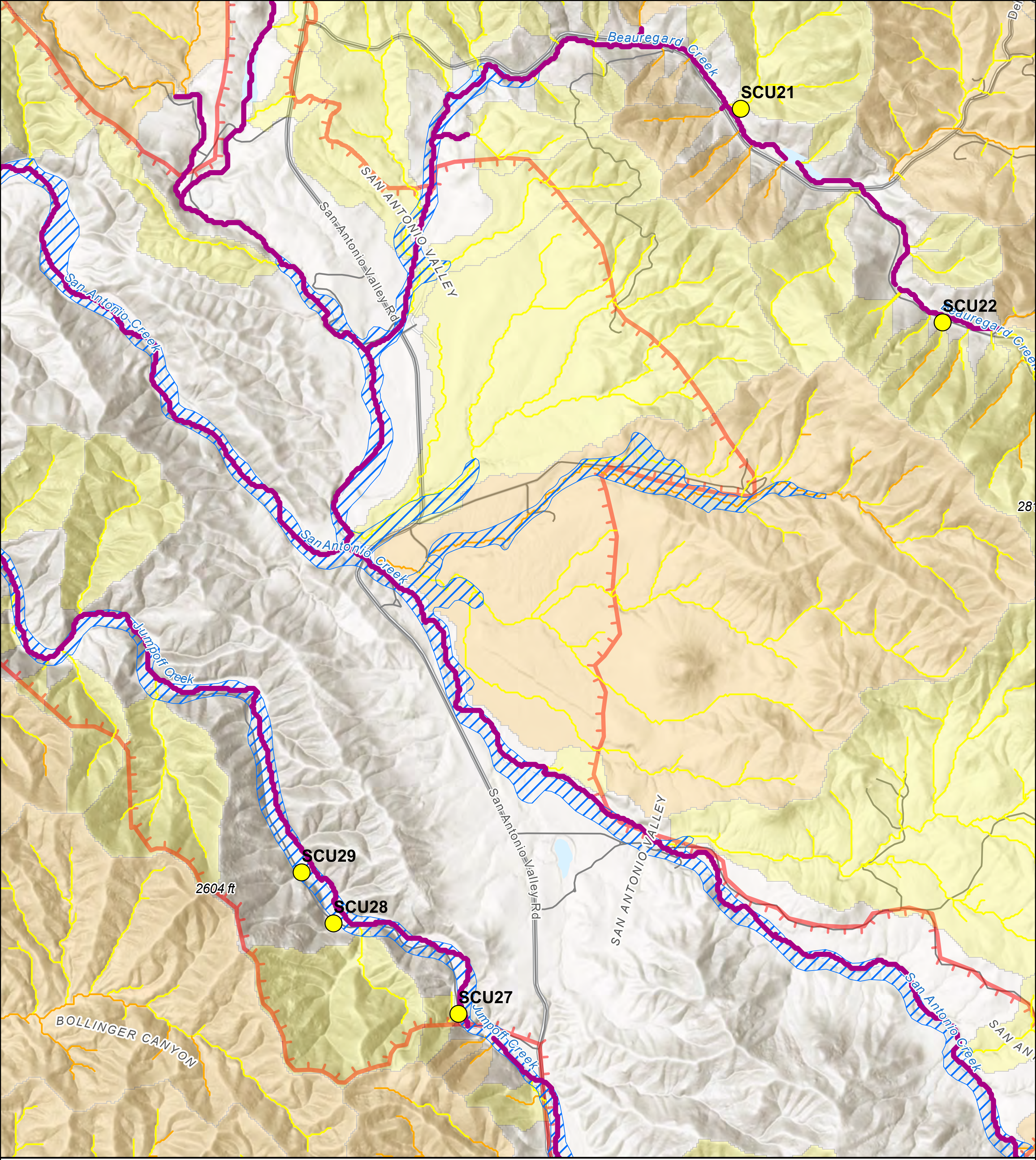
Fire Perimeters

N

Date Saved: 9/15/2020 2:37 PM

0 1 Miles

Scale: 1:24,000



Incident: CA-SCU-005740
SCU Lightning Complex

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USGS Watchstream

FEMA/DWR Floodplain

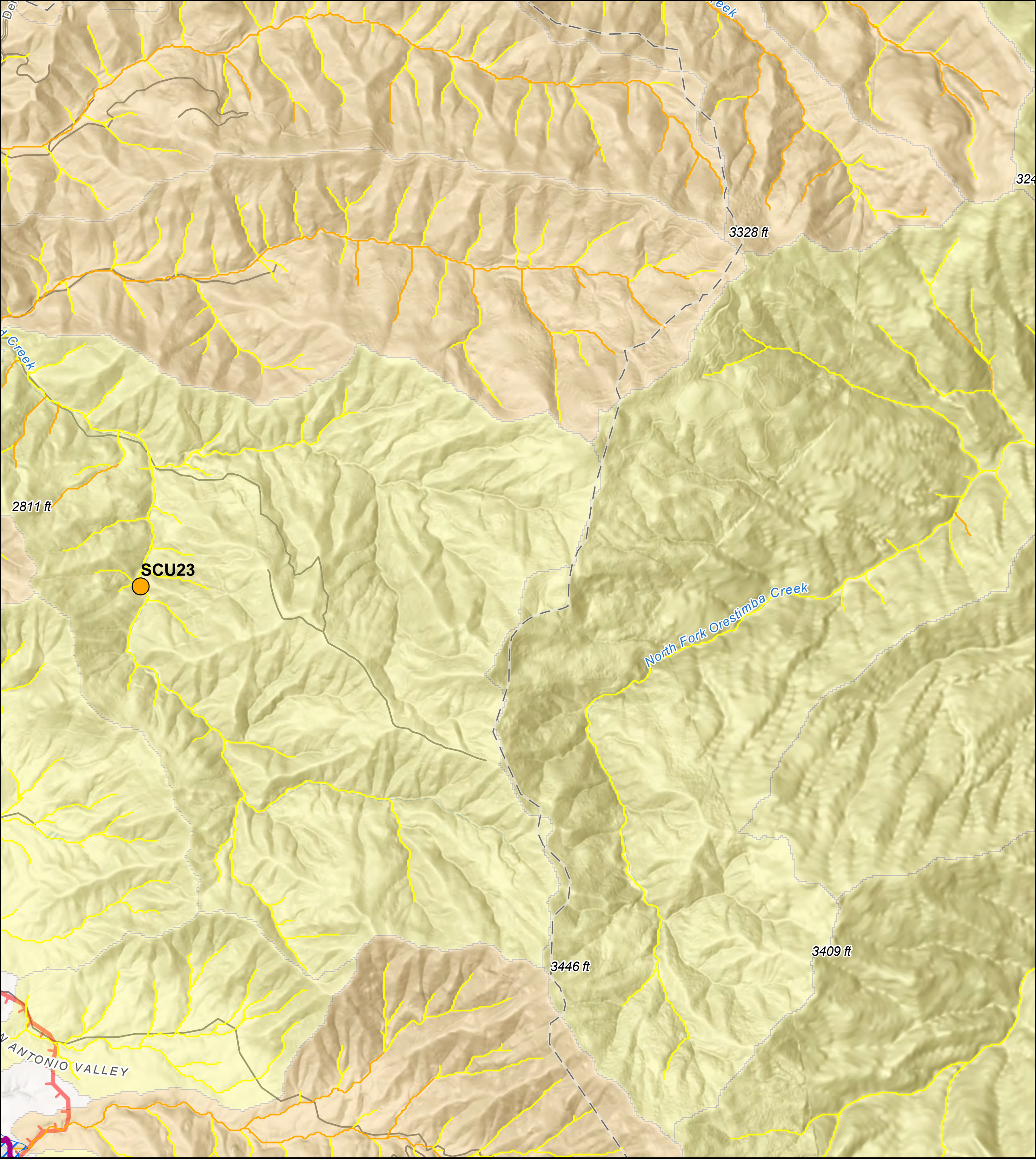
Fire Perimeters

N

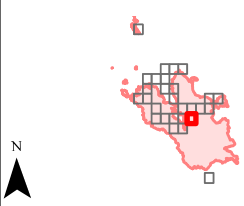
0 1 Miles

Date Saved: 9/15/2020 2:37 PM

Scale: 1:24,000



Incident: CA-SCU-005740
SCU Lightning Complex



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Value at Risk (Point)

Potential hazard to life

- High
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- Low

Values at Risk (Polygon)

Potential hazard to life

- Low
- Moderate
- high

Segment Combined Hazard

15 min 28 mm/hr

- Low
- Moderate
- High

Basin Combined Hazard

15 min 28mm/hr

- Low
- Moderate
- High

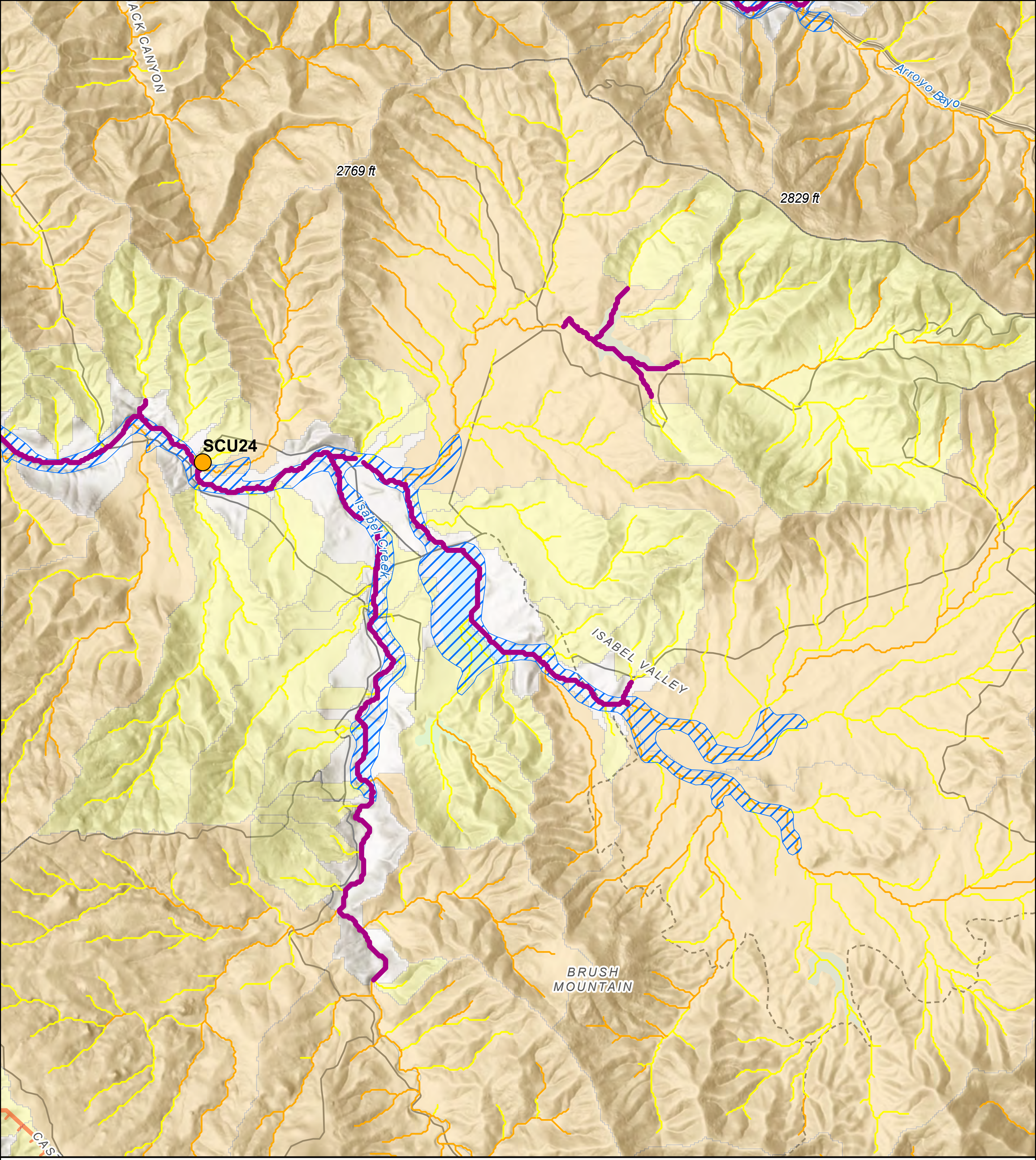
USGS Watchstream

FEMA/DWR Floodplain

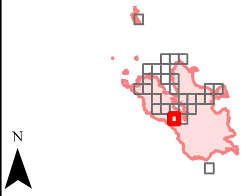
Fire Perimeters

0 1 Miles

Scale: 1:24,000



Incident: CA-SCU-005740
SCU Lightning Complex



Value at Risk (Point)
Potential hazard to life
- High
- Moderate
- Low

Values at Risk (Polygon)
Potential hazard to life
- Low
- Moderate
- high

Segment Combined Hazard
15 min 28 mm/hr
- Low
- Moderate
- High

Basin Combined Hazard
15 min 28mm/hr
- Low
- Moderate
- High

USGS Watchstream

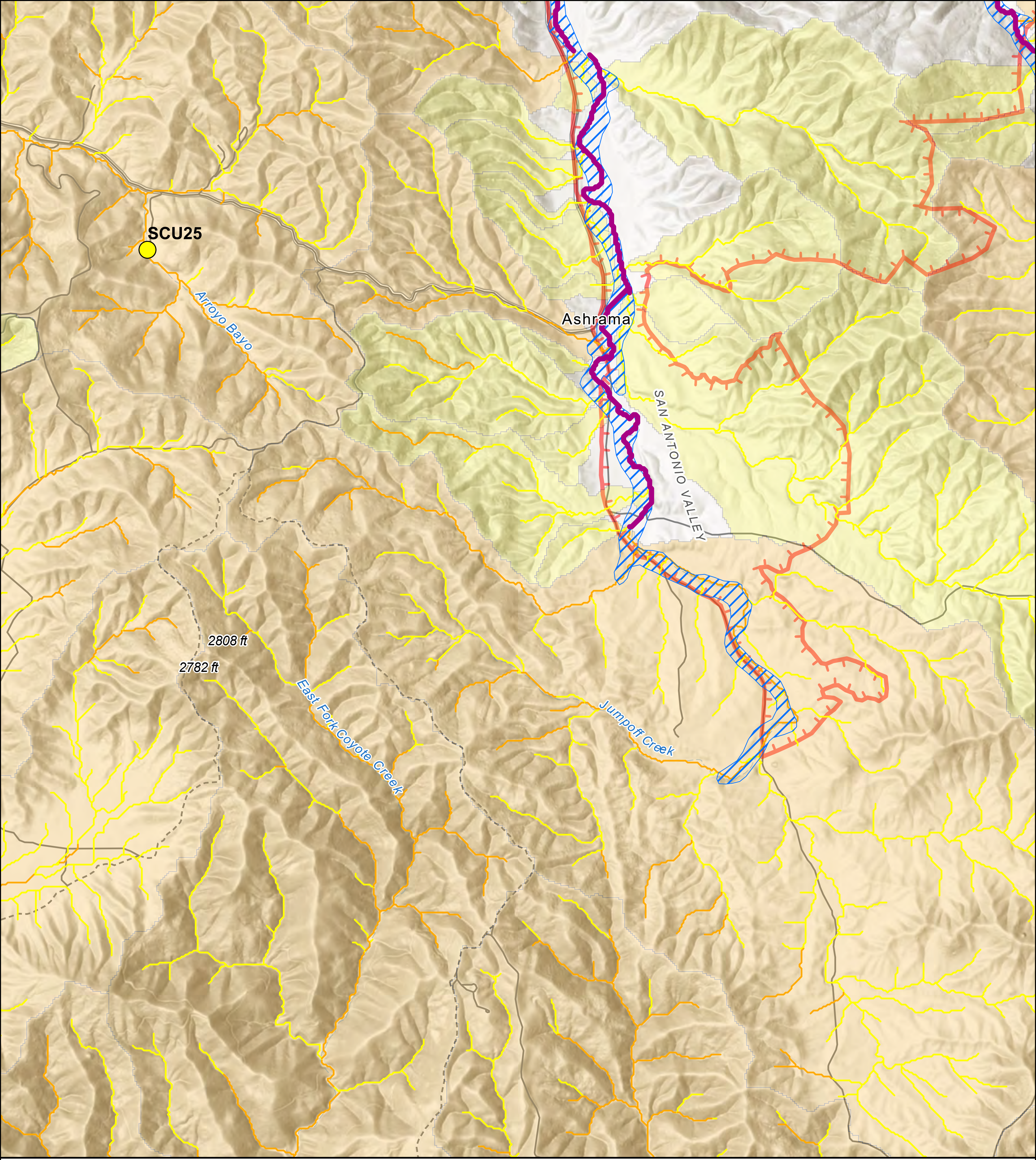
FEMA/DWR Floodplain

Fire Perimeters

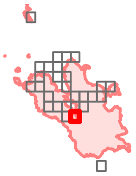
0 1 Miles

Date Saved: 9/15/2020 2:37 PM

Scale: 1:24,000



Incident: CA-SCU-005740
SCU Lightning Complex



Value at Risk (Point)

Potential hazard to life

- High
- Moderate
- Low

Values at Risk (Polygon)

Potential hazard to life

- Low
- Moderate
- high

Segment Combined Hazard

15 min 28 mm/hr

- Low
- Moderate
- High

Basin Combined Hazard

15 min 28mm/hr

- Low
- Moderate
- High

USGS Watchstream

FEMA/DWR Floodplain

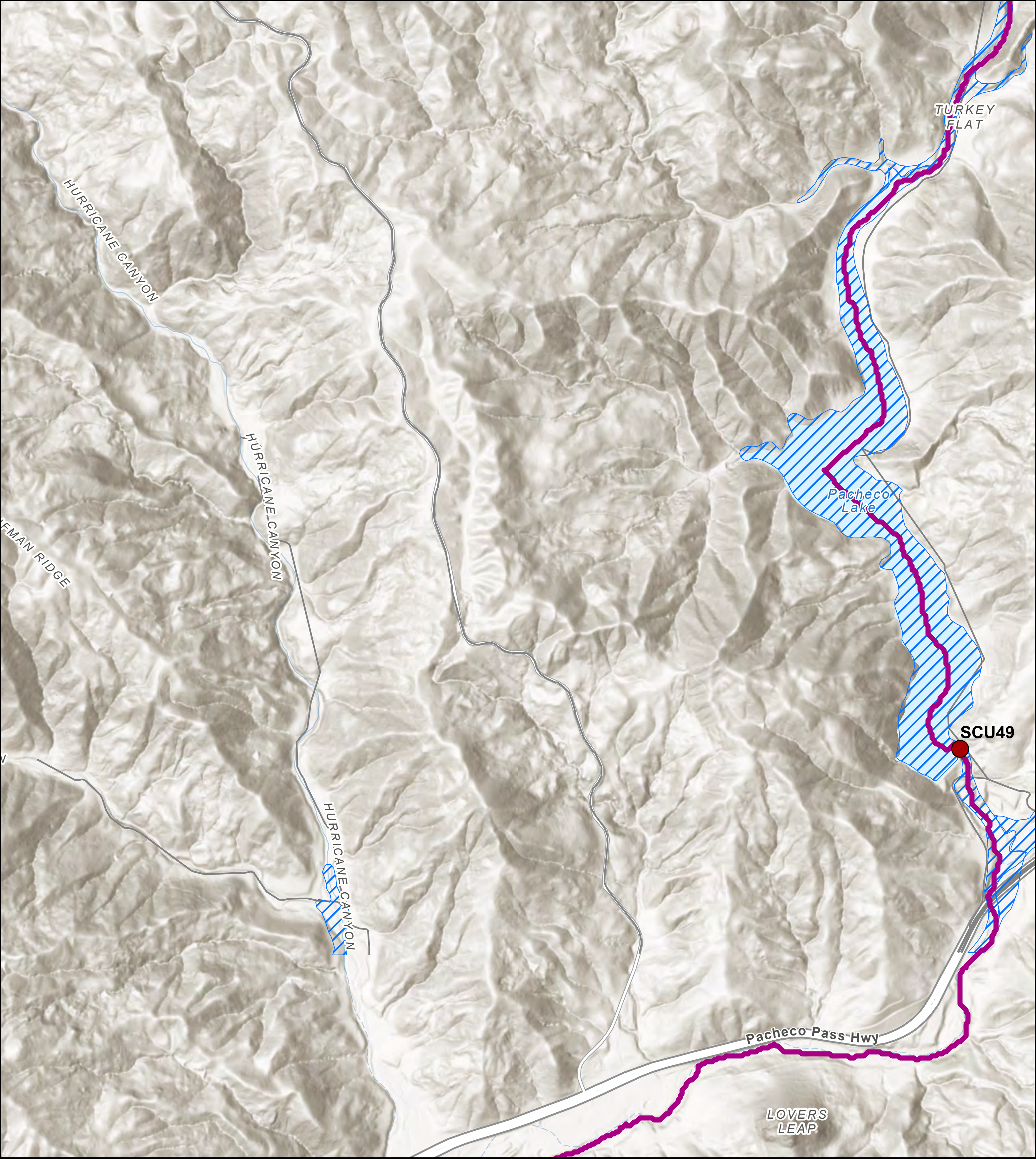
Fire Perimeters

N

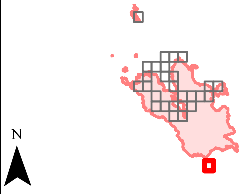
0 — 1 Miles

Date Saved: 9/15/2020 2:37 PM

Scale: 1:24,000



Incident: CA-SCU-005740
SCU Lightning Complex



Date Saved: 9/15/2020 2:37 PM

Value at Risk (Point)

Potential hazard to life

- High
- Moderate
- Low

Values at Risk (Polygon)

Potential hazard to life

- Low
- Moderate
- high

Segment Combined Hazard

15 min 28 mm/hr

- Low
- Moderate
- High

Basin Combined Hazard

15 min 28mm/hr

- Low
- Moderate
- High

USGS Watchstream

FEMA/DWR Floodplain

Fire Perimeters

0 — 1 Miles

Scale: 1:24,000

Appendix D: VAR Information Sheets

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VALUE AT RISK DETAIL

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Mines Road**

Site Number: **SCU02**

Feature: **Crossing structure and embankment**

Feature Category: **drainage structure**

Field Observation or Potential Hazard: Large bridge crossing on Arroyo Macho at oblique angle, forcing a bend in the creek. Creek confined upstream of crossing and widens at bend in crossing. Aggredation under bridge. Abundant vegetation in channel above and below crossing.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

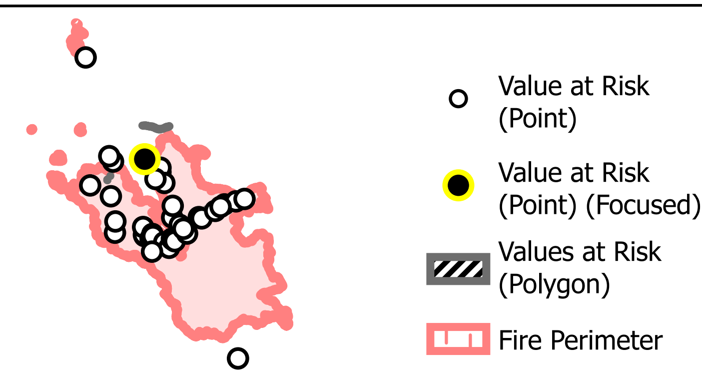
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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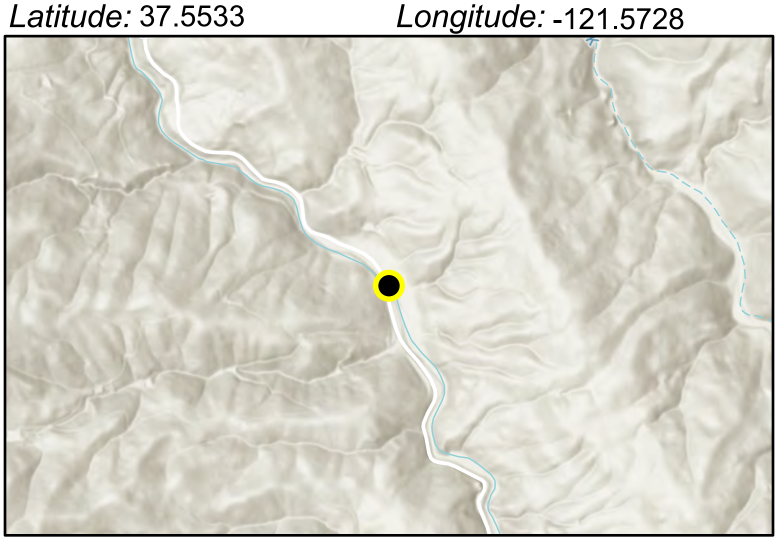


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex **_Incident Number: CA-SCU-005740_**

Community: **Mines Road**

Site Number: **SCU03**

Feature: **Home**

Feature Category: **home**

Field Observation or Potential Hazard: House situated on terrace above creek downstream of burn area. Slight bend in creek upstream from structure, could cause erosion and flooding issues. Lower terrace noted on other side of stream.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

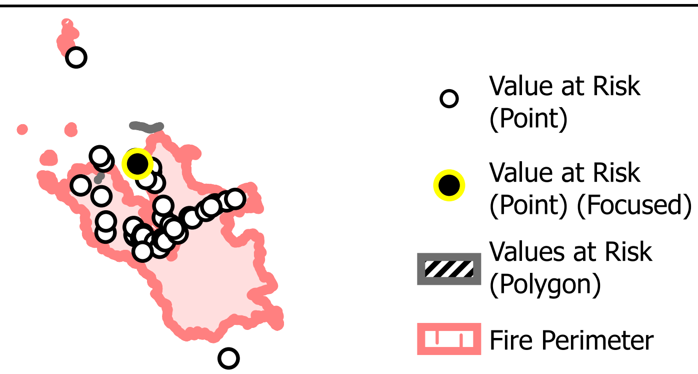
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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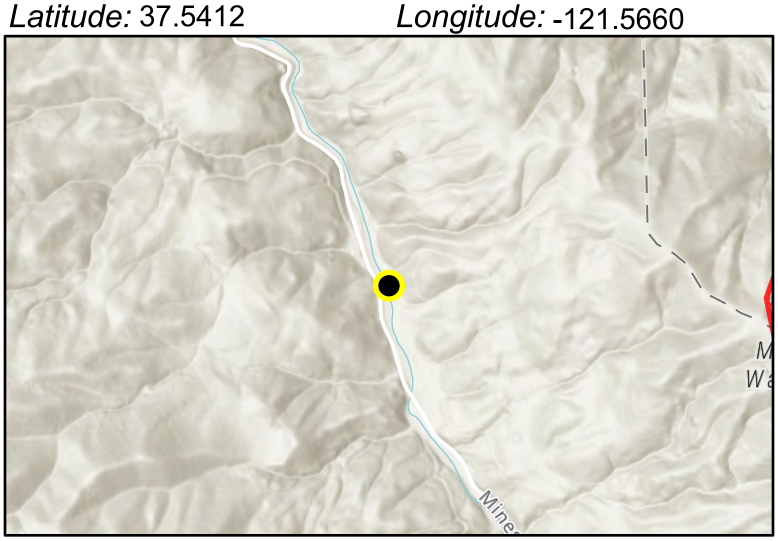


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex ***Incident Number: CA-SCU-005740***

Community: **Mines Road**

Site Number: **SCU04**

Feature: **Home**

Feature Category: **home**

Field Observation or Potential Hazard: Home situated at mouth of 2 steep sidehill drainages. Owners say one of the drainages flows in the winter, but goes down driveway, which is very close to house.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

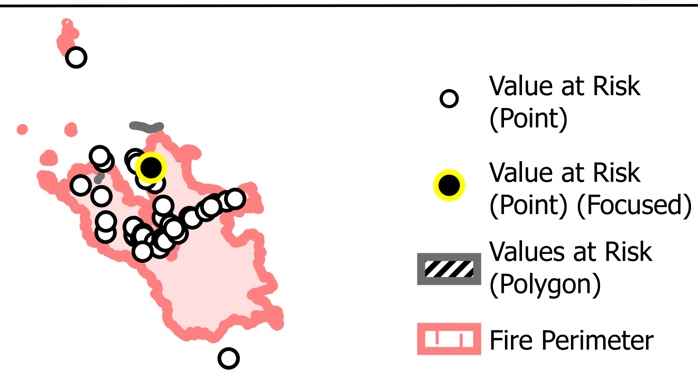
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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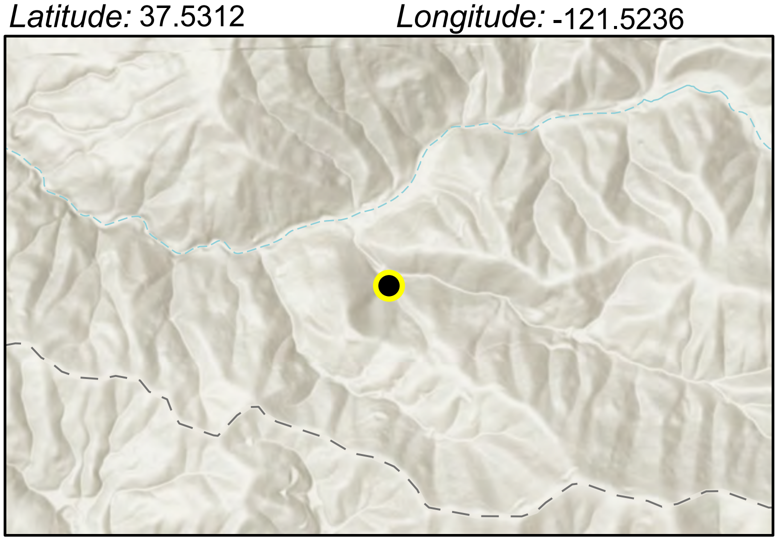


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Mines Road**

Site Number: **SCU05**

Feature: **Home**

Feature Category: **home**

Field Observation or Potential Hazard: Home situated above channel in floodplain. However, a stock pond impoundment is just upstream from house across creek. Unclear where creek drains through. Possible diversion channel on north side of property.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

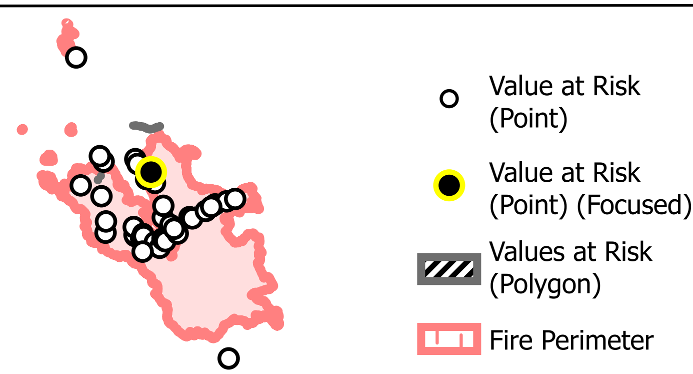
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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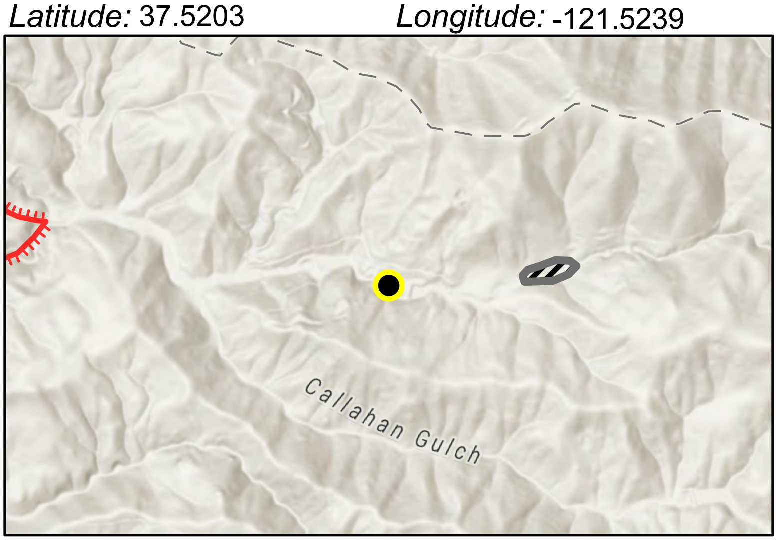


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Mines Road**

Site Number: **SCU07**

Feature: **RV**

Feature Category: **home**

Field Observation or Potential Hazard: RV on building pad 5 ft above stream channel

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

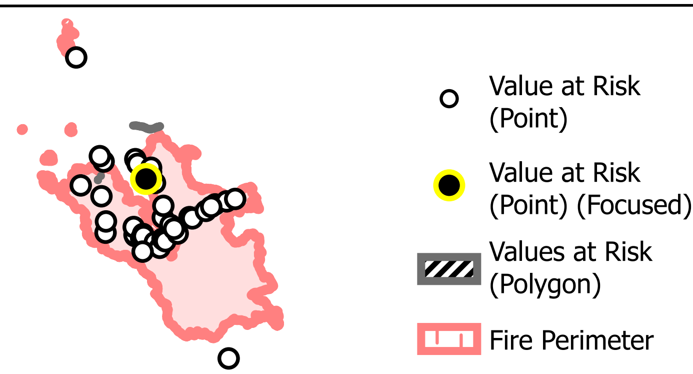
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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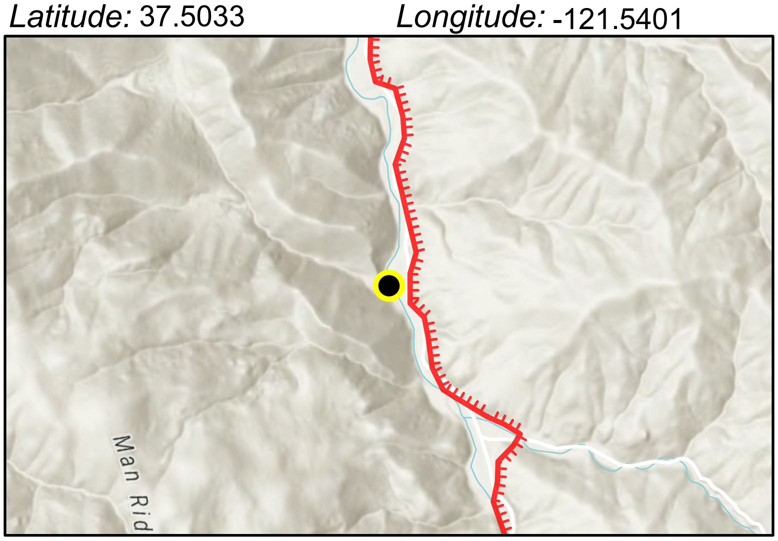


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Mines Road**

Site Number: **SCU08**

Feature: **Structure**

Feature Category: **home**

Field Observation or Potential Hazard: Burned structure located adjacent to channel on old fan. Upstream culvert looks new, indicating possible prior issues at sites. Sharp bend in main channel near structure could cause flood waters could jump out of channel during flood and impact structure.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

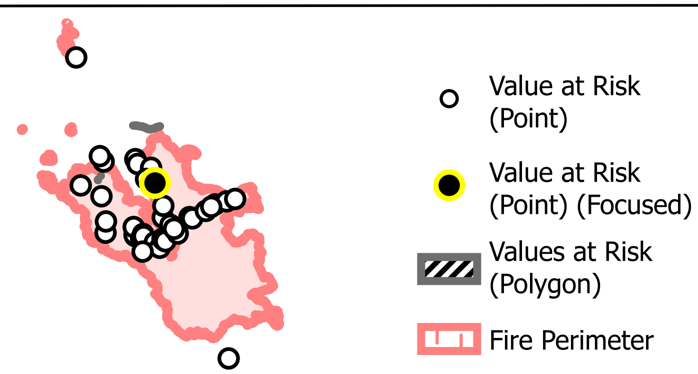
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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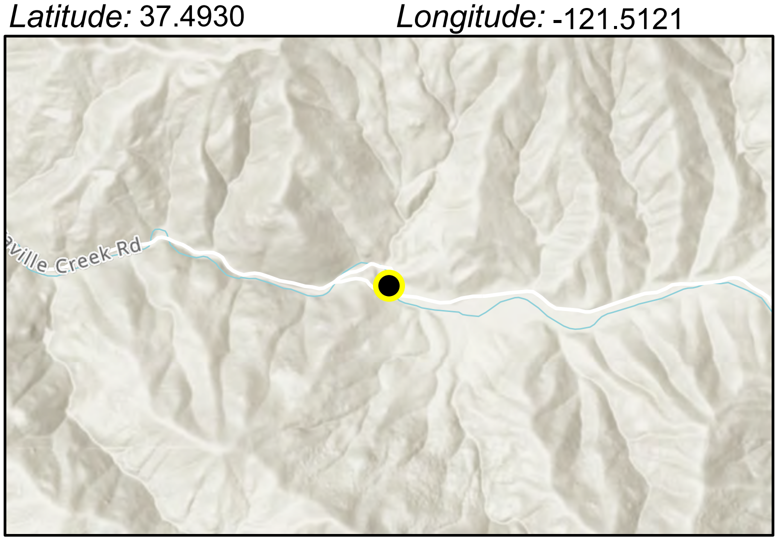


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Mines Road**

Site Number: **SCU10**

Feature: **Homes**

Feature Category: **home**

Field Observation or Potential Hazard: Several mobile homes located at mouth of drainage. Erosion/rilling present on driveway from prior flow out of catchment.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

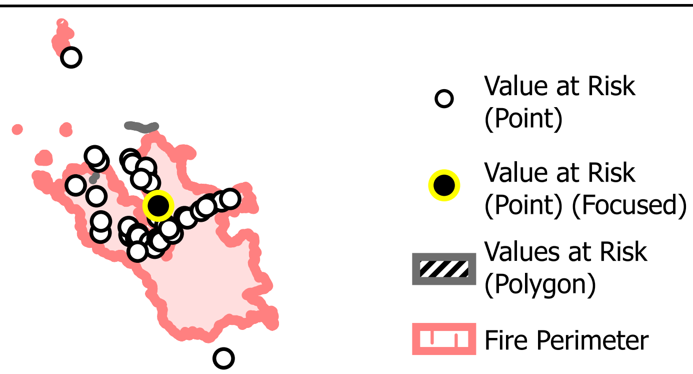
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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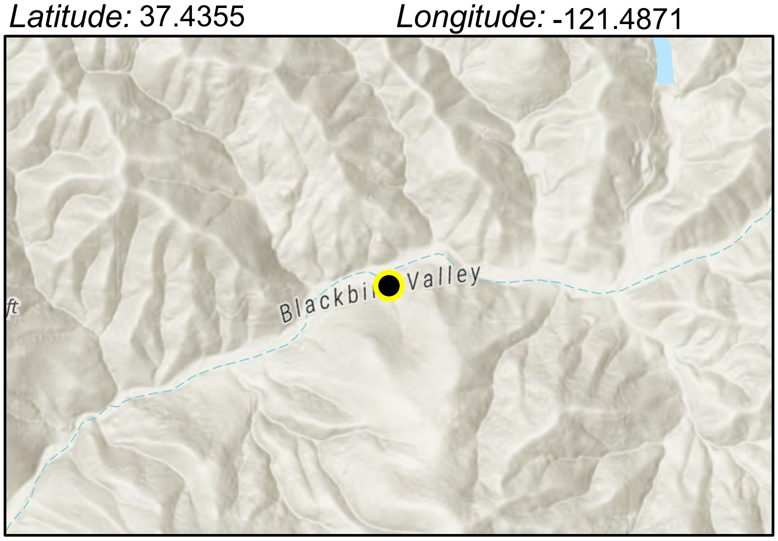


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex ***Incident Number: CA-SCU-005740***

Community: **Del Puerto Canyon**

Site Number: **SCU11**

Feature: **House and ranch structures**

Feature Category: **home**

Field Observation or Potential Hazard: House and ranch buildings in flood plain

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

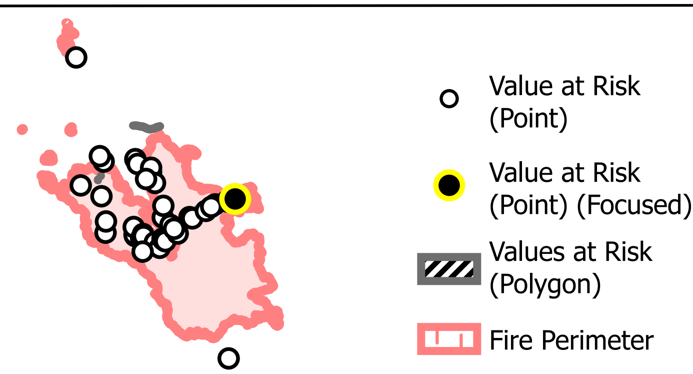
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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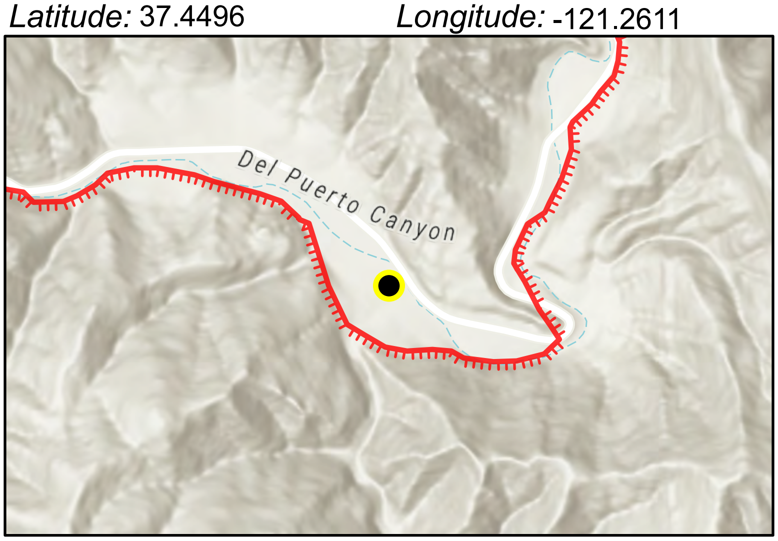


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex ***Incident Number: CA-SCU-005740***

Community: **Del Puerto Canyon**

Site Number: **SCU12**

Feature: **House and ranch buildings**

Feature Category: **home**

Field Observation or Potential Hazard: House and ranch structures in flood plain

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

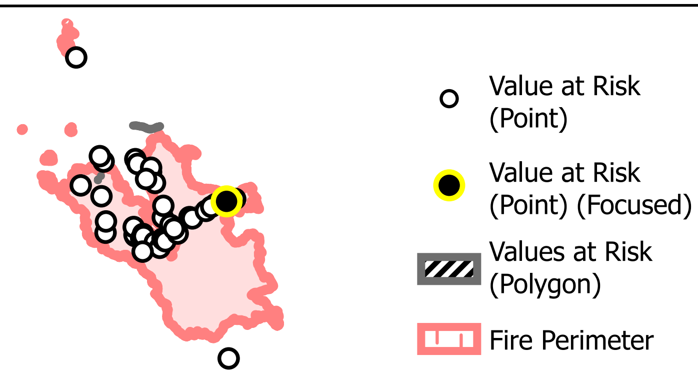
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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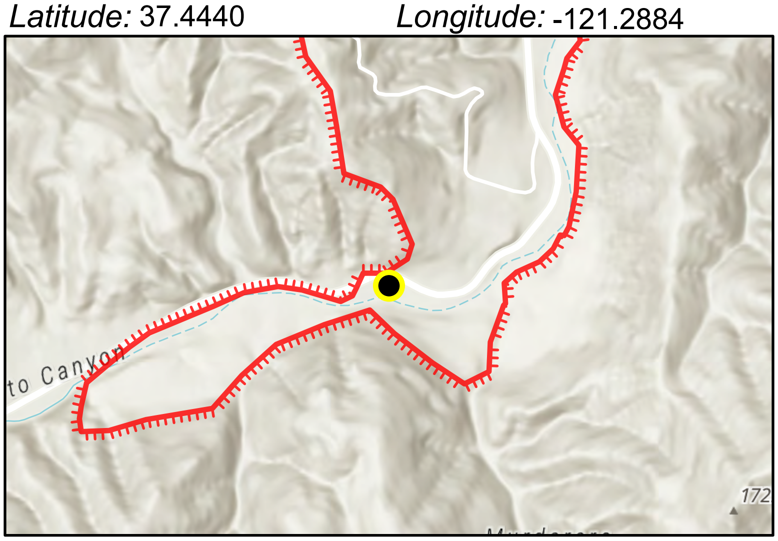


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex ***Incident Number: CA-SCU-005740***

Community: **Del Puerto Canyon**

Site Number: **SCU13**

Feature: **House**

Feature Category: **home**

Field Observation or Potential Hazard: Structure on low lying surface near channel, possible residence. Could not access.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

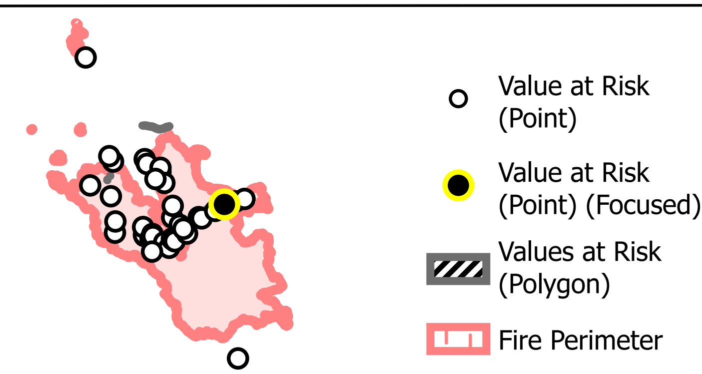
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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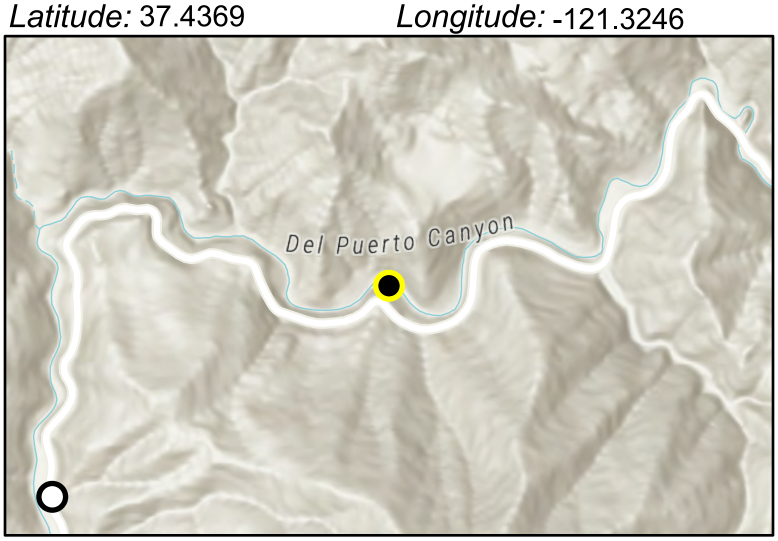


VALUE AT RISK DETAIL

Incident: *SCU Lightning Complex* *Incident Number:* *CA-SCU-005740*

Community: **Del Puerto Canyon**

Site Number: **SCU14**

Feature: **Highway 130**

Feature Category: **other**

Field Observation or Potential Hazard: Debris slide potential onto road. Low burn severity.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Traffic control**

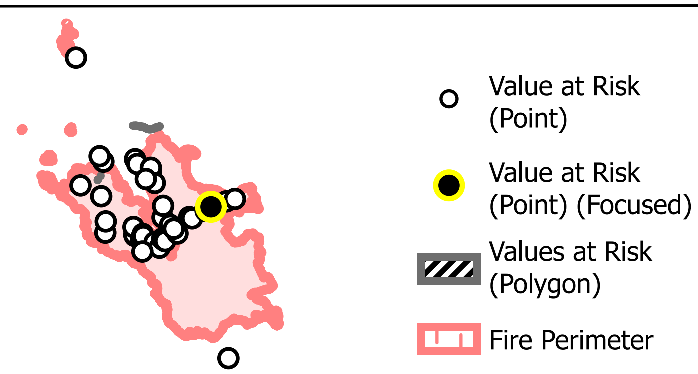
Preliminary Emergency Protective Measures (2): **Debris barrier**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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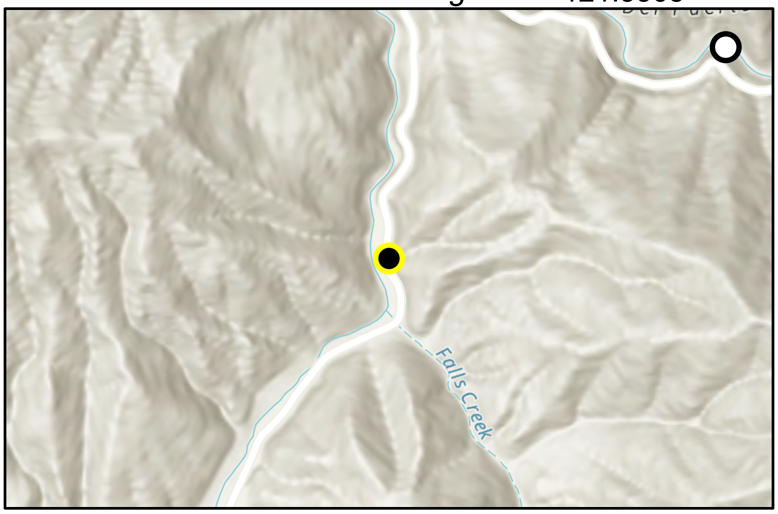


VALUE AT RISK DETAIL

Incident: ***SCU Lightning Complex*** *Incident Number:* ***CA-SCU-005740***

Community: **Del Puerto Canyon**

Site Number: **SCU15**

Feature: **House and ranch buildings**

Feature Category: **home**

Field Observation or Potential Hazard: House and ranch buildings in flood plain

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

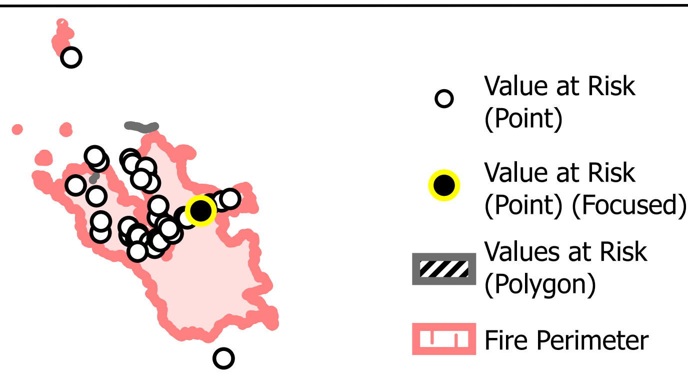
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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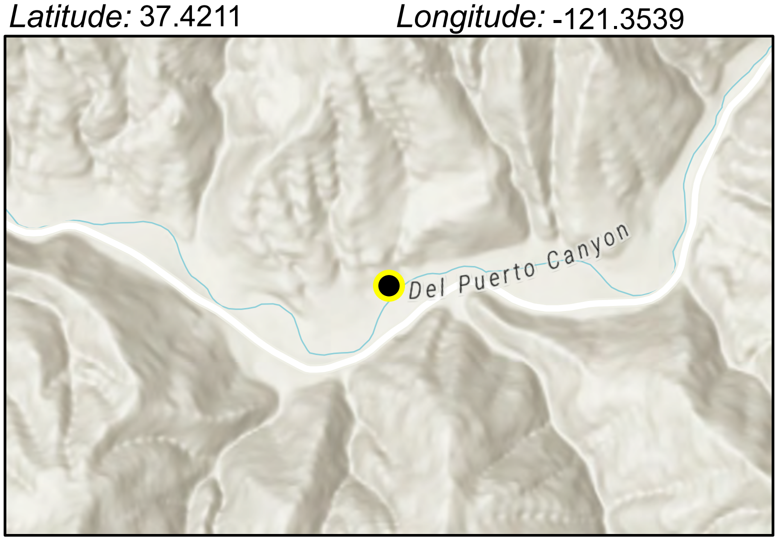


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex ***Incident Number: CA-SCU-005740***

Community: **Adobe Canyon**

Site Number: **SCU18**

Feature: **House and water storage tanks**

Feature Category: **home**

Field Observation or Potential Hazard: House on low lying surface near channel

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

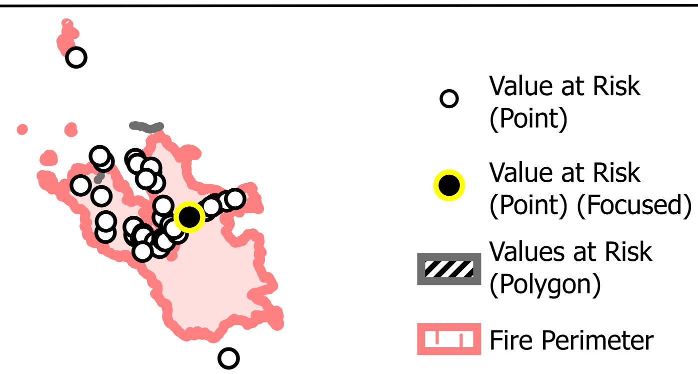
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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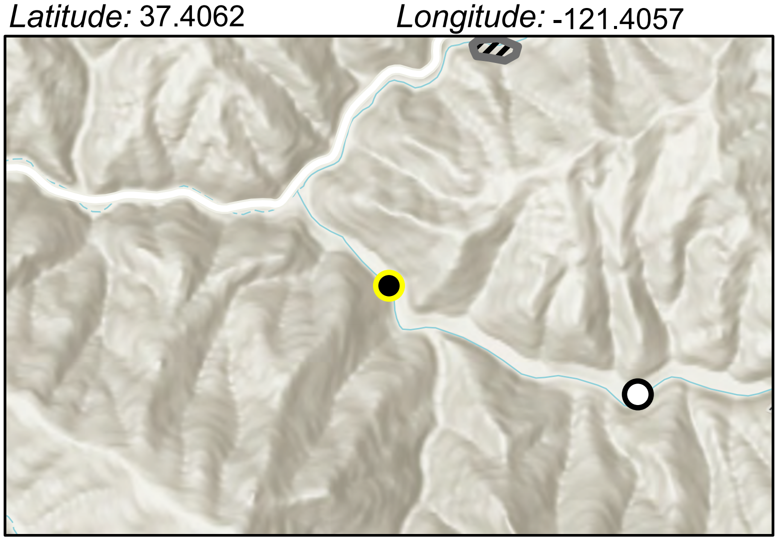


VALUE AT RISK DETAIL

Incident: *SCU Lightning Complex* *Incident Number: CA-SCU-005740*

Community: **Adobe Canyon**

Site Number: **SCU19**

Feature: **Home and chemical storage infrastructure**

Feature Category: **home**

Field Observation or Potential Hazard: Residential structure and chemical storage infrastructure near channel. Long-time resident said water has never come above the channel banks.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

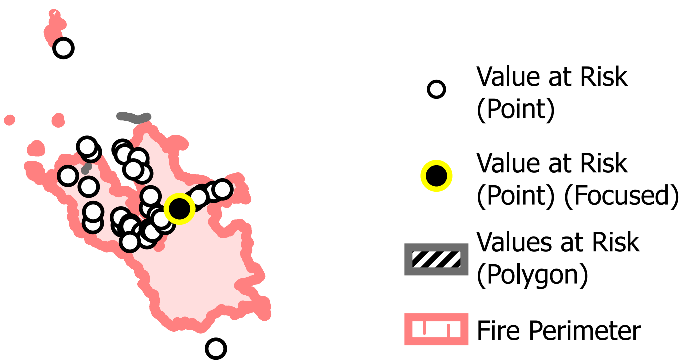
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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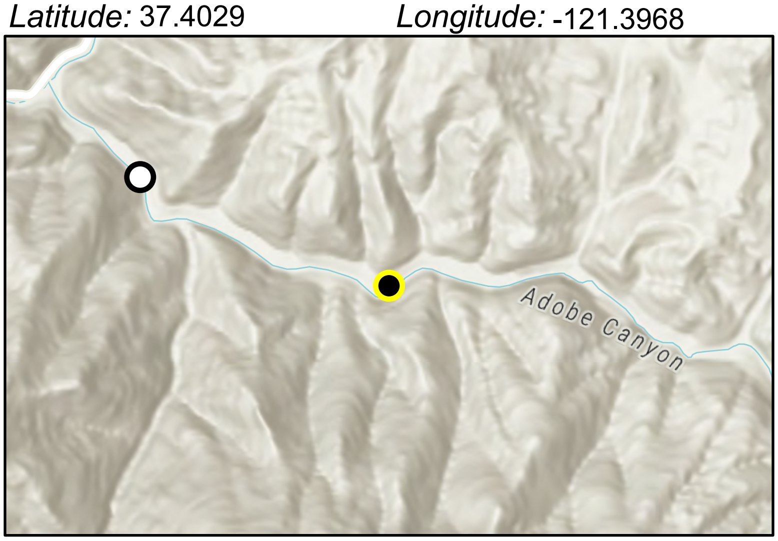


VALUE AT RISK DETAIL

Incident: *SCU Lightning Complex* *Incident Number: CA-SCU-005740*

Community: **Sweetwater Creek**

Site Number: **SCU20**

Feature: **Building**

Feature Category: **business**

Field Observation or Potential Hazard: Business, outbuilding on low surface next to creek.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

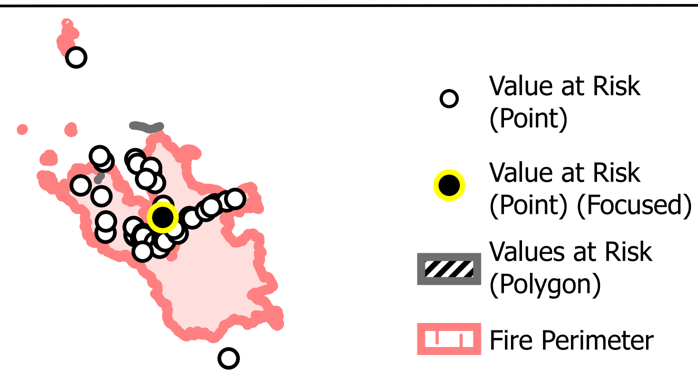
Preliminary Emergency Protective Measures (2): **Sandbags**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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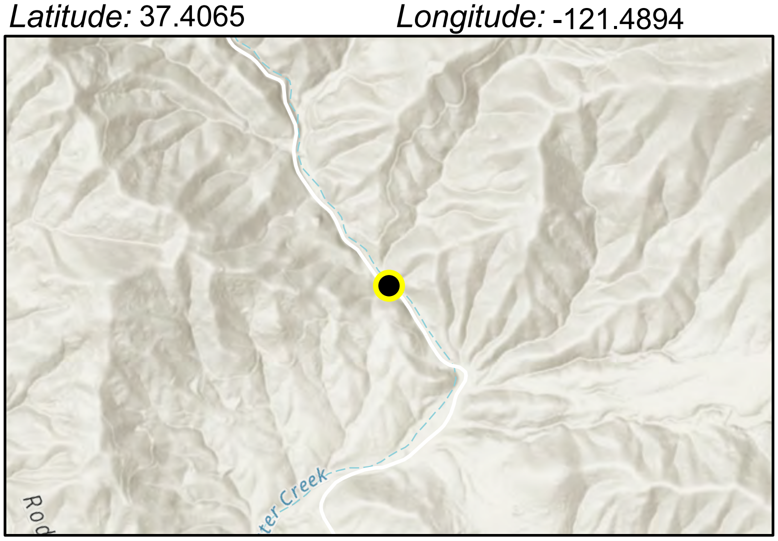


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex — *Incident Number:* CA-SCU-005740

Community: **Del Puerto Canyon**

Site Number: **SCU21**

Feature: **House**

Feature Category: **home**

Field Observation or Potential Hazard: House on a terrace near the channel. Two large culverts under driveway across channel have the potential to clog.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

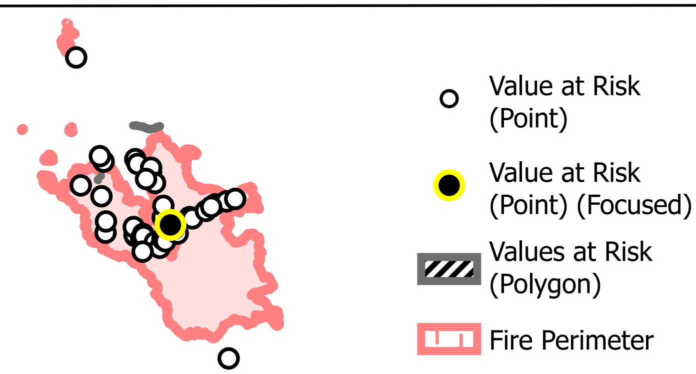
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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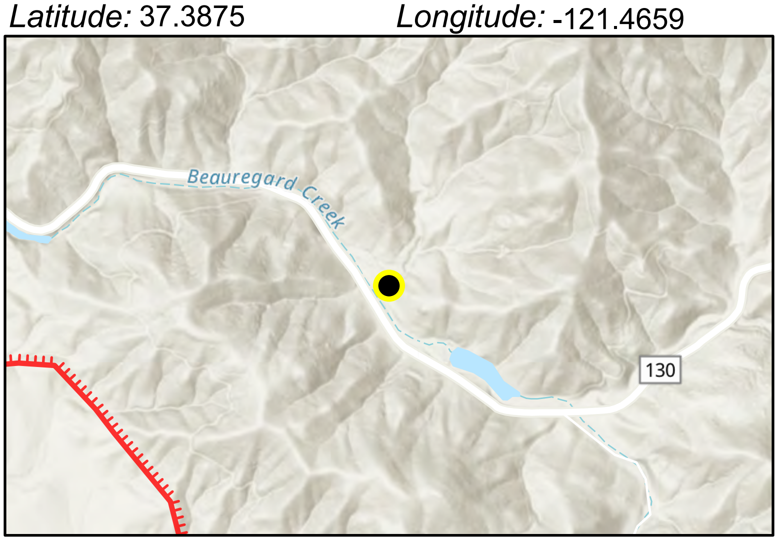


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex — Incident Number: CA-SCU-005740

Community: **Beauregard Creek**

Site Number: **SCU22**

Feature: **Trailers and ranch buildings**

Feature Category: **multiple**

Field Observation or Potential Hazard: Trailers and ranch buildings on low lying surface near channel

Potential Hazard to Life: **low** — *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

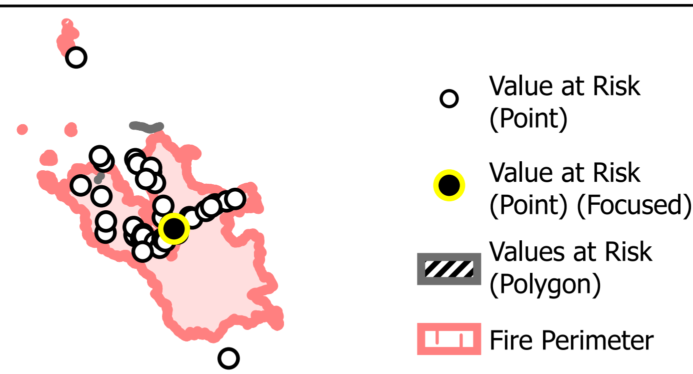
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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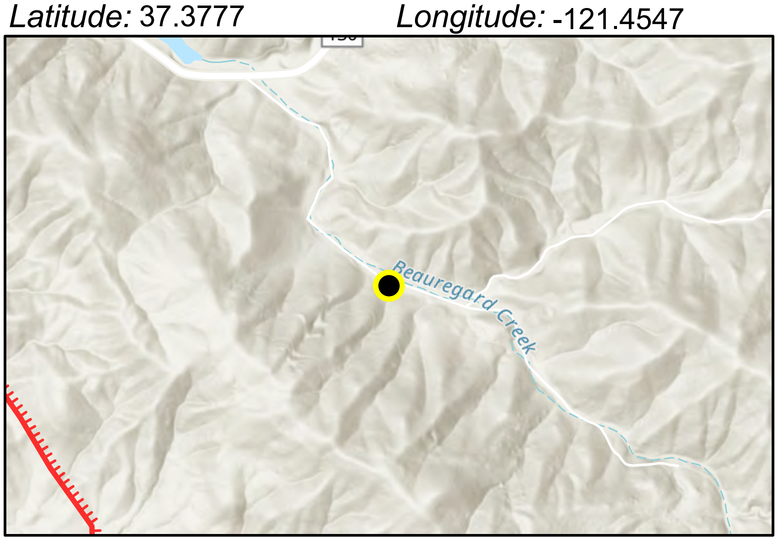


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex *Incident Number:* CA-SCU-005740

Community: **Beauregard Creek**

Site Number: **SCU23**

Feature: **Residential structure**

Feature Category: **home**

Field Observation or Potential Hazard: House on low lying surface near a channel

Potential Hazard to Life: **moderate** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

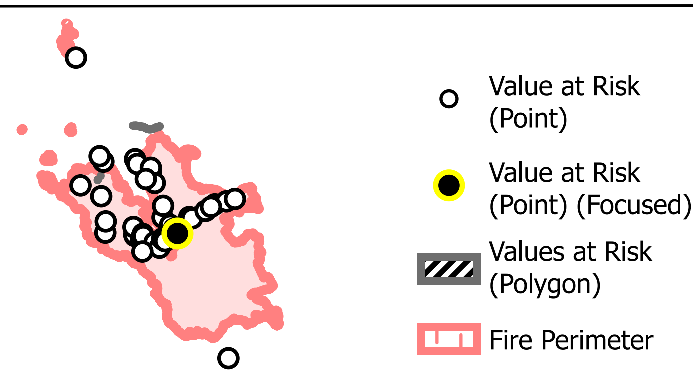
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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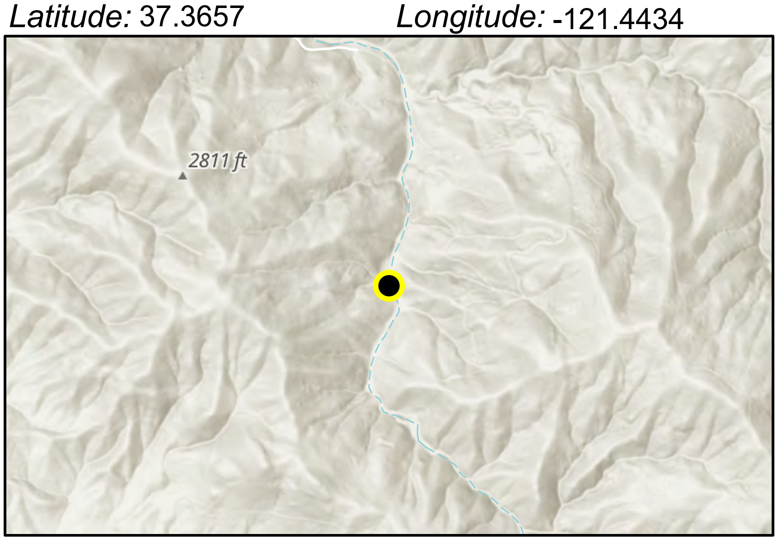


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Isabel Valley**

Site Number: **SCU24**

Feature: **House, if rebuilt**

Feature Category: **home**

Field Observation or Potential Hazard: Destroyed residential structure in flood plain, not much higher than active channel

Potential Hazard to Life: **moderate**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

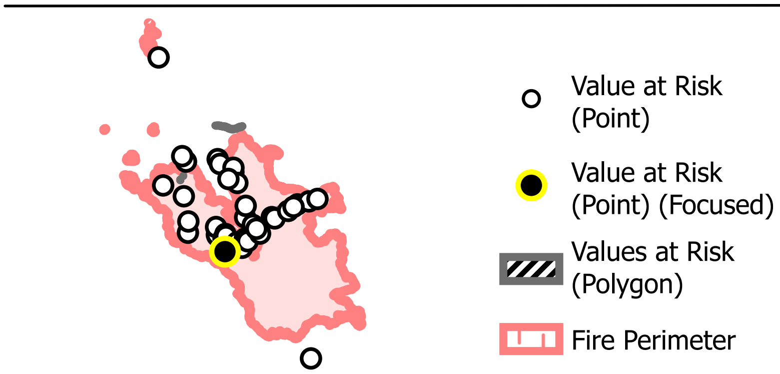
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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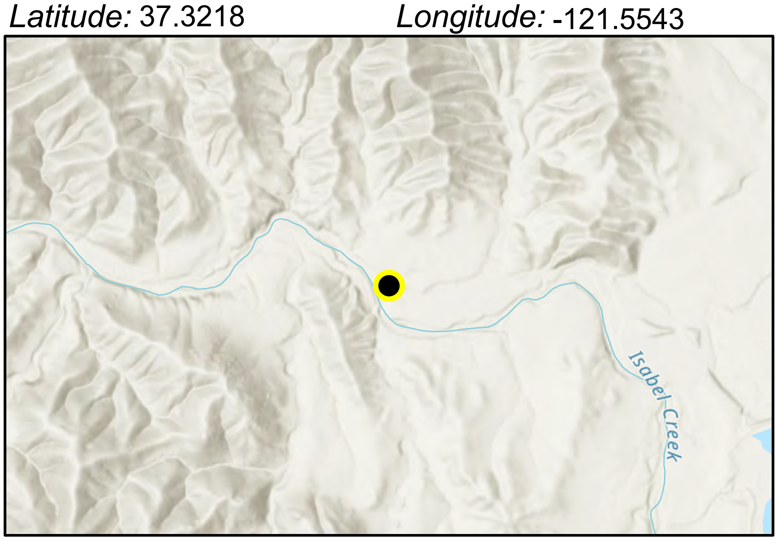


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Arroyo Bayo**

Site Number: **SCU25**

Feature: **House, if rebuilt**

Feature Category: **home**

Field Observation or Potential Hazard: Destroyed house near channel. Shed and excavator nearby

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

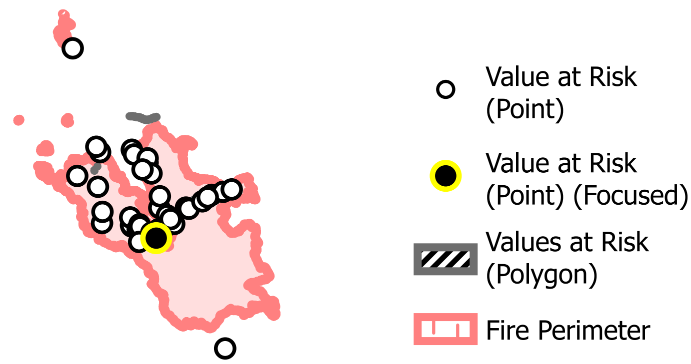
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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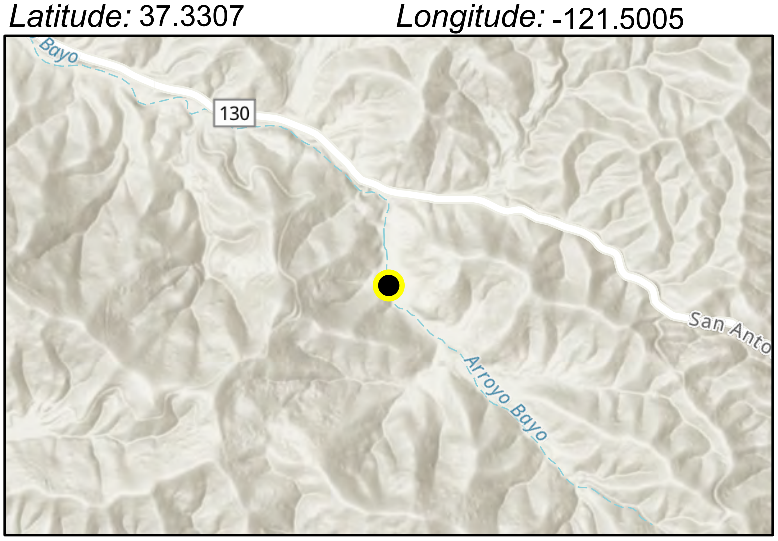


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex ***Incident Number: CA-SCU-005740***

Community: **Bollinger Canyon**

Site Number: **SCU26**

Feature: **House**

Feature Category: **home**

Field Observation or Potential Hazard: House in potential flood plain, on low lying surface near channel

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

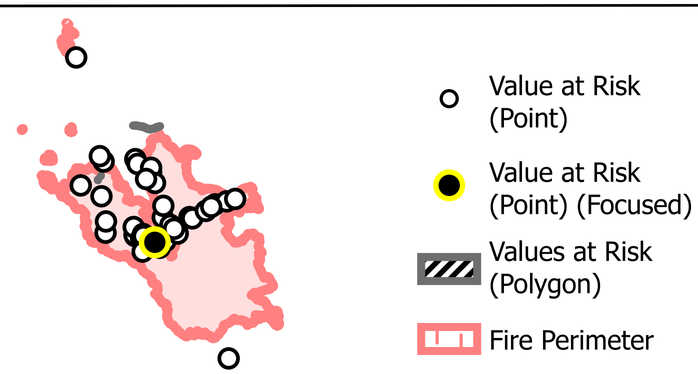
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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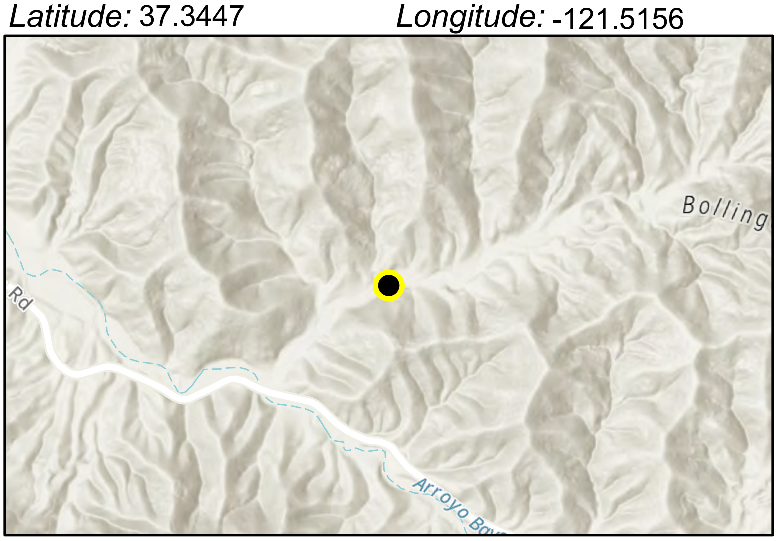


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **San Antonio Valley**

Site Number: **SCU27**

Feature: **House**

Feature Category: **home**

Field Observation or Potential Hazard: House on low lying surface near channel

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

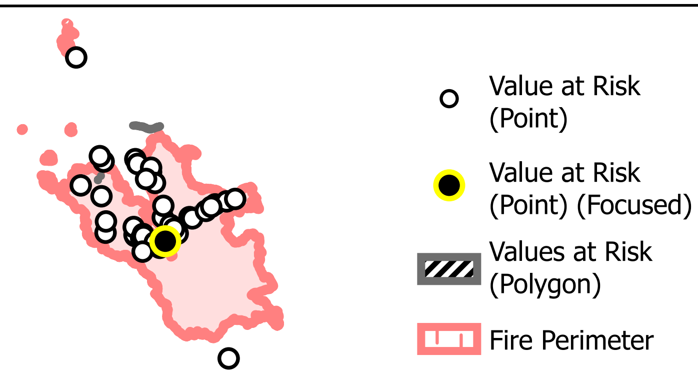
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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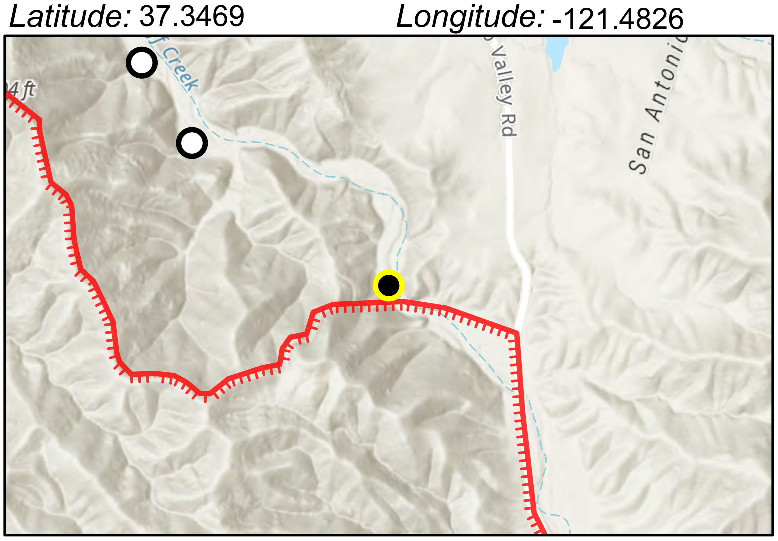


VALUE AT RISK DETAIL

Incident: *SCU Lightning Complex* *Incident Number:* *CA-SCU-005740*

Community: **San Antonio Valley**

Site Number: **SCU28**

Feature: **House**

Feature Category: **home**

Field Observation or Potential Hazard: House on low lying surface near channel

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

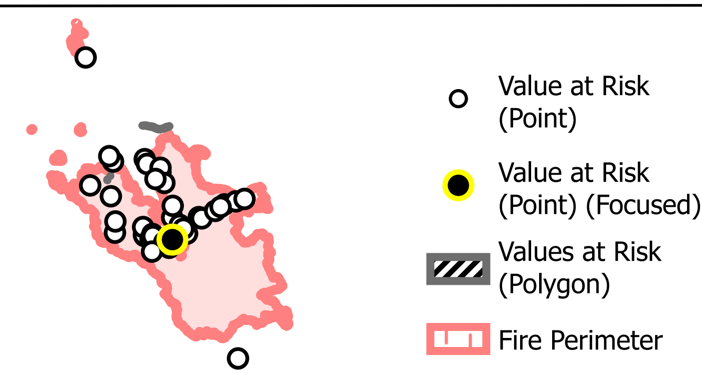
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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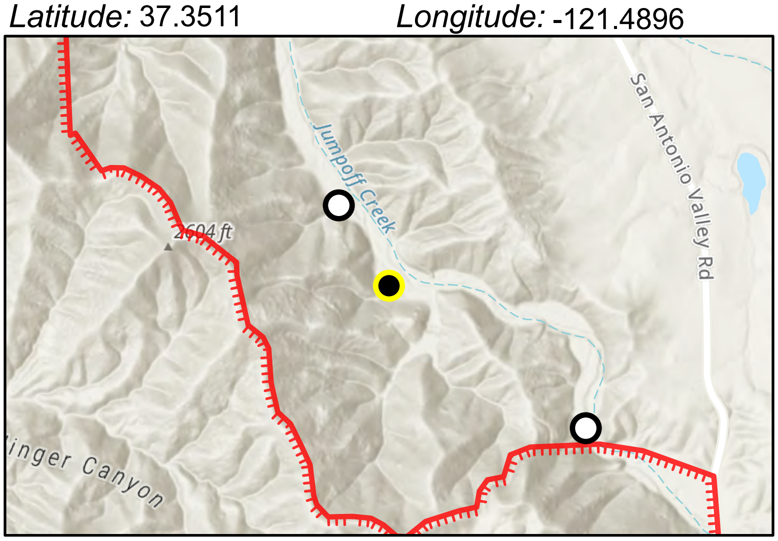


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex ***Incident Number: CA-SCU-005740***

Community: **San Antonio Valley**

Site Number: **SCU29**

Feature: **House**

Feature Category: **home**

Field Observation or Potential Hazard: House on low lying surface near channel

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

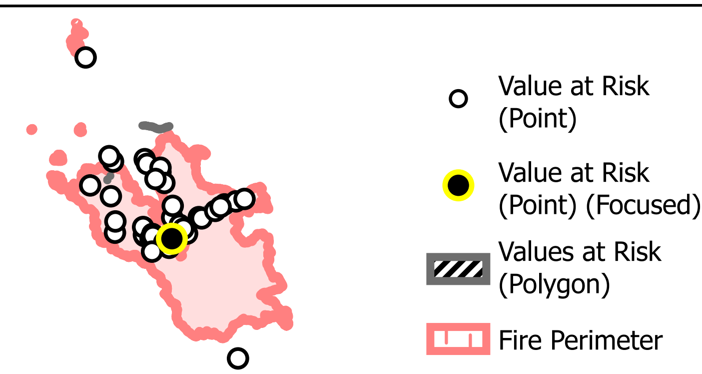
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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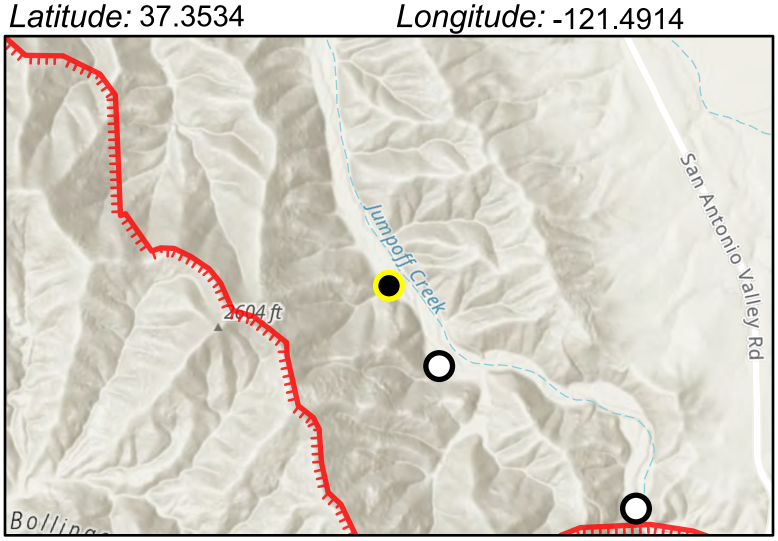


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex ***Incident Number: CA-SCU-005740***

Community: **Arroyo Bayo**

Site Number: **SCU30**

Feature: **House, if rebuilt**

Feature Category: **home**

Field Observation or Potential Hazard: Destroyed house in flood plain

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

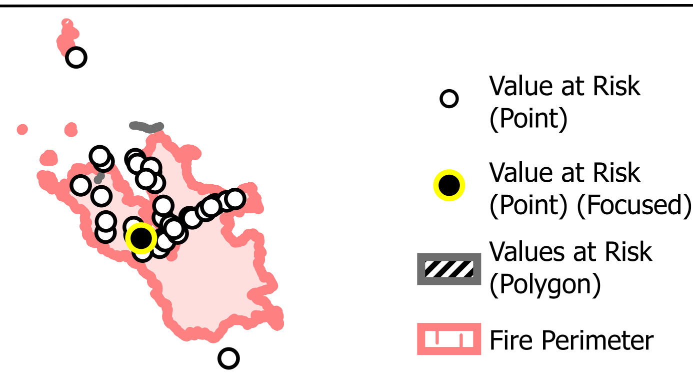
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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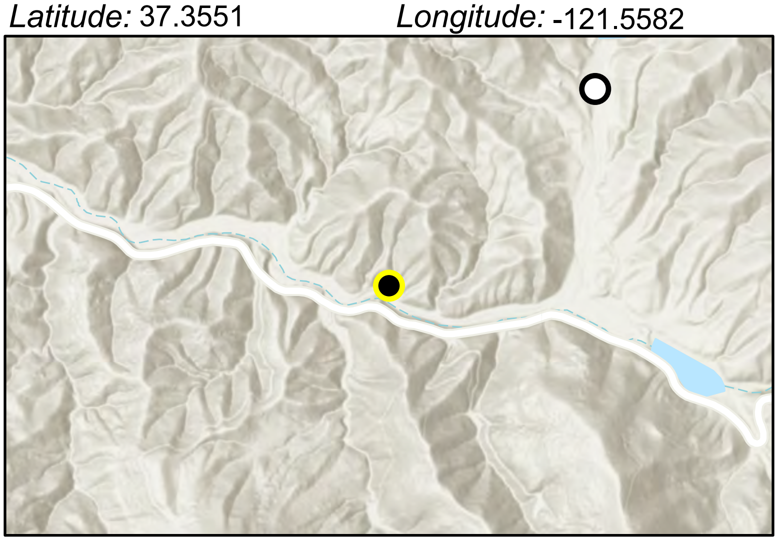


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Arroyo Bayo**

Site Number: **SCU31**

Feature: **Structures. Possible habitation**

Feature Category: **other**

Field Observation or Potential Hazard: Destroyed residential structure and ranch buildings on low lying surface near channel. Earthen dams up canyon.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

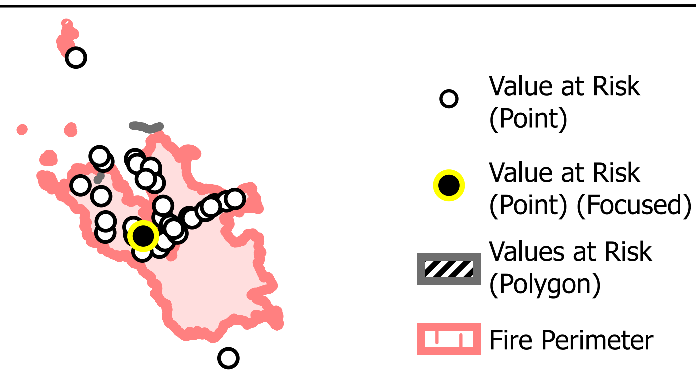
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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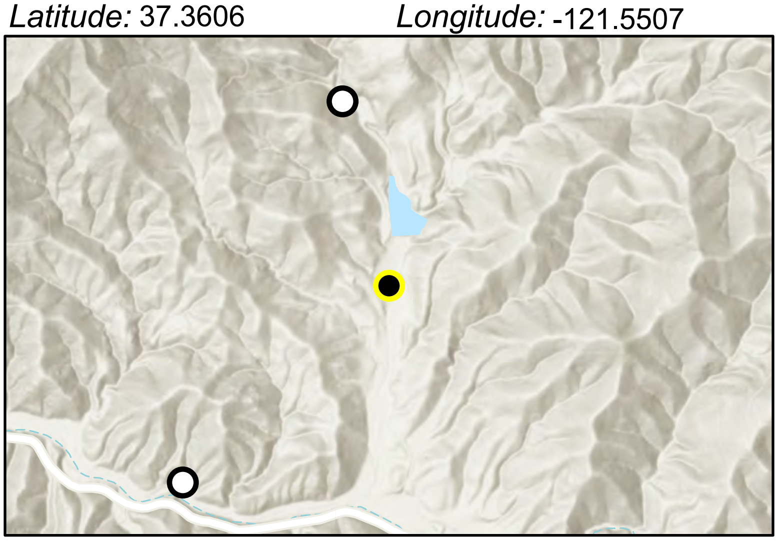


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Arroyo Bayo**

Site Number: **SCU32**

Feature: **House**

Feature Category: **home**

Field Observation or Potential Hazard: Long culvert runs under building pad. Culvert is 60 in, half full of sediment. Has elbow in it somewhere under the building pad. If it clogs it could flood house.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

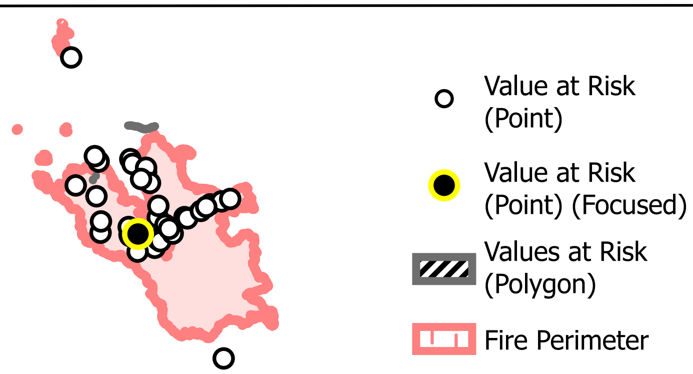
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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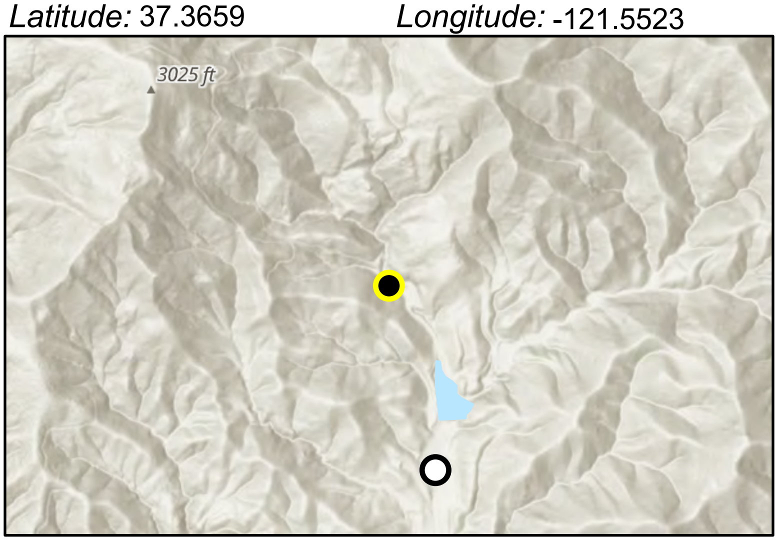


VALUE AT RISK DETAIL

Incident: ***SCU Lightning Complex*** *Incident Number:* ***CA-SCU-005740***

Community: **Arroyo Valle**

Site Number: **SCU33**

Feature: **House**

Feature Category: **home**

Field Observation or Potential Hazard: Houses, barns, and livestock areas in low lying flood plain. Main house on building pad upslope. Talked to homeowner, said they haven't had flood issues in the 30 yrs she's lived there. Trailers near creek are storage only.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

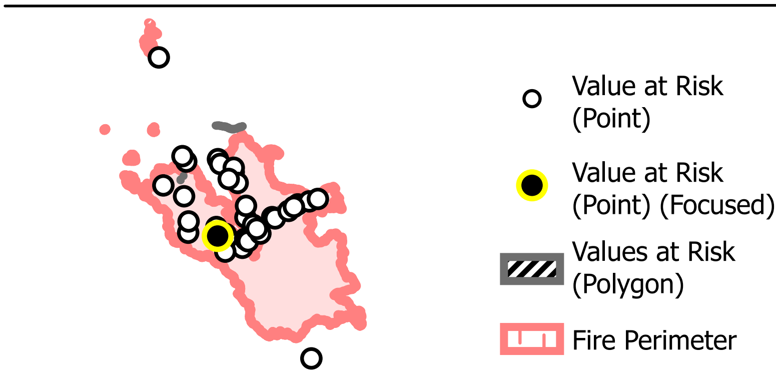
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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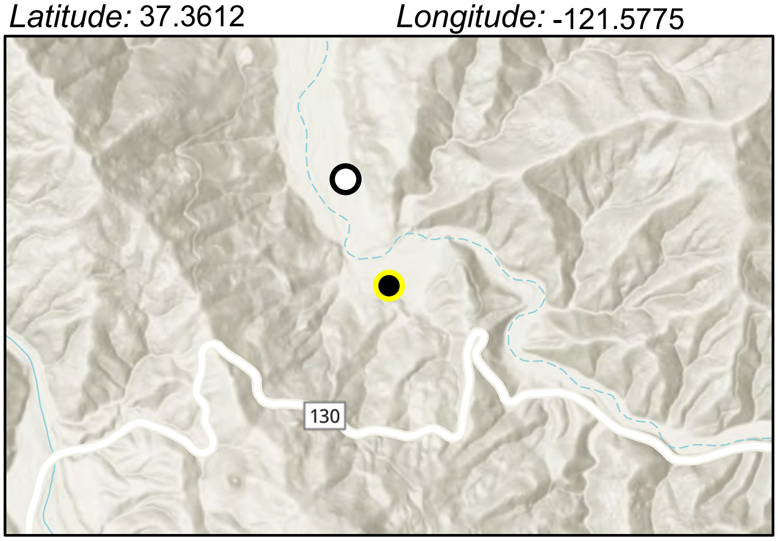


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Arroyo Valle**

Site Number: **SCU34**

Feature: **House**

Feature Category: **home**

Field Observation or Potential Hazard: House and barn in floodplain

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

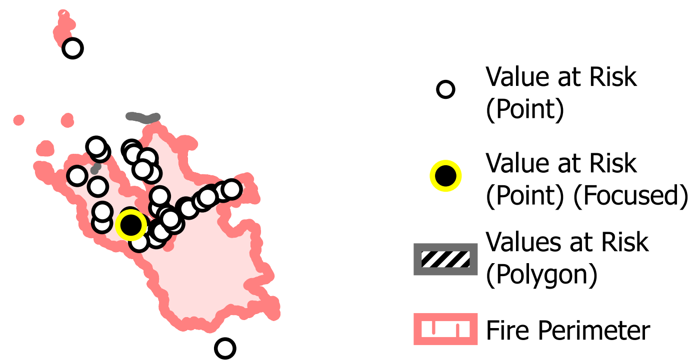
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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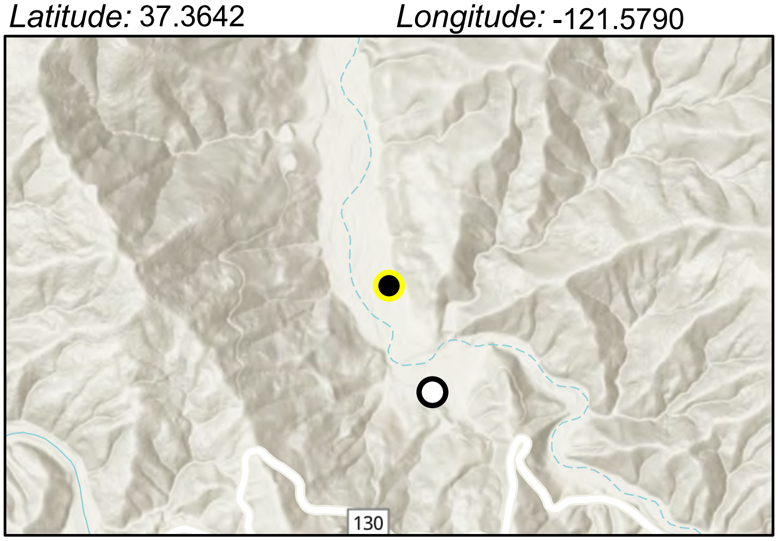


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Arroyo Valle**

Site Number: **SCU35**

Feature: **Houses**

Feature Category: **home**

Field Observation or Potential Hazard: Cabins in flood plain

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

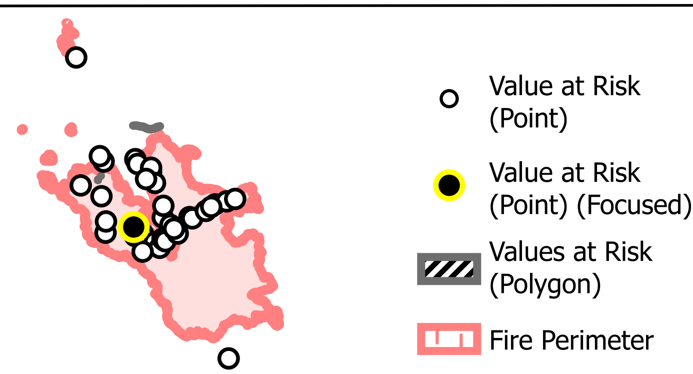
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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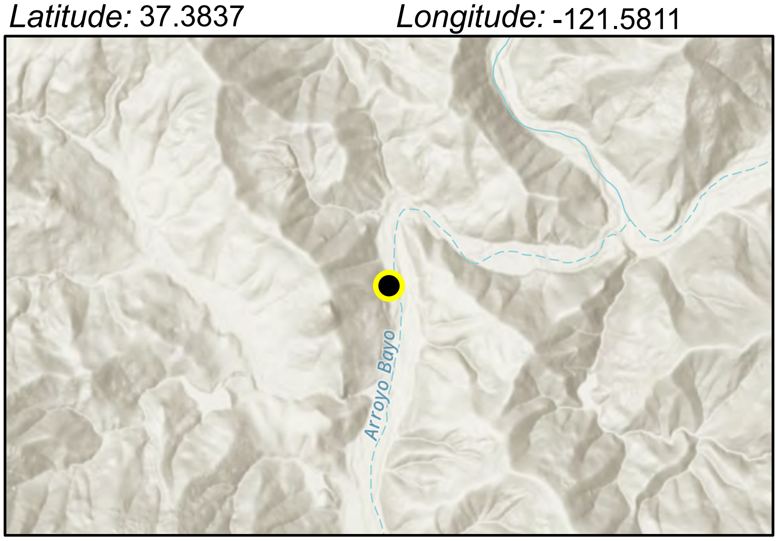


VALUE AT RISK DETAIL

Incident: *SCU Lightning Complex* *Incident Number:* *CA-SCU-005740*

Community: **Kincaid Road**

Site Number: **SCU39**

Feature: **Home**

Feature Category: **home**

Field Observation or Potential Hazard: Burned structure situated on colluvium adjacent to channel. Large blocky debris noted in channel. Possible flood and debris flow hazard.

Potential Hazard to Life: **moderate** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

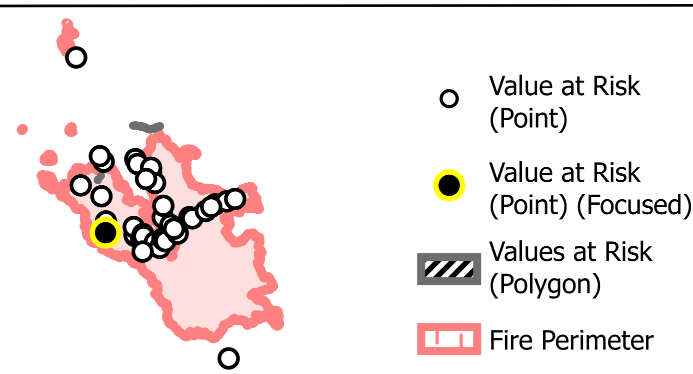
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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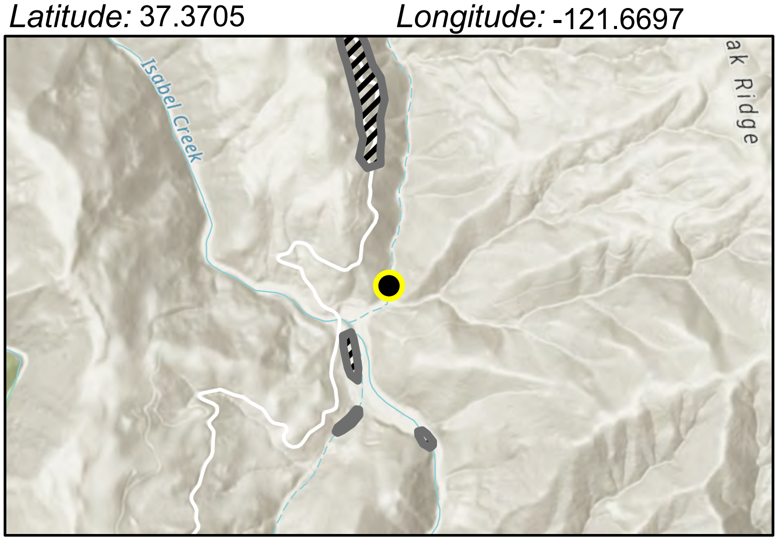


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Kincaid Road**

Site Number: **SCU41**

Feature: **Home**

Feature Category: **home**

Field Observation or Potential Hazard: Single family home located on floodplain adjacent to channel.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

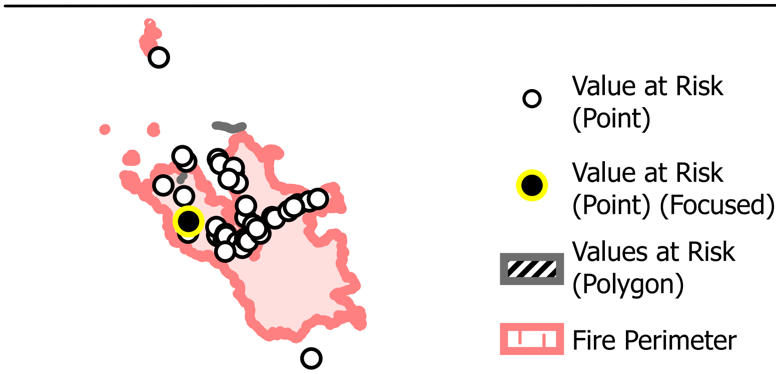
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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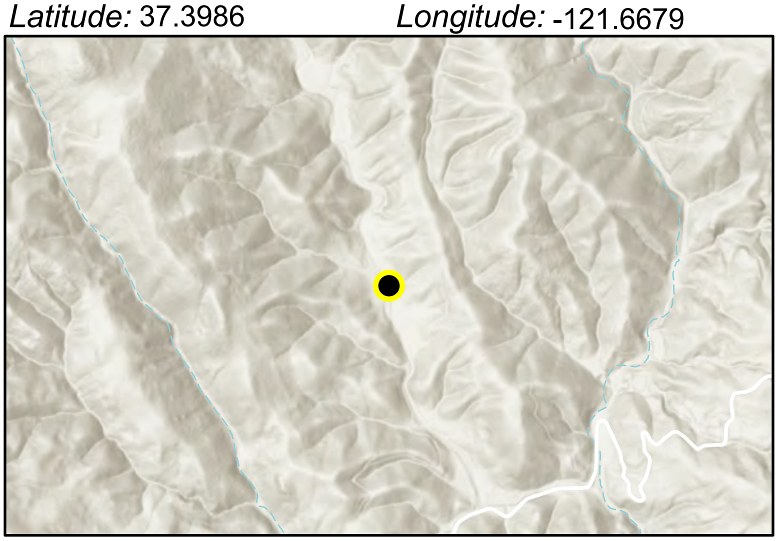


VALUE AT RISK DETAIL

Incident: *SCU Lightning Complex* *Incident Number:* *CA-SCU-005740*

Community: **Alameda Creek**

Site Number: **SCU42**

Feature: **Home and outbuildings**

Feature Category: **home**

Field Observation or Potential Hazard: Multiple structures located between 2 debris flow channels. Channels are incised and have blocky debris in them. Structuresappear to be well above channels, but flows could jump if channels clog. Utility line crosses one of the channels

Potential Hazard to Life: **moderate** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

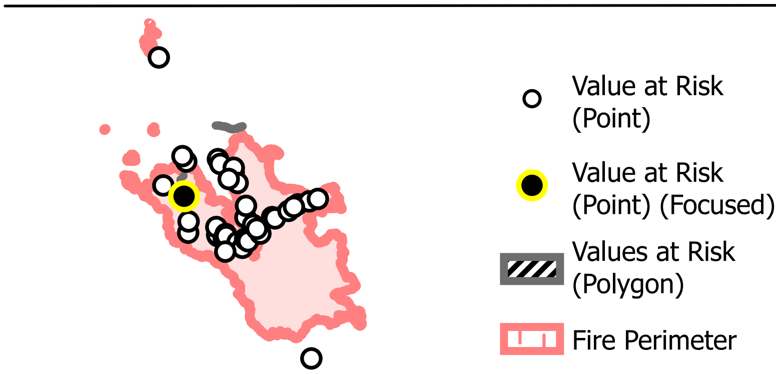
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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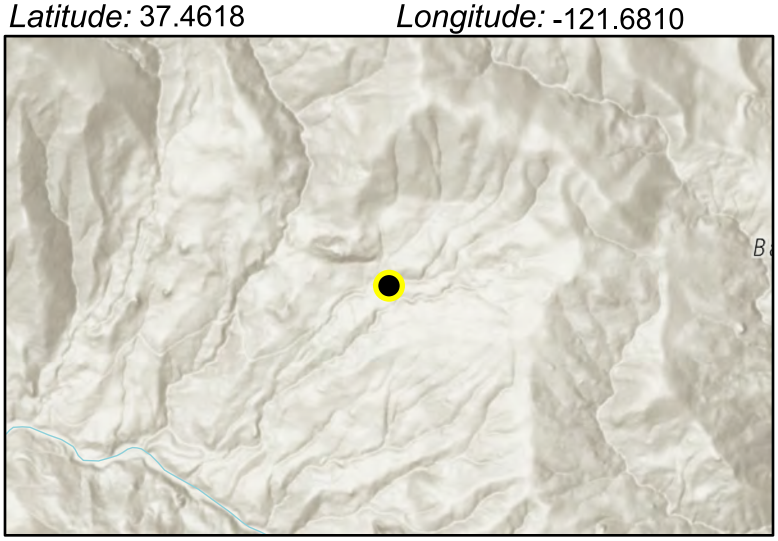


VALUE AT RISK DETAIL

Incident: ***SCU Lightning Complex*** *Incident Number:* ***CA-SCU-005740***

Community: **Sunol Alameda Creek**

Site Number: **SCU43**

Feature: **Cabin.**

Feature Category: **home**

Field Observation or Potential Hazard: Cabin built at mouth of catchment. Debris at mouth of catchment. Deflection wall and berm adjacent cabin. Rockfall hazards present too.

Potential Hazard to Life: **moderate** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

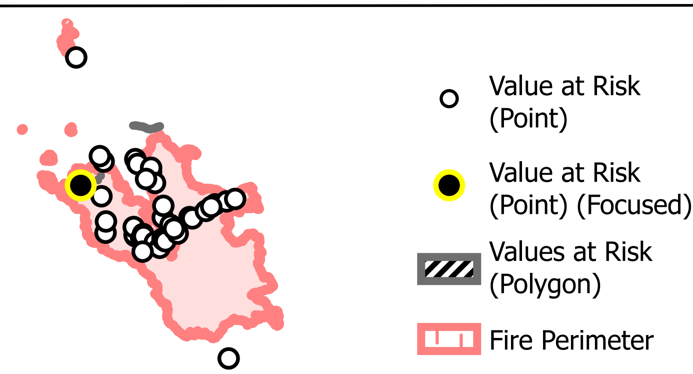
Preliminary Emergency Protective Measures (2): **Deflection structure**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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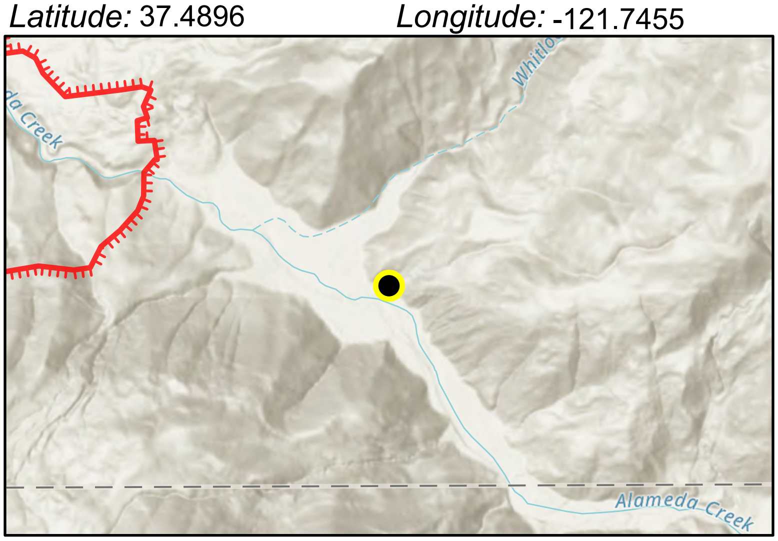


VALUE AT RISK DETAIL

Incident: ***SCU Lightning Complex*** *Incident Number:* ***CA-SCU-005740***

Community: **Arroyo Valle**

Site Number: **SCU46**

Feature: **Barn**

Feature Category: **other**

Field Observation or Potential Hazard: Structure situated adjacent to incised channel and downstream from crossing that is undersized. Lots of woody debris in channel above crossing. If water flows over crossing, will go down road and into barn.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

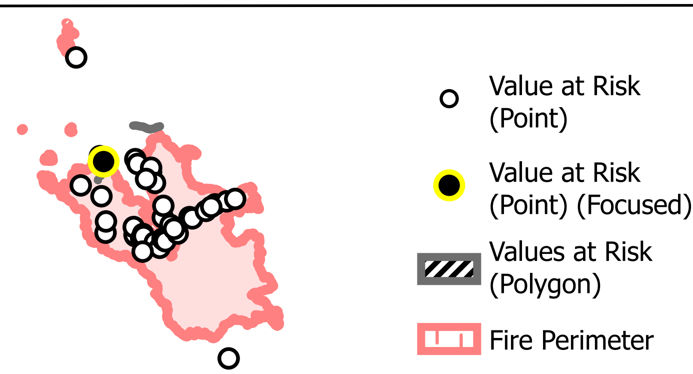
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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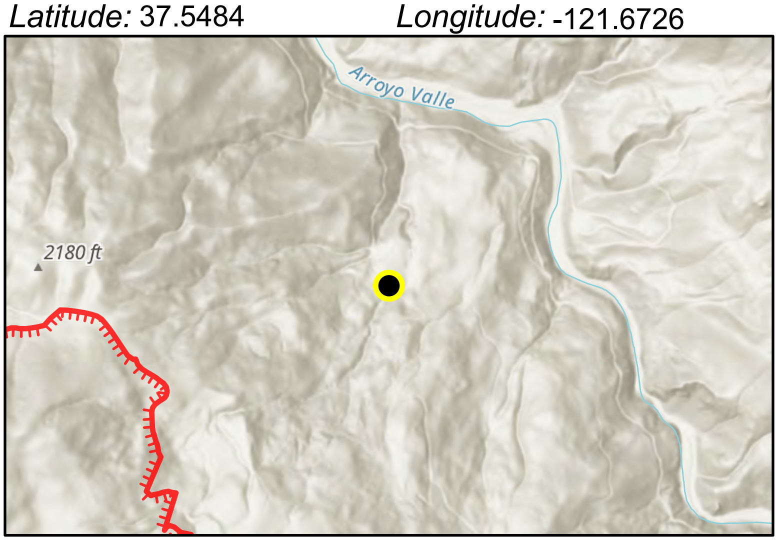


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex ***Incident Number: CA-SCU-005740***

Community: **Arroyo Valle**

Site Number: **SCU47**

Feature: **Ranch buildngs**

Feature Category: **home**

Field Observation or Potential Hazard: Multiple structures located on older flood terrace above channel. Local said flood waters reach the bottom of adjacent bridge during bad weather years, which is same elevation as structures, indicating possible flood hazard.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

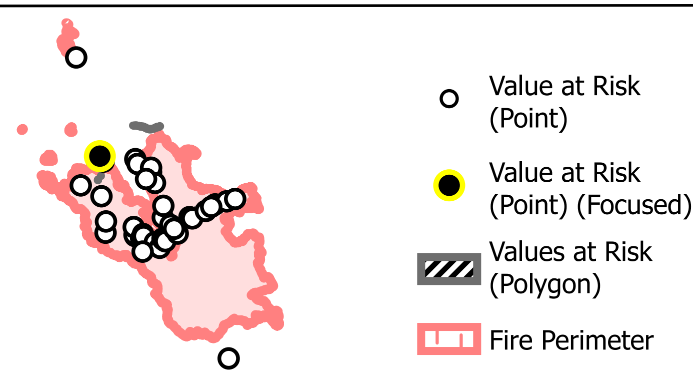
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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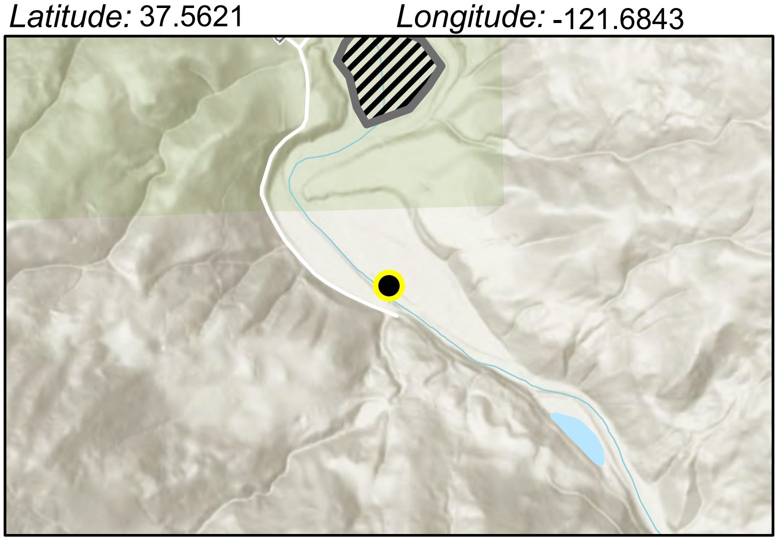


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex ***Incident Number: CA-SCU-005740***

Community: **Pacheco Reservoir**

Site Number: **SCU49**

Feature: **Spillway and dam**

Feature Category: **other**

Field Observation or Potential Hazard: Pre-existing damage to spillway from 2017 storm. May be impacted by future storm events. Concrete is missing from left wall and bank is eroded.

Potential Hazard to Life: **high** *Potential Hazard to Property:* **high**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

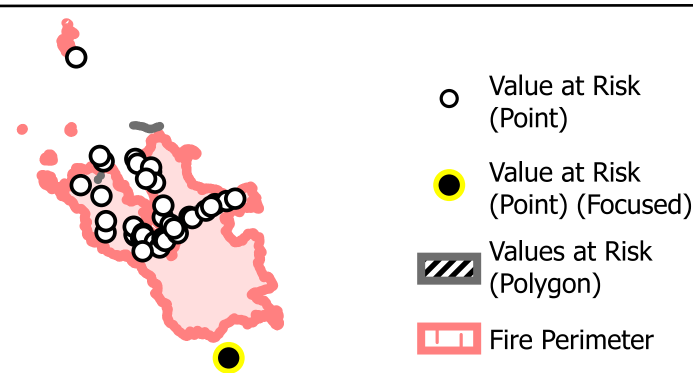
Preliminary Emergency Protective Measures (2): **Early Warning**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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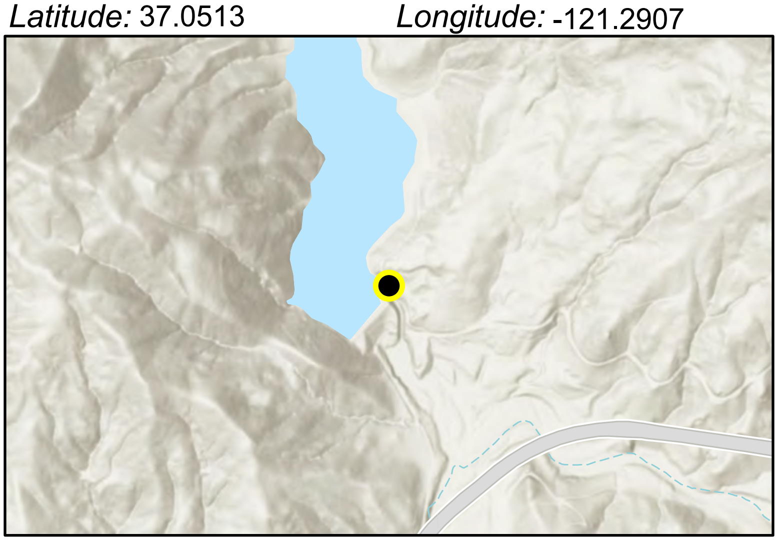


VALUE AT RISK DETAIL

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Los Vaqueros Reservoir**

Site Number: **SCU50**

Feature: **Drinking water quality.**

Feature Category: **utilities**

Field Observation or Potential Hazard: 394 ac. catchment drains through narrow channel to reservoir forebay. Large transported boulders in channel and plastered to sidewalks of channel. Up to 3-4 feet on long axis. Boulders appear be source from geologic unit incised through.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

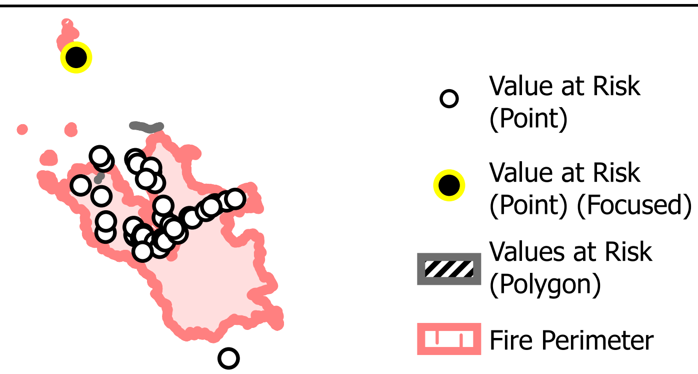
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Preliminary Emergency Protective Measures (4): **NA**

Description: NA

LOCATION AND PHOTO



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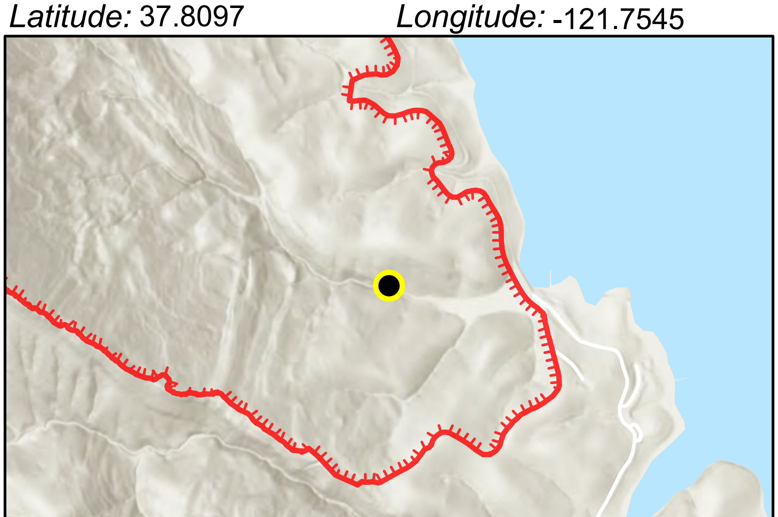


VALUE AT RISK DETAIL - Polygons

Incident: SCU Lightning Complex ***Incident Number: CA-SCU-005740***

Community: **Hollow Corral Creek**

Site Number: **SCU01**

Feature: **Residences, road and OHV park facilities**

Feature Category: **multiple**

Field Observation or Potential Hazard: Residences, outbuildings, park facilities and County road in FEMA floodplain.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

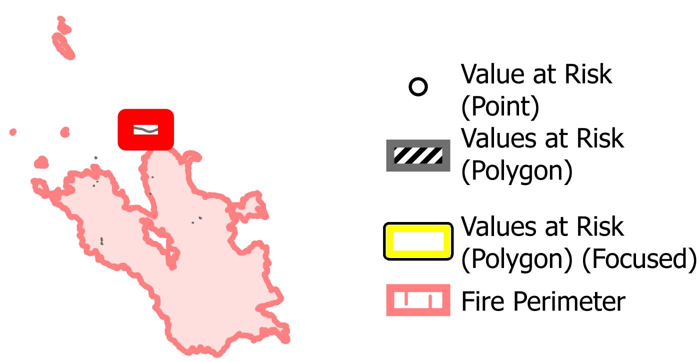
Preliminary Emergency Protective Measures (1): **Early Warning**

Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Description: NA

LOCATION AND PHOTO



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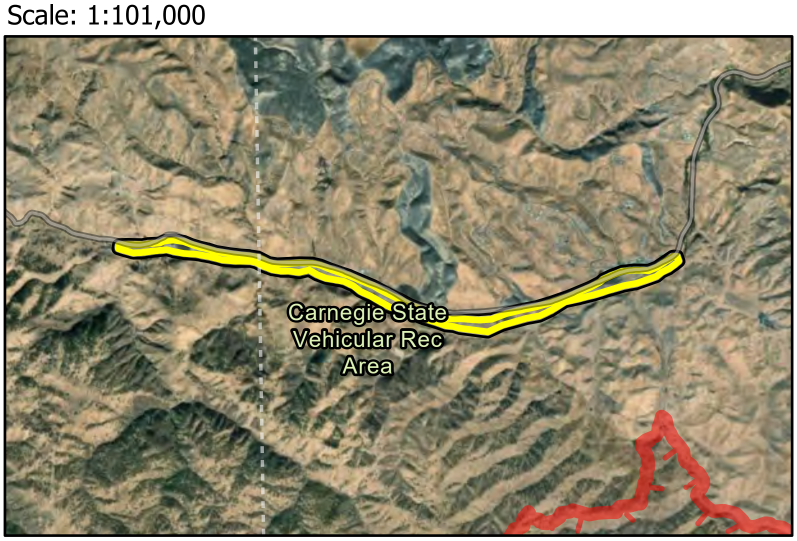


VALUE AT RISK DETAIL - Polygons

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Mines Road**

Site Number: **SCU06**

Feature: **Homes**

Feature Category: **home**

Field Observation or Potential Hazard: Multiple structures located in floodplain adjacent to channel. One structure located across channel from steep sidehill drainage.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

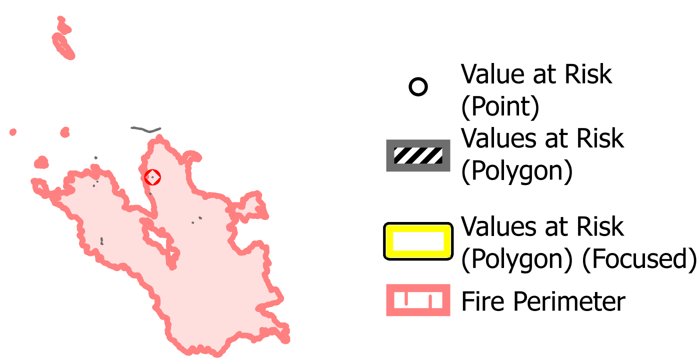
Preliminary Emergency Protective Measures (1): **Early Warning**

Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Description: NA

LOCATION AND PHOTO



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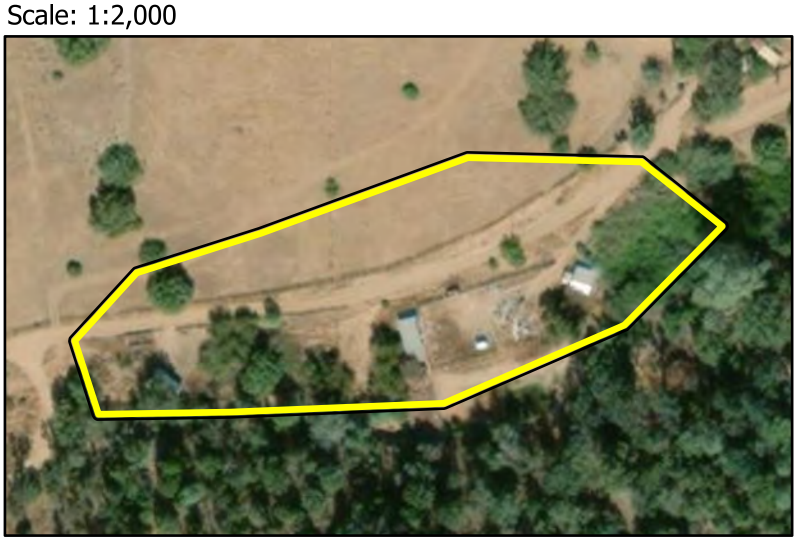


VALUE AT RISK DETAIL - Polygons

Incident: SCU Lightning Complex ***Incident Number: CA-SCU-005740***

Community: **Smith Gulch**

Site Number: **SCU09**

Feature: **Structures**

Feature Category: **home**

Field Observation or Potential Hazard: Structures located at the mouth of two converging drainages and adjacent to stream channel. Two crossings near structures are undersized or have abundant debris in upstream side of channel.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

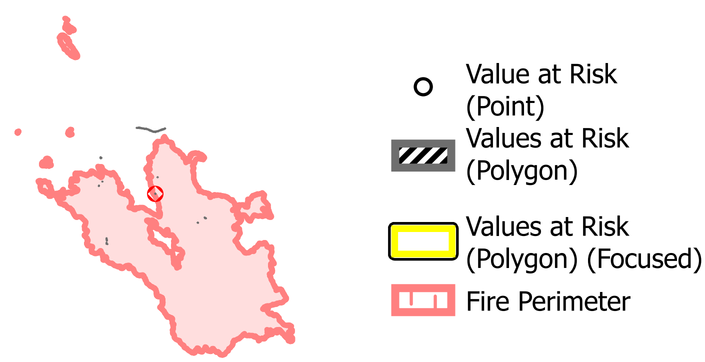
Preliminary Emergency Protective Measures (1): **Early Warning**

Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Description: NA

LOCATION AND PHOTO



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VALUE AT RISK DETAIL - Polygons

Incident: SCU Lightning Complex ***Incident Number: CA-SCU-005740***

Community: **Deer Creek Campground**

Site Number: **SCU16**

Feature: **Campground facilities**

Feature Category: **recreational**

Field Observation or Potential Hazard: Campground on river terrace, outbuilding near possible debris flow channel

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

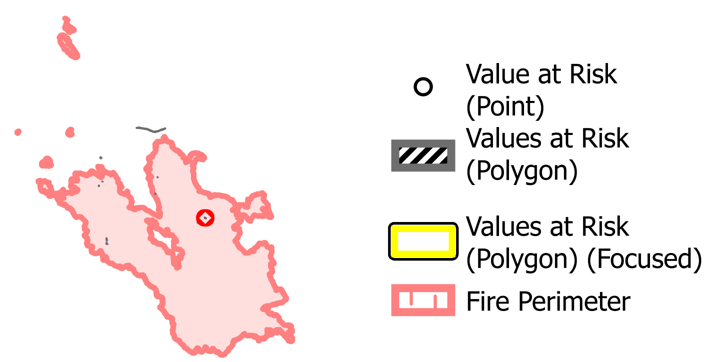
Preliminary Emergency Protective Measures (1): **NA**

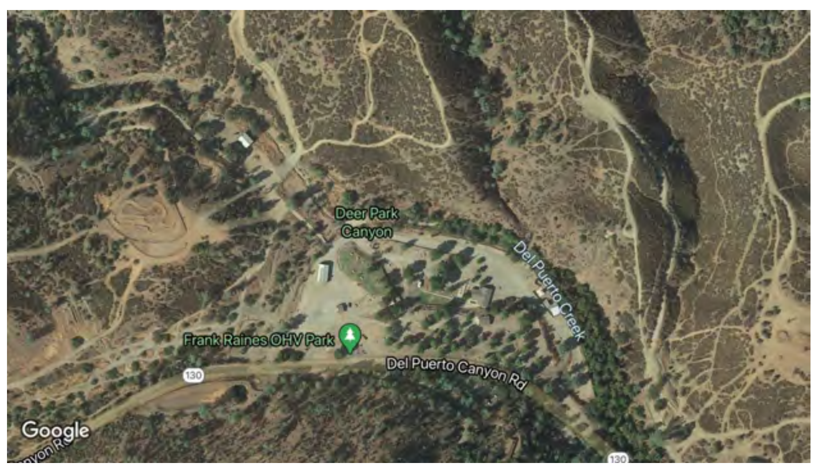
Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Description: NA

LOCATION AND PHOTO





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VALUE AT RISK DETAIL - Polygons

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Del Puerto Canyon**

Site Number: **SCU17**

Feature: **House and ranch structures**

Feature Category: **NA**

Field Observation or Potential Hazard: House on alluvial fan, ranch structures on low lying surface near the channel.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

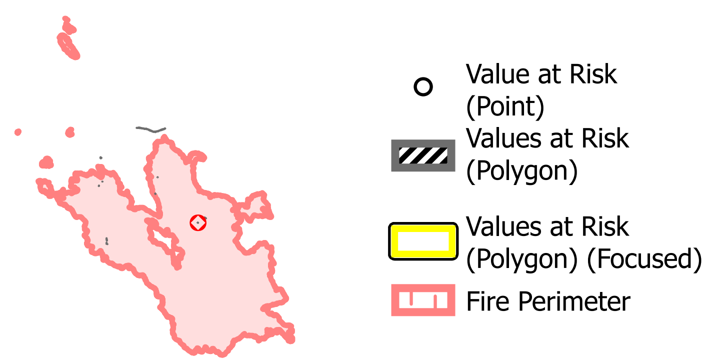
Preliminary Emergency Protective Measures (1): **Early Warning**

Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Description: NA

LOCATION AND PHOTO



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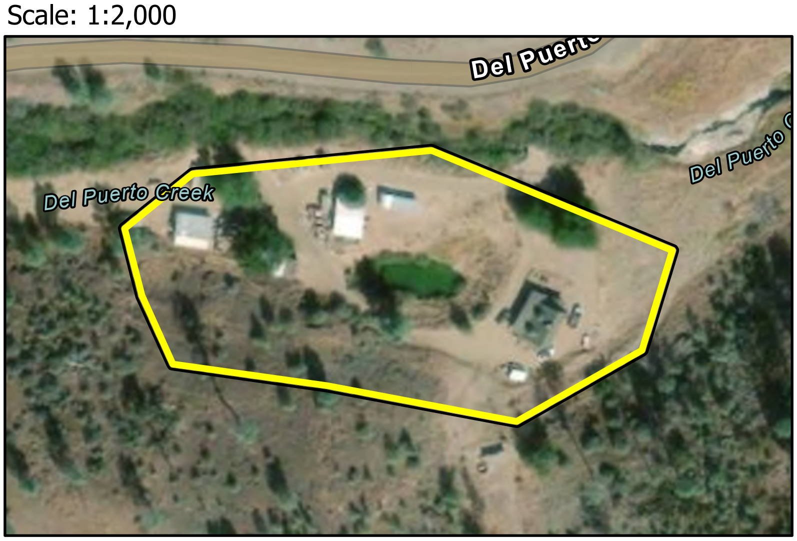


VALUE AT RISK DETAIL - Polygons

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Kincaid Road**

Site Number: **SCU36**

Feature: **Residences**

Feature Category: **home**

Field Observation or Potential Hazard: Multiple mobile homes located across or adjacent to creek at mouth of narrow drainage. Appears to be on active floodplain.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

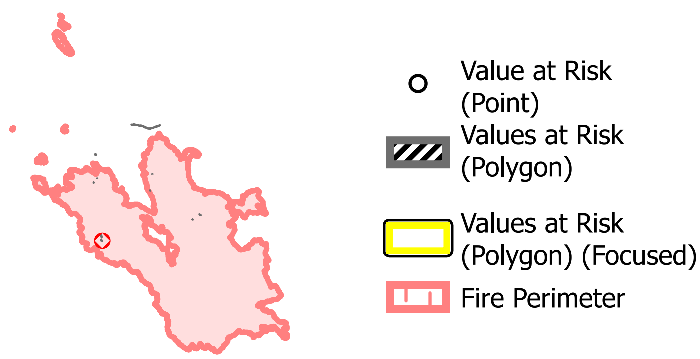
Preliminary Emergency Protective Measures (1): **Early Warning**

Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Description: NA

LOCATION AND PHOTO



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VALUE AT RISK DETAIL - Polygons

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Kincaid Road**

Site Number: **SCU37**

Feature: **Homes**

Feature Category: **home**

Field Observation or Potential Hazard: Multiple single-story residences located in or adjacent to channel at mouth of narrow drainage.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

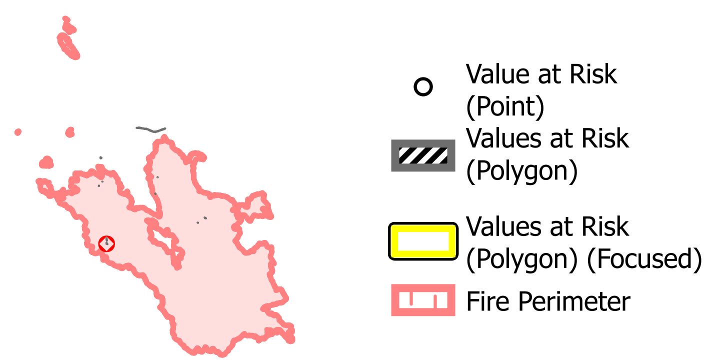
Preliminary Emergency Protective Measures (1): **Early Warning**

Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Description: NA

LOCATION AND PHOTO



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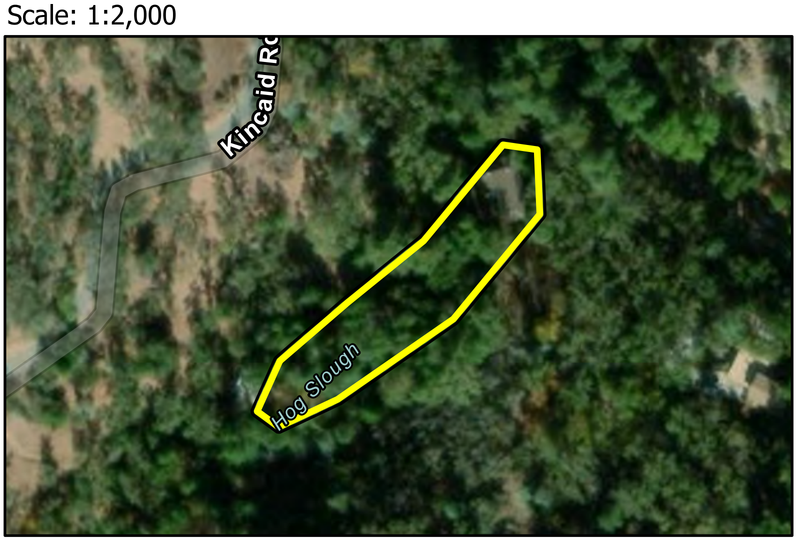


VALUE AT RISK DETAIL - Polygons

Incident: SCU Lightning Complex   *Incident Number: CA-SCU-005740*

Community: **Kincaid Road**

Site Number: **SCU38**

Feature: **Homes and tents**

Feature Category: **home**

Field Observation or Potential Hazard: Home located in floodplain adjacent to shallow channel. A number of tents set up around property as well. Site is located just downstream from a confluence of 3 drainages. Large boulder noted on floodplain adjacent to house.

Potential Hazard to Life: **moderate**   *Potential Hazard to Property:* **moderate**

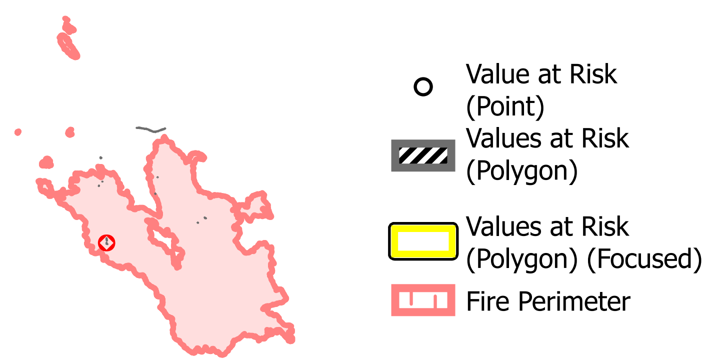
Preliminary Emergency Protective Measures (1): **Early Warning**

Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Description: NA

LOCATION AND PHOTO



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VALUE AT RISK DETAIL - Polygons

Incident: SCU Lightning Complex ***Incident Number: CA-SCU-005740***

Community: **Kincaid Road**

Site Number: **SCU40**

Feature: **Road/crossings**

Feature Category: **drainage structure**

Field Observation or Potential Hazard: Multiple crossings along this stretch of road that are undersized or non-existent. Potential for clogging and overtopping. Narrow gullies could pose debris flow hazard risk.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

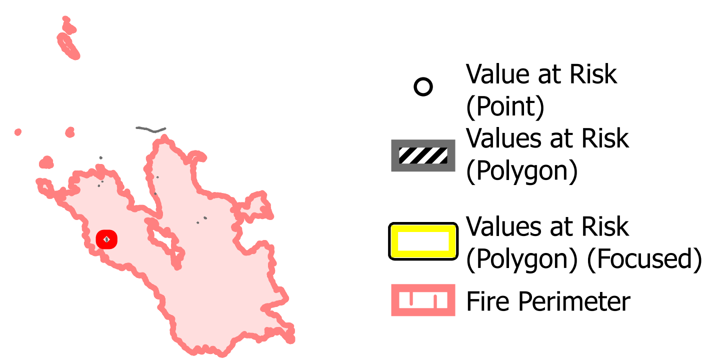
Preliminary Emergency Protective Measures (1): **Monitor and maintain**

Preliminary Emergency Protective Measures (2): **Early Warning**

Preliminary Emergency Protective Measures (3): **NA**

Description: NA

LOCATION AND PHOTO



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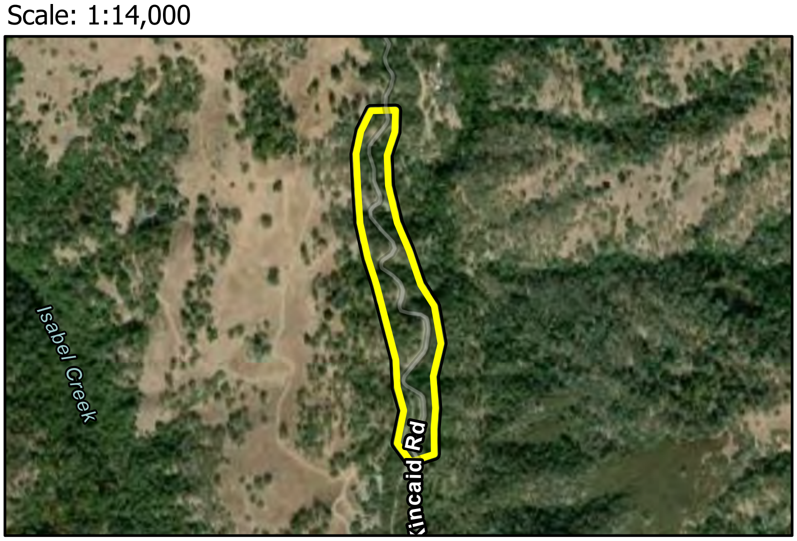


VALUE AT RISK DETAIL - Polygons

Incident: ***SCU Lightning Complex*** *Incident Number:* ***CA-SCU-005740***

Community: **Valpe Ridge**

Site Number: **SCU44**

Feature: **Homes and outbuildings**

Feature Category: **home**

Field Observation or Potential Hazard: Multiple structures located the base of steep drainages. One structure is located in a channel, and two others are adjacent to and slightly above main channels. Blocky debris noted in gullies, indicating debris flows previously.

Potential Hazard to Life: **moderate** *Potential Hazard to Property:* **moderate**

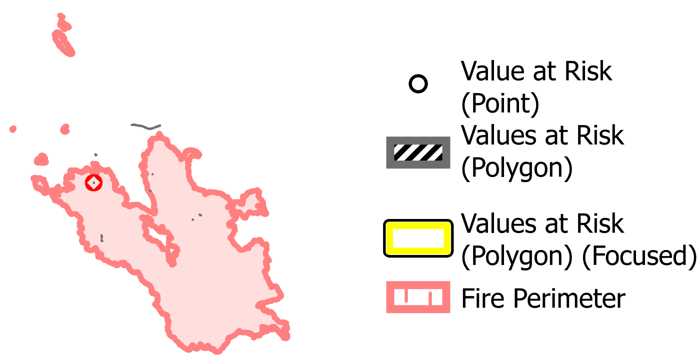
Preliminary Emergency Protective Measures (1): **Early Warning**

Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Description: NA

LOCATION AND PHOTO



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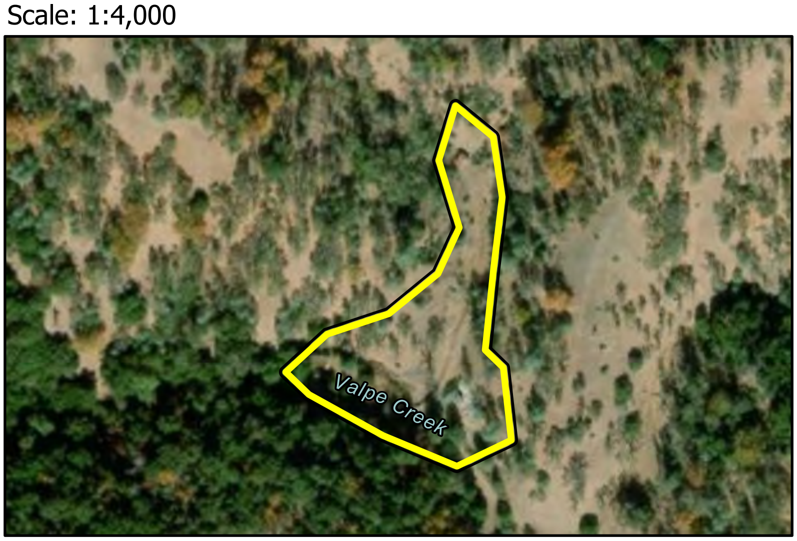


VALUE AT RISK DETAIL - Polygons

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Shafer Creek**

Site Number: **SCU45**

Feature: **Homes**

Feature Category: **home**

Field Observation or Potential Hazard: Multiple homes located on graded (?) valley bottom below 4 converging steep drainages. Berms constructed at base of one channel to divert flow and between another channel and adjacent structures, indicating past flood issues. Blocky debris in drainages.

Potential Hazard to Life: **moderate** *Potential Hazard to Property:* **moderate**

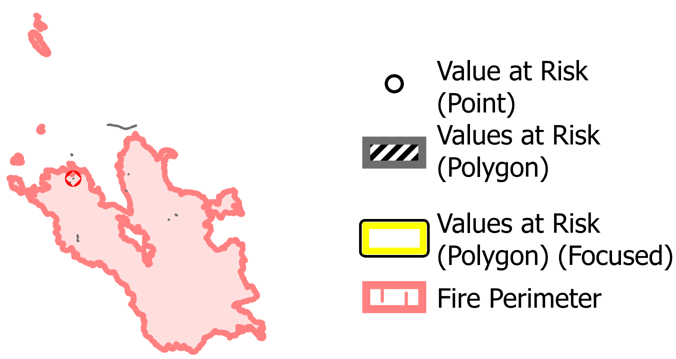
Preliminary Emergency Protective Measures (1): **Early Warning**

Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Description: NA

LOCATION AND PHOTO



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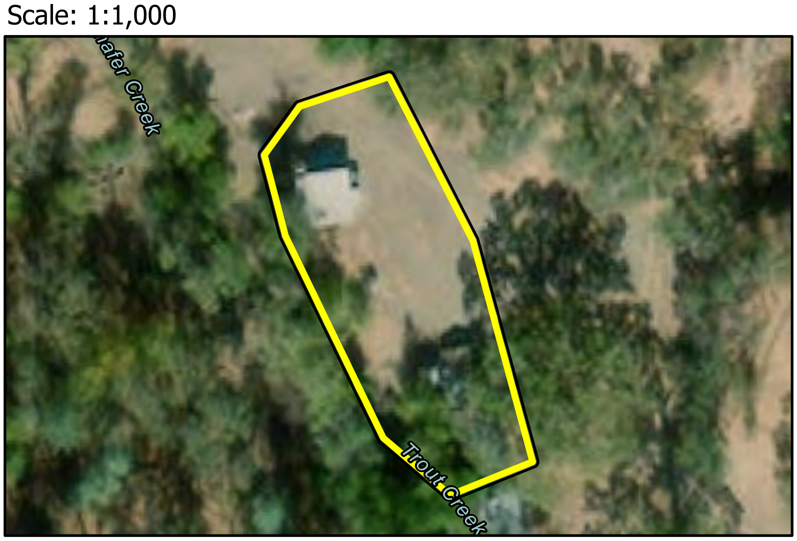


VALUE AT RISK DETAIL - Polygons

Incident: SCU Lightning Complex *Incident Number: CA-SCU-005740*

Community: **Del Valle Regional Park**

Site Number: **SCU48**

Feature: **Campers**

Feature Category: **recreational**

Field Observation or Potential Hazard: Campground located on floodplain terrace, with young geomorphic fetures. Main stream channel on northeast side of campground, overflow channl on southwestside of terrace. Restroom buildings and other structures on terrace as well.

Potential Hazard to Life: **moderate** *Potential Hazard to Property:* **low**

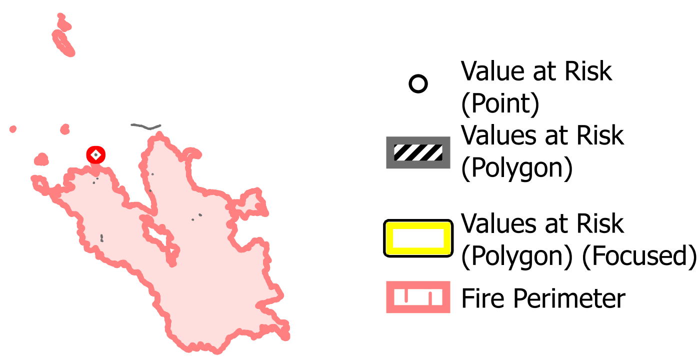
Preliminary Emergency Protective Measures (1): **Early Warning**

Preliminary Emergency Protective Measures (2): **NA**

Preliminary Emergency Protective Measures (3): **NA**

Description: Consider restricting camping during rain events

LOCATION AND PHOTO



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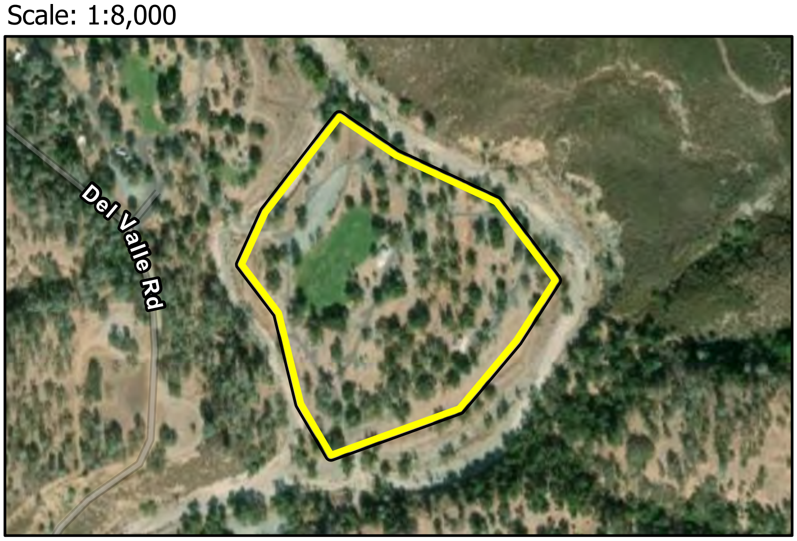

Appendix E: Building and Rebuilding Site Checklist

Cal OES, CAL FIRE, CGS, USDA, USGS, USACE, FEMA

Watershed Clearinghouse

Temporary and Permanent Housing/Building and Rebuilding Site Hillslope Checklist

By consuming the vegetative cover and reducing soil infiltration, wildfire significantly increases the risk of damaging runoff, erosion, sedimentation, landslides, debris flows, and rockfalls generated from burned hillslopes. While we can model and map potential flood zones and debris flows, site specific hillside drainage, stability, and erosion conditions are typically evaluated as part of local government permitting processes. Additionally, housing sites that were damaged or destroyed by the fire were not assessed by the WERT. Due to fire-related changes to soils and hydrology, local officials should at a minimum complete a checklist review of site-specific hillslope conditions for temporary and permanent housing and building/rebuilding sites. The following factors should be considered as part of the evaluation.

<u>On hillslopes above potential temporary housing and permanent building sites</u>:

Could runoff from the hillslope concentrate in swales and small drainages and flow onto the site, and flood or otherwise damage the proposed structure, or present a life-safety hazard?

- ✓ Is the hillslope behind the structure steep and erodible, where rilling, gullying, or shallow failures could deliver a sufficient volume of sediment and debris to damage the proposed structure or pose a life--safety hazard?
- ✓ Are large rocks, boulders, or other material present on the slope that pose a rock- or debris fall hazard that could impact the proposed structure, or present a life-safety hazard?
- ✓ Is there evidence of recent or impending erosion or mass wasting that could damage the proposed structure or pose a life-safety hazard (e.g. debris torrents/flows, deep-seated slides or slumps)?

<u>On hillslopes below potential temporary housing and permanent building sites</u>:

- ✓ Is there evidence of recent or impending fillslope landslide-type failures that indicate an elevated risk of building pad failure?
- ✓ Is the building pad located above a watercourse where normal- or flood flows could potentially erode the toe of the slope and trigger failure?

If any of these conditions are present, then mitigations need to be implemented, or alternative sites need to be identified and evaluated. Technical experts such as licensed engineers or geologists may be needed to support the local agency's evaluation.