Freeway Complex

CA-ORC-075221

Burned Area Recovery Team (BART) Report

December 12, 2008

DRAFT

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BURNED AREA RECOVERY TEAM (BART) REPORT

The scope of the assessment and the information contained in this report should not be construed to be either comprehensive or conclusive, or to address all possible impacts that might be ascribed to the fire effect. Post fire effects in each area are unique and subject to a variety of physical and climatic factors which cannot be accurately predicted. The information in this report was developed from cursory field examination by licensed resource professionals and should be viewed in conjunction with other relevant sources of information. Neither the State of California nor any Agency or Department participating as a member of the Burn Area Response Team (BART) makes any warranty, express or implied, nor assume any legal liability for the information disclosed herein.

EXECUTIVE SUMMARY

FREEWAY COMPLEX
CA-ORC-075221

Affected watersheds in Orange, Los Angeles, Riverside and San Bernardino Counties

Introduction

A Burned Area Recovery Team (BART) was deployed to the Freeway Complex Fire area to evaluate assets at risk in the affected burn area and downstream of the burned areas. The BART had three main objectives:

- Identify on-site and downstream threats to public health or safety from landsliding, debris torrents, flooding, road hazards, and other fire related problems.
- Identify threats to watershed resources including: excessive erosion, impaired water quality, threats to wildlife, fisheries, botanical values and cultural resources.
- Determine measures needed to prevent or mitigate identified threats.

The Freeway fire began on November 15, 2008 at 9:07 AM under a strong Santa Ana condition with sustained winds of 40 mph, gusting to 60 mph and humidity's 4-6%. Under these conditions, the fire spread rapidly in a west, northwest direction from the origin near the 91/71 freeway interchange. At 10:46 AM a second fire was reported near the Olinda Alpha Landfill and burned under the same conditions. The two fires merged late in the first day and ultimately burned 30,305 acres.

The complex burned through open land in the Chino Hills State Park, as well as urban areas along the perimeter of the fire. The fire destroyed 187 residences, 2 commercial buildings and damaged 127 residences and 2 commercial buildings. Of the 30,305 acres, 13,400 acres burned in the Chino Hills State Park (95 percent of the Park burned) and 16,905 acres burned on private, municipal and special district lands. The fire impacted land in all of the following counties and cities:

Counties: Orange, Los Angeles, Riverside, San Bernardino
Cities: Anaheim, Brea, Chino Hills, City of Industry, Corona, Diamond Bar, Yorba Linda

The burned area is characterized by low hills with steep slopes ranging in elevation from 312 feet to 1,781 feet with dense residential areas on roughly two thirds of the perimeter of the fire. The fire burned well inside many residential areas through a combination of a heavy ember environment and structure-to-structure ignition. Many of these residential structures are located in "micro" watersheds with steep slopes or drainages leading directly to the back yard or the back wall of the residence.

Two watersheds were affected, burning 27,106 acres in the Santa Ana River watershed and 3,199 acres in the San Gabriel River watershed. Of those watersheds, 3.3% burned at high severity, 39.1 % moderate severity, 33.7 % low severity, with the remaining 23.8 % showing no effect (Appendix III, Map #2).

Because the fire was followed almost immediately by a rain event, an Incident Management Team was deployed before the fire was fully controlled to aid local government in undertaking emergency protective measures. Rapid evaluations were made and mitigations implemented to protect lives and property. BART specialists arrived December 2, 2008 to begin a more comprehensive "rapid" survey of the burned area to identify potential threats to life, property and natural resources and to offer recommendations for treatments to reduce those risks. These surveys and mitigation recommendations are not fully comprehensive and may be combined with other sources of information to evaluate appropriate protective measures.

The recommendations found in this report are to be used as a guideline for possible mitigation to reduce the possibility of damage to assets at risk. These treatments fall into one of two broad categories: Those which can be considered temporary or short term measures designed to be quickly and are relatively inexpensive to implement, and those that are considered permanent or long term treatments designed to facilitate the recovery of the watershed at an accelerated pace, while concurrently minimizing the exposure to the values at risk.

The following information summarizes key findings contained in the initial Freeway Complex BART assessment.

Loss of Human Life and Property

The principle concern in the Freeway complex is loss of human life and property due to slides, mud and debris flows. Numerous residences sit in minor drainages and below slopes which have burned areas upstream or directly above them and those burned slopes are at a substantially increased risk of sliding or erosion. If a slide occurs it may impact a structure directly or add sediment load to drainages, increasing the force and impact of sediment laden runoff. Some homes and structures subject to these hazards are located in the Box Canyon, Brush Canyon, San Antonio Canyon, Olinda Village and Horseshoe Bend.

In addition, railroad tracks located in the Horseshoe bend and Scully Hill area are potentially at risk from slides and mud flow sending material onto tracks creating a hazard to trains transiting the area. Also, homes in the Hidden Hills area are in some cases located near the edge of slopes which have demonstrated historic slide and sloughing activity. Because the fire has caused a loss of some vegetative cover, these slopes are potentially at a greater risk of slides, sloughing and erosion. If this soil movement occurs it may place these homes at a greater risk of failure. For the approximate locations of theses threats to human life and property, see the Technical Specialist Reports and the Risk to Lives and Property Maps (Appendix III, Maps A-01 – D-03)). In all cases, where precipitation may trigger soil or slope movement, close attention should be

paid to advisory outlooks, watches and warnings issued by the National Weather Service's Flash-Flood and Debris-Flow Early Warning System
(www.wrh.noaa.gov/lox/main.php?suite=hydrology&page=debris-flow_project)

Watershed Evaluation

The fires in the Freeway Complex burned in several watersheds over the 30,305 acre fire area including the Aliso Creek, Blue Mud Canyon, San Antonio Creek, Telegraph Canyon, Carbon Canyon, and Tonner Canyon drainages. Loss of vegetation in these watersheds will result in the reduction of interception and evapotransperation. In addition, hydrophobic soils are formed when waxy substance released by volatized plant material during hot fires, follow thermal gradients into the soil and congeal as continuous surfaces in areas of moderate and high burn intensity. According to Burn Severity mapping (Appendix III, Map #2) obtained from Burned Area Reflectance Classification (BARC) data, 42 percent of the fire area burned at moderate to high burn intensity. The predominant soil type association in the complex is Soper-Fontana-Calleguas-Balcom-Anaheim Association, covering 98 percent of the area burned (Appendix III, Map #6). This association does not include highly erosive soil types, however, geologic maps as well as visual evidence observed, indicate the entire burned area shows extensive historic and current slide activity (Appendix III, Map #4). Observed slide areas ranged from small 20 foot by 20 foot sloughing to a large, full rotational slide 300 feet wide and 600 feet long. Slide areas can be triggered when soils become saturated during and following rain events. While run-off may not be extreme as indicated by the burn severity data and soil type, the potential for slope and thus soil movement is still high.

Hydromulching and hydroseeding are not generally effective in controlling the type of slide activity identified in the burn area and has therefore not been identified for broad application. In addition, sprouting of annuals was observed through-out the burn area and application of a hydromulch product may impede the site revegetation already underway.

Values at Risk

In general, as a result of the fire and the burn severity previously discussed there is an increased risk for storm events to result in flooding, slides, mud and debris flow. As storm intensity increases or as duration rises, there will be an increased risk for the storm event to trigger flooding, rockfall, mud sliding and debris flows.

A. Threats to Human Life, Property, and Infrastructure

As a result of the reduction in vegetation, burn severity, development of hydrophobic soils and steep unstable slopes, the impact to houses, associated human occupancy, and other infrastructure (e.g. railroads, waterlines, gas lines, culverts etc.), located within or adjacent to the fire perimeter, are at an increased risk to threats of mudslides, hill slope failure, flooding and debris flow. This threat includes the loss of life and property. The risk is greatest in Box Canyon, Brush Canyon, San Antonio Canyon, Olinda Village and Horseshoe Bend as well as the railroad lines in Horseshoe Bend and Scully Hill.

Several significant critical infrastructure assets are located in the fire area. Members of the team met with representatives from each of the entities below to determine the level of risk post-fire conditions posed to their facilities, as well as inquiring about their ability to continue operations should damage occur. The following is a summary of significant infrastructure that was reviewed:

Burlington Northern Santa Fe Railroad (BNSF)
Description: Rail lines run along the southern edge of the fire
Risk: Slide and/or mud and debris flows onto the tracks
Mitigation: BNSF has installed K-rails, constructed new and cleaned out or enlarged existing catch basins at critical locations. BNSF will be deploying patrols during rain events.
BART Recommendations: In addition to actions already taken, install an automated early warning/monitoring system to alert oncoming trains of possible mud and debris flow onto the track.

Metropolitan Water District (MDW)
Description: Large supply lines run through the fire area.
Risk: Erosion, slide and/or mud and debris flows.
Mitigation: MWD have installed K-rails and sandbags to protect structures connected with their pipeline. MDW representatives state that even if structures associated with the pipeline are impacted, the pipeline will continue to function. Inspections will occur during and after rain events.
BART Recommendations: Provide protection for three critical points identified in the Geo-Technical report. Continue regular monitoring and clean out protection structures after storms.

Southern California Gas
Description: Large supply lines run through the burned area
Risk: Slide, mud and debris flow
Mitigation: So Cal Gas representatives state that the line was constructed to withstand the types of threats expected. Representatives also state their bypass capacity is sufficient to maintain service if lines in the fire area are disrupted. They also have regular patrols of the lines which are augmented after precipitation events.
BART Recommendations: Continue regular patrols particularly after storms.

B. Threats to Water Quality

There are several potential sources of water quality impacts from the Freeway Complex Fire. These include runoff originating from burned residential and commercial structures, increased sediment loading in the local storm drainage courses that discharge into the Santa Ana and San Gabriel Rivers, and contamination of surface water if nearby sewer collection systems are damaged by debris flow. Flow in the Santa Ana River is diverted to spreading basins for ground water recharge down stream from the Imperial Highway Bridge. Orange County Water District has already recognized the need for additional monitoring of River flows in response to potential water quality impacts to River water quality.

C. Threats to Recreational Resources

Recreation opportunities in Chino Hills State Park have been temporarily suspended due to the park being closed to remove burned tree hazards and allow park staff to survey the entire network of trails and roads for potential damage. There is also increased risk to individuals using the park during and shortly after rain events. However, Park officials have stated the Chino Hills State Park is generally closed after rain events to protect public safety and prevent damage to the dirt roads in the Park. State Park officials do not anticipate long term impacts to the recreational opportunities in the Park.

D. Threats to Wildlife and Botanical Values

As a result of the fire and the impacts from the loss of vegetation and burn severity, some biological and botanical species are at increased risk. Some species have suffered direct impacts as a result of the destruction of their habitat by the fire. Other species may suffer impacts as a result of increased erosion, mud flows and sedimentation. Suppression activities which resulted in soil disturbances may also increase the possibility of the introduction of invasive species. Those areas that contain species or habitat for species which are listed as state or federally rare, endangered, or threatened species, state species of special concern are at the greatest risk.

E. Threats to Cultural Resources

The identified asset at risk is potential loss of cultural resources; cultural resources are at risk of loss due to exfoliation of rock surfaces, site erosion from increased surface water runoff, soil overburden from landslide potential, increased visitor impacts due to heightened visibility, and fire-altered elements. Post-fire impact evaluations revealed the Freeway Complex, although likely to increase immediate erosion and landslide potential, should not markedly affect damage to assessed sites. The fire has increased site visibility, and reached conditions capable of altering lithic artifacts.

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Technical Report Summaries

Following are summaries of the Technical Specialists reports for the Freeway Complex BART team. More detailed information regarding any particular subject is contained in the full Technical Specialist report attached to this document.

Hydrology/Water Quality

I. Resource Setting

The 30,305-acre Freeway Complex Fire started on November 15, 2008, and was contained on November 20, 2008. The type of burn severity at the Freeway Complex Fire ranged from low to high: 3.3% had high severity, 39.1% had moderate severity, and 33.7% had low severity, and the remaining area within the burn perimeter showed no effect. This information was provided by the Burned Area Reflectance Classification (BARC) map. A storm event occurred on November 26, 2008 and produced approximately 1.4 inches of precipitation. The precipitation occurred before initial Burned Area Recovery Team (BART) surveys were completed, and revealed some of the areas that were affected as a consequence of the burn.

The burn region topography consists of mild to very steep slopes ranging from 312 feet to 1,781 feet in elevation. Chaparral, sagebrush, grass, and trees generally cover the area. The fire caused reduction of vegetation cover, increasing soil hydrophobicity. Annual rainfall variability averages approximately 14 inches per year (CIMIS station No. 75 – Irvine October 1987 to Present). Approximately 8.8 inches (63%) of the rainfall in this region occurs between the months of December and February with a historical monthly maximum precipitation as high as 27 inches (February 1992). The burn area impacted 5 hydrologic sub-areas within the Santa Ana Region 8 and Los Angeles Region 4 planning area (Regional Water Quality Board).

II. Observations

In the City of Anaheim, there are concerns regarding some of the steep burned slopes but it appears that the hillsides have been reinforced with straw waddles by the property owners. One debris basin at the intersection of Weir Canyon Road and Santa Ana Road was severely burned and burned vegetation could clog the inlet culvert and cause flooding over the streets.

The BNSF Railroad has specific areas in the Horseshoe Bend and Scully Hill areas which may be severely impacted by debris flow or landslides caused from a rainfall. It appears that BNSF is currently working in some of these areas to mitigate the potential problem by the use of debris basins.

In the City of Yorba Linda, there are several residences and streets that are subject to flooding and/or debris flow. In general, homes that have back yards literally at the discharge of a watershed are extremely vulnerable to flooding. These residences typically exist along the streets of San Antonio, Black Forest, and Hidden Hills. In addition to potential flooding of low lying homes, houses at the top of hills are subject to erosion concerns, with some yards showing signs of shifting downward.

There are a few residences and streets within the City of Chino Hills that are subject to flooding and/or debris flow. In general, homes which have back yards which are against small steep hills which are burned, are extremely vulnerable to flooding.

In Sleepy Hallow, the steep slopes around the fire are low to moderately burned and the community has utilized sand bags to direct water around properties and into steep narrow streets, any impacts here are expected to be minimal.

In the community of Olinda Village, a small ranch is in direct alignment with the discharge of the primary watershed above Olinda Village and there is a very high potential for this property to be flooded. The remaining portions of this community appear to be in satisfactory condition.

The Chino Hills State Park has dirt roads with culverts under the roads which may sustain damage from flooding and debris. Southern California Gas Company lines which day-light in the park appear to be secure.

There are several potential sources of water quality impacts from the Freeway Complex Fire. These include runoff originating from burned residential structures, increased sediment loading in the local storm drainage courses that discharge into the Santa Ana and San Gabriel Rivers, and contamination of surface water if nearby sewer collection systems under the Santa Ana River and Carbon Creek are damaged by debris flow.

Flow in the Santa Ana River is diverted to spreading basins for ground water recharge down stream from the Imperial Highway Bridge. Orange County Water District has already recognized the need for additional monitoring of River flows in response to potential water quality impacts to River water quality.

III. Recommendations

1. Any dead/fire burned trees and vegetation, and live standing trees that could cause damming or choking of debris in creeks or drainage basins should be removed immediately.
2. An early warning monitoring system with various monitoring points along the hillside above the railroad would be advised. Additionally, a minimum of three debris basins should be constructed around Horse Shoe Bend to collect debris prior to the debris flow making contact with the tracks.
3. Emergency evacuation plans should be implemented for all communities within the burn area.
4. In general, residences located at the base of the hills in Chino Hills, Yorba Linda, and Brea should take precautions to limit impacts of future rainfall through the use of k-rail, sandbags, or other flood prevention barriers.
5. Keeping any existing culverts free of debris should be a priority to ensure proper drainage.
6. The ranch in the Olinda Village area will require a large soil berm, k-rail, or rip rap to direct watershed discharge around the threatened property.
7. The Chino Hills Regional Park should be safely monitored for debris and sediment flows during and after rain events, as large amount of debris may flow into the sediment basin reservoir.
8. All other Debris/Sediment/Detention Dams should be monitored during and after rain events.
9. Emergency mitigation measures should be considered for the possibility of an uncontrolled sewage spill in the Santa Ana River or San Gabriel River systems.

Geotechnical

I. Resource Setting

The Freeway Fire occurred in the area generally known as the Chino Hills. The Chino Hills are bounded on the northeast by the Chino Basin and on the southwest by the East Coastal Plain. The Chino Hills blend to the northwest into the lower lying Puente Hills. The Santa Ana River flows southwesterly from the Chino Basin along the Santa Ana River Canyon into the East Coastal Plain.

Brea Creek originates north of the Freeway Fire and drains southwestwardly through the fire perimeter on the western side. Carbon Canyon Creek originates primarily in the central portion of the fire and drains south westerly to the Santa Ana River. The Aliso Creek drainage occupies the majority of the eastern portion of the fire and drains directly into the Santa Ana River.

The Chino Hills are bounded on the south by the Whittier Fault Zone and on the northeast by the Chino Fault. Both fault zones merge to the southeast into the Elsinore Fault Zone. Structurally, the area is a broad southeast-plunging anticline with progressively older formations exposed to the southeast.

The age of the formations within the Freeway Fire perimeter ranges from late Holocene to Upper Cretaceous. Nearly two-thirds of the burn area is underlain by the Puente Formation, which is subdivided into four members. The age of the formation becomes progressively older from west to east as lower members of the Puente Formation are exposed in the plunging anticline.

As shown on the Geologic Map (Appendix III, Map #4), over 20% of the burn area is identified as landslides or young landslides. Landslides, whether active or inactive, may be adversely affected as a consequence of the fire removing the vegetative canopy and grass cover, decreasing the reinforcing effect of roots.

II. Observations

Eight (8) high-value at-risk sites, some with multiple homes, are identified as having high risks to lives or property based on our visual observation and need immediate actions. They are briefly described below. Their locations are shown on Detail Map # A-01 through D-03 in Appendix III.

1. The Banyon Rim site is located above houses at the end of Banyon Rim Road. Photographs and anecdotal evidence obtained and viewed during our visit suggest the site is subject to flooding and debris flows during heavy rains. Two existing landslides were observed on two of the canyons in this site posing a potential threat to the properties located below the end of Banyon Rim Road and the surrounding area. The landslide at the east side was observed to be moving after the rain event on November 27, 2008. Signs of landsliding observed include crown, scarp, transverse cracks, bulging, etc. It is anticipated that the effects of the moderate to high burn severity in the headwater areas that drain to the landslide body will increase and magnify the size and intensity of landslides, debris flows, and flooding as a function of the severity of winter and spring rains. The slide area is approximately 150,000 square feet. The toe of the slide is about 150 feet from the backyard of the houses. It is considered unlikely that this narrow space will be able to hold down-moving debris when debris flow does occur.

2. Houses located on down-slopes, along Hidden Hills Road, between Green Mount Place and High Tree Circle, are subject to a high potential of landslides. Three existing, large-size landslides have developed at this site posing a potential threat to properties upslope. One home's backyard was observed to have partially failed. Signs of landsliding were observed to include crown, scarp, transverse cracks, bulging, etc. This site is subject to landsliding when water from headwater areas, infiltrating into the landslide body, increases the driving force and reduces resistance force of the landslide body during a heavy rain. However, the effects of the burn severity in the headwaters areas in relation to the existing landsliding are judged limited. The headwater areas of these existing landslides appear to be mostly non-vegetated or sparsely vegetated, and the burn severity appears to be low to moderate.

3. The community located at the end of Twilight Canyon Road is exposed to hazards of debris flow and flooding from slopes at its north and west side, described in the paragraph above. It is anticipated that the effects of the low to high burn severity in the headwater areas that drain to the bottom of the valley will increase and magnify the size and intensity of landsliding, debris flows, and flooding as a function of the severity of winter and spring rains. Existing earth dikes and K-rails are not likely to have enough capacity to hold the down-moving mud if debris flow does occur. These earth dikes and K-rails could be blocked by another existing landslide right above the earth dike between the basin and the other (larger) basin to the east. Additionally, slopes at the community's west side are severely burned and show high erodibility. A portion of these slopes also show signs of distress including irregular shape, tilted trees, and bulging. Impacts to the Community from increased potential of debris flow and flooding during a heavy rain appear highly likely.

4. Along Mission Hills Lane, between Brentwood Place and Skyline Drive, three existing landslides, on down-slopes, have developed in this area. These slides have the potential to adversely affect the homes near the slopes. Signs of landslide were observed to include crown, scarp, transverse cracks, bulging, etc. This site is subject to landsliding when water from surrounding area infiltrating into the landslide body increases and magnifies the size and intensity of landsliding as a function of the severity of winter and spring rains. However, the effects of the burn severity in the headwater areas to the existing landsliding are judged to be limited.

5. In the Horseshoe Bend area, existing severe erosion, medium to large landslides, and rock fall potential, all of which could impact the railway tracks and downhill commercial structures were observed. A total of five existing landslides (including the landslides described in item 4) were observed on the upslopes of this section. It is anticipated that the effects of the moderate to high burn severity in the headwaters and drain to this area will increase and magnify the size and intensity of flooding, landsliding, rock fall, and debris flows to the railway tracks and downhill commercial buildings when a heavy rain occurs.

6. Approximately 26 houses toward down-slopes along Avenida De Marcia between Avenida De Kristine and Avenida De Michelle, and toward down-slopes on Avenida De Kristine and Avenida De Michelle are subject to high likelihood of rock and earth falls, severe erosion, and possible slope instability. These houses' backyards are located at the top of the existing slopes. The slopes are nearly vertical, approximately 100 to 200 feet high, with high soil erodibility. The soil on the slopes appears to be very loose. Severe soil erosion (deep incised gullies and surficial sliding) was observed along the slopes affecting

some of the backyards. The effects of the burn severity to the existing slopes are judged very limited. Only sporadically burned bushes were observed on the near-vertical slopes.

7. Along Santa Ana Canyon Road between Woodcreek (approximately half a mile east of the Weir Canyon Road) and the entrance to Kindred Community Church, six existing and active landslides were observed that could impact Santa Ana Canyon Road and SR 91 Freeway. Signs of landslide were observed to include crown, scarp, bulging, rock falling, etc. Piles of mud and fallen rocks were observed on the eastbound side of the Weir Canyon Road. Potential hazards of debris flows and flooding to the roadways are anticipated when a heavy rain occurs. In addition, another landslide above the first bench in this area was observed to block the concrete V-ditch. It is anticipated that the effects of the high burn severity in the headwater areas that drain to this area will increase and magnify the size and intensity of flooding, landsliding, rock fall, and debris flows when a heavy rain occurs.

8. Along the 57 Freeway on both north and southbound lanes between East Lambert Road and Tonner Canyon Road, hydroseeding has already been applied by Caltrans on slopes on both sides of the freeway. The soil on the slopes appears to be very loose. It was observed that at portions where straw check dams were applied, light erosion with shallow gullies has appeared. The affect of possible mudflow and flooding to the roadway appears likely when a heavy rain occurs. However, the effects of the burn severity in the headwater areas to the existing landsliding are judged to be very limited. Sporadically burned bushes were observed on the slopes.

9. Existing severe erosion, surficial sloughing and rockfall potential were observed along Carbon Canyon Road that could impact the roadway, creek and drainage structures. It is anticipated that the effects of the moderate to high burn severity in the headwater areas that drain to the road will increase and magnify the size and intensity of flooding and debris flows when a heavy rain occurs.

10. Existing landslides and/or severe erosion were observed at several locations along the Metropolitan Waterline that could impact the waterline. It is anticipated that the effects of the moderate to high burn severity in these areas will increase and magnify the soil erodibility when a heavy rain occurs.

III. Recommendations

Following are site specific recommendations for the risks identified above. Sites should be further evaluated by Professional Geologists or Professional Geotechnical Engineers with experience in slope stability and debris flow hazard identification and mitigation to fully document the scope of the problems at each site.

1. It is recommended that the Banyon Rim site should not be inhabitant during winter and spring storms. Warning should be provided to residents of pending risks and danger. Emergency response plans, including early warning systems and evacuation plans, should be developed by emergency agencies. It is further recommended that a comprehensive geotechnical investigation be conducted to determine the characteristic and geometry of the landslides.

2. At the Hidden Hills site, warning should be provided to residents of pending risks and danger. Emergency response plans, including early warning systems and evacuation plans, should be developed by emergency agencies. It is further recommended that a

comprehensive geotechnical investigation be conducted to determine the characteristic and geometry of the landslides.

3. For the Twilight Canyon site, it is recommended that measures be taken to stabilize the existing landslide in the middle portion between the basin and adjacent basin to the east in order to prevent it from blocking the channel. For the east-facing slopes, it is recommended that the following temporary measures be taken:
    - Detailed study of the east-facing slope with irregular shape and bulging
    - Apply erosion control on the slopes
    - Cleaning of the clogged drop inlets and protect them
    - Repair and maintenance of the silt fence and closing of the existing gap
    - Placement of sandbags and K-rails for run-off control
    - Divert water run-off

    Emergency response plans, including early warning systems and evacuation plans, should be developed by emergency agencies.

4. The Mission Hills site should be monitored for further movement of the slopes and emergency response plans, including early warning systems and evacuation plans be developed by emergency agencies.

5. For the BNSF site, emergency response plans, including early warning systems and evacuation plans, should be developed. A comprehensive geotechnical investigation should be performed for long-term performance, and temporary measures should be taken immediately to prevent the potential blocking of the railroad tracks and flooding of the downhill commercial structures. Temporary measures could include:
    - Widening and cleaning existing basins
    - Constructing new basins in portions of this area where high potential of debris flow exists but basins are not currently built
    - Diverting surface run-off
    - Placing sandbag or rock check dams to catch deposit and to deflect possible mudflow or debris flow
    - Applying erosion control on the slopes
    - Construction of slough walls

    Additionally a house sits above the railroad which is exposed to hazards of severe erosion and potential slope instability or landsliding due to the severely erodible soil. Erosion control measures should be taken to prevent further erosion on the slope. Installing slope indicators (SI's) at the top of the slope to monitor any slope movement is also recommended.

6. In the Avenida De Marcia area, it is recommended that erosion control measures be taken to protect the slope face through the rainy season with erosion control mats. Installing slope indicators (SI's) at the top of the slope to monitor any slope movement which might occur is also recommended. A detail geotechnical study should be conducted for long-term performance.

7. At the Anaheim site, piles of mud which slid to the side of the roadway should be cleaned. Protective measures such as erosion control should be taken as soon as possible to prevent the potential of mudflow, debris flow and flooding from entering the roadway. The blocked V-ditch should be cleaned. Failed slopes should be repaired or re-graded to prevent further mud movement to the roadway. A detail geotechnical study should also be performed for long-term performance.

8. Along the 57 Freeway site, erosion control measures such as straw check dams, K-rails or sandbag check dams should be applied and/or be reinforced on the hydroseeding treated slopes. Retaining walls could also be a viable option. The failed portion should be repaired. For long-term performance, a detail geotechnical study should be performed.

9. Through Carbon Canyon, erosion control measures such as straw check dams, K-rails or sandbag check dams should be applied and/or be reinforced on slopes. Retaining walls could also be a viable option. The failed portion should be repaired. For long-term performance, a detail geotechnical study should be performed.

10. At Metropolitan Water District locations, general erosion control measures such as sandbags, rock check dams, and erosion control mats should be applied and/or reinforced at affected points. Detailed treatments at selected points are contained in the full report.

Bridges

I. Resource Setting

Resource Setting – The 30,305 acre Freeway Complex Fire burned large swaths of Chino Hills State Park and small pockets on the fringe of surrounding neighborhoods of Anaheim, Brea, Yorba Linda, Diamond Bar and Chino Hills. The geography consists of steep hills and valleys bordered by alluvial fans and the Santa Ana River and Flood plain to the South.

II. Observations

The risks are very low and do not pose an emergency.

III. Recommendations

1. The railing on the wood bridge in Aliso Canyon should be replaced. The estimated cost is $ 1600.00.
2. The bridges along the Santa Anna River should be periodically monitored for the build up of jam debris. The California Department of Transportation (CAL TRANS) Office of Structures Maintenance Investigation, was contacted on December 4, 2008, and notified of the situation.

Soils

I. Resource Setting

The 30,305 acre Freeway Fire Complex burned public and private lands. This assessment is an evaluation of soil conditions in burned areas upslope to the values at risk. The areas evaluated are located in Chino Hills, northeast and east portions of Yorba Linda, northwest corner of Riverside County, Tonner Canyon, Soquel Canyon and Horseshoe Bend.

II. Observations

The erodibility of a soil type influences erosion potential from a sloping area. A soil association is an area that has a specific combination of soil types. Almost all of the burn area (97.9%) is a Soper-Fontana-Calleguas-Balcom-Anaheim Association. There are two

narrow strips of Urban land-Sorrento-Hanford Association (1.7%) on the southeast edge and a small area of Zamora-Urban land-Ramona Association (0.4%) at the southwest corner of the burn area.

BARC maps provided by the United States Geological Survey (USGS) indicated the level of burn severity within the fire boundaries. The levels are no effect, low, moderate and high burn soil severity. High severity burns will alter the way water infiltrates into the soil and can cause an increase in soil erosion. Moderate burn severity can also alter water soil infiltration. Rainfall and runoff carry the eroded soil downhill into water channels, thus increasing the potential for debris flows, mudslides, flooding and rockfall risks. The Freeway complex BARC data yielded the following results:

- No Effect 23.8%
- Low 33.7%
- Moderate 39.1%
- High 3.3%

All of the extensive high severity and most of the moderate severity burn areas are distant from values at risk and away from water channels in populated areas.

Plant canopies and plant debris on the ground protect the soil from rainfall impact and slow down water runoff. Fire burns off the vegetation and plant litter. This speeds up and increases soil erosion from rain and water runoff compared to pre-fire conditions. Plant roots hold the soil in place and help rain to infiltrate into the soil. Fires can be hot enough to burn the roots, reducing and/or eliminating root function. The severity of erosion and runoff is influenced by frequency, intensity and amount of rainfall, slope steepness and length.

III. Recommendations

The homes and businesses designated as high risk should not be occupied during storm events. Structures with a moderate risk should have an individual emergency plan and be part of a local evacuation plan. Locations with any risk to human life and safety should be followed up with site-specific investigations by the appropriate licensed professionals.

Recommended treatments for individual home sites can be found in the County of San Diego Homeowners' Guide and the USDA Natural Resources Conservation Service Fire Restoration Information for site treatment and protection recommendations at:
www.co.san-diego.ca.us/dplu/docs/AfterFire.pdf
http://www.ca.nrcs.usda.gov/programs/ewp/2007/info_homeowners.html

Natural Resources

I. Resource Setting

The 30,305 acre Freeway Complex Fire started in the area of the westbound 91 Freeway on November 15, 2008 and was fully contained on November 20, 2008. The fire burned State, County, and Private land in Los Angeles, San Bernardino, Riverside, and Orange Counties. Forty four percent of the fire occurred in Chino Hills State Park (13,400 Ac), of which 94.7% of the park burned. Burn area elevations span from 312 feet at Horseshoe Bend along the Santa Ana River to 1781 feet at San Juan Hill within Chino Hills State Park. This report will focus on direct and indirect impacts of the fire to threatened and endangered species and several California species of special concern that

occur within the fire perimeter on State Responsibility Lands (State, County, local, and Private ownership).

II. Observations

The fire burned 25 separate vegetation types, which represent 5 major categories: shrubland (29% of the area within the fire perimeter), hardwood forest/woodland (15%), mixed conifer hardwood/woodland (<1%), grassland (47%), and Urban/Bare Rock (9%). Federally or state listed species have been reported to occur in the region of the Freeway Complex Fire area: 4 wildlife and 2 plant species. In addition 4 sensitive vegetation communities occur in the area. Listed species within the fire disturbance perimeter include Braunton's milk-vetch (*Astragalus brauntonii*), least Bell's vireo (*Vireo bellii pusillus*), coastal California gnatcatcher (*Polioptila californica californica*), southwestern willow flycatcher (*Empidonax traillii extimus*), Santa Ana sucker (*Catostomus santaanae*), and Santa Ana River Woollystar (*Eriastrum densifolium ssp. Sanctorum*). Sensitive vegetation communities within the fire disturbance perimeter include California walnut woodland, southern coast live oak riparian forest, southern cottonwood willow riparian forest, and southern sycamore alder riparian woodland (CNDDB, 2008).

The ecological integrity of natural communities in the Freeway Complex Fire impact area is a value at risk because disturbance can allow encroachment of invasive weeds. Weeds compete with native plants for moisture, nutrients, sunlight, and can alter vegetation structure. This can create unsuitable habitat for native wildlife and contribute to unnaturally high fire frequency, which may result in type-conversion (permanent changes in vegetation type, diversity and species composition). Forty two percent of the fire area burned at a moderate or high intensity and it is certain that a number of wildlife and plants perished in the fire. Many plants and animals have evolved to live in fire-adapted ecosystems, and it is likely that many of the sensitive species will recover post fire. However, six fires have occurred within portions of the Freeway Complex Fire perimeter within the last six years and very few "fire-adapted" species are adapted to a fire interval of this frequency.

III. Recommendations

Treatment objectives are to monitor sensitive wildlife and plant species, protect sensitive natural communities from human-caused disturbance, promote native plant re-colonization of burned areas, and avoid spreading invasive weeds into currently unoccupied areas. General treatment recommendations include:

- Minimize invasive weeds and further degradation of native habitats by limiting public access to burn areas until vegetation can recover.
- Restoration of endangered species habitat, where appropriate, in disturbed and high intensity burn areas.
- Invasive species suppression, surveys, and monitoring for a minimum of five years.
- Monitor vegetation recovery in burned and unburned fire disturbance impact areas to assess long term health or possible decline of sensitive natural communities.
- Coordinate with local agencies regarding maintenance activities to avoid, minimize, and mitigate additional species impacts.
- Conduct post-fire surveys for rare, threatened, endangered, or species of special concern. Monitor and survey locations and habitats burned or indirectly impacted by the fire.
- Preserve natural stream bottoms and size all culverts (bottom-less preferred) to allow for fish/amphibian/reptile/mammal and 100 year flood water movement

through culverts. This measure is recommended for both temporary and permanent repairs to streams.

General recommendations during implementation of all remedial actions include:

- Control of fill material for permanent and emergency repairs should come from the local drainage areas as close as possible to the site. This will help to prevent/contain the spread of exotic weeds and help maintain the composition of native vegetation communities that currently exist.
- Propagate plants from the closest possible stands, using a local seed source, when restoring sensitive wildlife habitat.
- Avoid using hydroseed and hydromulch within the fire impact perimeter. If mulching is essential, biodegradable matting such as jute netting or wood fiber is preferred.
- If clearing channels is necessary to reduce risk to life and property, only the minimum amount of vegetation should be cleared that accomplishes the desired effect.
- Do not plant or seed invasive species. Refer to the CalEPPC List: Exotic Pest Plants of Greatest Ecological Concern in California, October 1999.
- Conduct invasive weed surveys during the 2009-2010 growing seasons.
- When detected, control weed populations and follow up with monitoring for at least 5 years.
- For areas along and abutting Chino Hills State Park, where emergency treatments are needed to protect values at risk, efforts should be taken to consult with park staff to evaluate potential impacts to the park (Chino-Citrus Sector office 951-780-6222).

Cultural Resources

I. Resource Setting

The Freeway Complex burned between November 15 and November 20, 2008, and consumed approximately 30,305 acres in the Chino Hills and Santa Ana River corridor west of the Highway 71/91 interchange. Fire impacted four counties – Orange, San Bernardino, Los Angeles and Riverside, and burned nearly 95% of Chino Hills State Park. Of the total burned acreage, 3.31% burned with high intensity, 39.12% with moderate intensity, 33.74% with low intensity and 23.82% with no effect.

II. Observations

Fire causes myriad adverse affects on cultural resources common to the Freeway Complex burn area. Fire's affect on cultural resources is influenced by its intensity (how hot it burns) and duration (how long it burns). Factors affecting these elements include fuel type, fuel load and arrangement, fuel condition, topography and weather (Wiltz n.d.). In any fire, organic materials like textiles and wooden structural elements are susceptible to combustion. High temperatures (intensity) or long exposure time (duration) can also alter artifacts. Lithic materials discolor, craze and fracture (DeBano et al. 1998:271) when temperatures are high enough or exposure is long enough; temperatures reaching ~350°c to 500°c affect cryptocrystalline silicates (Buenger 2003), and sandstone surfaces can discolor, spall and become more friable when temperatures reach 300°c (Winthrop 2005). Bone and shell degrade at temperatures near 700°c (Buenger 2003), and historic ceramics, glass and metals can melt and craze at these higher temperatures (Winthrop 2005). Furthermore, temperatures of ~675°c alter archeomagnetic dates on lithic materials, and carbon-14 dating methods are impacted by the introduction of charcoal (DeBano et al. 1998:274). Smoke obliteration, chemical exposure, spall and exfoliation

also damage sandstone shelters and rock art surfaces. Indirect fire affects on cultural resources include erosion, soil deflation resulting from root combustion that can destroy subsurface integrity, burned out trees that can fall onto site elements and heightened visitor impacts due to increased visibility.

III. Recommendations

Fire affects cultural resources directly and indirectly, and often indirect affects generate greater potential to threaten cultural resources than direct affects.
Treatment Objective: Identify and mitigate potential impacts to cultural resources.
Treatment Description: Treatments aim to reduce potentially adverse impacts to cultural resources.

1. Because general surveying for sites is beyond the BART focus, areas likely to contain cultural resources should be surveyed before vegetation has an opportunity to reestablish to pre-fire conditions.
2. Proposed clearing of downed vegetation and debris from within drainages should be completed with hand tools, material should be carried to minimize dragging and ground disturbance and an archaeologist should be present to monitor if tree felling occurs or debris removal cannot be undertaken utilizing disturbance-minimizing techniques.
3. Due to increased visibility, archaeological sites should be monitored until vegetation grows back
4. The proposed Pepper Tree Farm berm construction should undergo Native American Consultation and utilize a Native American monitor, if consultation recommends, during undertaking.
5. An archaeological review and Native American consultation should occur prior to management of invasive weed species in the Anaheim Wetland area
6. Archaeological review should occur prior to ground disturbing activities, implementation of proposed mitigation measures, additional rehabilitation or new construction efforts affiliated with BART recommendations.
7. The Native American Heritage Commission should be notified, and Native American consultation initiated, prior to ground disturbing activities, implementation of proposed mitigation measures, additional rehabilitation or new construction efforts, and, if deemed necessary, a Native American monitor will be present during undertaking

Public Assistance

I. Resource Setting

The 2008 wildfires (FEMA-1810-DR-CA) affected 30,305 acres in Orange, Los Angeles, Riverside and San Bernardino Counties. These fires, which generally occurred on the slopes of hills and mountains destroyed vegetation and caused “hydrophobic” soils to form, a condition causing the soil to repel water rather than absorb it. The affected watersheds were consequently subject to conditions under which rain could cause significant erosion and runoff, leading to mudflows, debris flows, and flooding.

II. Observations

The purpose of this survey was to identify projects that may reduce or eliminate immediate threats posed by erosion and other effects of storms in burned watersheds. The Public Assistance Team (OES/FEMA) conducted a rapid assessment of the fire area to determine whether the post-fire effects pose a threat to life or property. CALTRANS was mission tasked to place flood control measures at strategic locations. The City of Yorba

Linda identified debris basins and small inlets that required clearing on an Emergency Basis. The need of Emergency Operations Centers in direct response to a specific event for the coordination of efforts to protect life, property, and infrastructure were evaluated.

III. Recommendations

The use of the economic recovery criterion when a significant percentage of the commercial sector of a community is impacted was briefly discussed. According to the Geotechnical Report signs of landslide were observed. There is no information available indicating if these existing landslides are active and or inactive. Under Public Assistance Program generally certain and specific facility and integral ground restoration, emergency protective measures and debris removal might be considered. Only the ground necessary to physically support a facility is considered integral to its function. However, Under sections 403 and 502 of the Stafford Act, emergency protective measures to stabilize slopes and hills that were damaged by a disaster may be eligible only if necessary to eliminate or lessen immediate threats to life, public health, safety, or significant additional damage to improved public or private property.

DRAFT TECHNICAL SPECIALIST'S REPORT
BURN AREA RECOVERY TEAM (BART) Report

Resource: Hydrology/Water Quality

Fire Name: Freeway Complex CA-ORC-075221 December 2008

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I. Resource Condition Assessment

A. Resource Setting

The 30,305-acre Freeway Complex Fire started on November 15, 2008, and was contained on November 20, 2008. The type of burn severity at the Freeway Complex Fire ranged from low to high: 3.3% had high severity, 39.1% had moderate severity, and 33.7% had low severity, and the remaining area within the burn perimeter had no effect on burn severity. This information was provided by the Burned Area Reflectance Classification (BARC) map (Map #2 – Appendix 3). A storm event occurred on November 26, 2008 and produced approximately 1.4 inches of precipitation. The precipitation occurred before initial Burned Area Recovery Team (BART) surveys were completed, and revealed some of the areas that were affected as a consequence of the burn.

The burn region topography consists of mild to very steep slopes ranging from 312 feet to 1,781 feet in elevation. Chaparral, sagebrush, grass, and trees generally cover the area. The fire caused reduction of vegetation cover, increasing soil hydrophobicity. Annual rainfall variability averages approximately 14 inches per year (California Irrigation Management Information System (CIMIS) Station No. 75 – Irvine October 1987 to Present). Approximately 8.8 inches (63%) of the rainfall in this region occurs between the months of December and February with a historical monthly maximum precipitation as high as 27 inches (February 1992).

The burn area impacted 5 hydrologic sub-areas within the Santa Ana Region 8 and Los Angeles Region 4 planning area Regional Water Quality Board (RWQCB). Map #5 in Appendix 3 presents the hydrologic boundaries within the Complex Fire region. Listed below are the two Hydrologic Units affected by the fire and the associated burned areas for each planning watershed.

Santa Ana River Hydrologic Unit

Planning Watershed	In Burn Perimeter (acres)	Watershed (acres)	% Burned
Chino	1,546	199,772	1%
Yorba Linda	10,745	27,218	40%
Santa Ana Narrows	14,816	32,212	46%

San Gabriel River Hydrologic Unit

Planning Watershed	In Burn Perimeter (acres)	Watershed (acres)	% Burned
La Habra	2,433	23,471	10%
Anaheim	766	40,937	2%

Within these 5 hydrologic sub-areas, there exist many smaller "micro-watersheds" that are not identified by the Santa Ana and Los Angeles Region Basin Plans. The BART team assessed potential risks at the discharge points of the smaller micro-watershed areas in more detail because of the potential damage to life, property, or infrastructure. Some of the areas assessed include, but are not limited to, Aliso Creek Drainage (7,000 acres), Brush Canyon (930 acres), Lost Trough (700 acres), Box Canyon (360 acres), Blue Mud Canyon (1,550 acres), and many other "unidentified" micro-watersheds. These drainages can be identified on Map #5 of Appendix 3.

The table below presents the type and length of water features that exist within the burn area.

Flowline Type	Feet	Miles
Artificial Path	3,429	0.65
Canal/Ditch	29,815	5.65
Connector	6,452	1.22
Intermittent	696,309	131.88
Perennial	16,238	3.08
Underground Pipeline	35,465	6.72
Total	787,707	149.19

Beneficial uses for the impacted water bodies include: 1) municipal and domestic water supply; 2) Groundwater; 3) Rare, Threatened or Endangered Species; 4) contact and non-contact recreation; 5) warm and cold freshwater habitats; 6) warm and coldwater migration; 7) warm and coldwater spawning habitat; and 8) wildlife habitat (SARWQCB).

The following assumptions were used for the Freeway Complex assessment:

- Post fire increases in runoff and erosion are directly proportional to the percentage of burned area within a watershed and the severity of the fire;
- Post fire impacts are greatest for high severity fire areas, and percent ground cover is lowest for high severity fire;
- Ground cover reduction is the primary driver for post fire increases in runoff and erosion;
- Concentrated areas of high burn severity will have more impacts than dispersed areas;
- Generally, hydrologic and surface erosion impacts to life, property and other values of concern will decrease with increasing distance from burned areas. This is based on the assumption that impacts decrease in the downstream direction due to in-channel storage, dilution, obsticles, etc.

Debris Flow Analyses

At the request of the State Office of Emergency Services, the United States Department of Interior Geological Survey (USGS) performed an emergency assessment of debris-flow hazards from the area burned by the Freeway Complex Fire of 2008. The approach used tools developed specifically for post-fire debris flow processes, and addressed two of the fundamental questions in debris-flow hazard assessments: Where might debris flows occur and how big might they be? A visual map of potential debris impacted areas is included in Attachment A along with a letter from USGS (Attachment B) describing the assumptions made in constructing the model. The debris flow volumes are calculated in response to a 10 year recurrence interval based on a 3-hour storm producing 2 inches of precipitation. Of the 211 basins evaluated, probabilities greater than 80 percent were calculated for two basins, and probabilities between 60 and 80 percent were calculated for 82 basins. The remaining basins showed probabilities of less than 60 percent.

Calculated debris-flow volumes ranged between 400 cubic meters (m^3) and 32,000 m^3 in response to the 10-year recurrence, 3-hour duration storm. Debris-flow volumes greater 10,000 m^3 were calculated for 13 basins and volumes between 1,001 m^3 and 10,000 m^3 were calculated 184 of the basins evaluated. Debris flows within this range of volumes pose significant hazards to life and property. Debris flow behavior is highly unpredictable and the map in Attachment A presents the best available information to date.

B. Findings of the On-The-Ground Survey

To begin identifying values at risk, reconnaissance was conducted from December 2, 2008, through December 9, 2008. Our field investigations included areas identified by flood damage that occurred during the rain event between November 23 and 25, 2008. Areas of particular concern included inhabited areas within City of Yorba Linda, City of Anaheim, City of Chino Hills, City of Brea,

Olinda Village, and Sleepy Hollow. Additionally, we evaluated both public and private access roads throughout the burn area, paying particular attention to culverts along roadsides, residential areas and railroad tracks.

Access was by four-wheel drive vehicle, foot, and helicopter (City of Anaheim). Visual observations were recorded in field notebooks. Distances were measured with vehicle odometer or by pacing. When possible, culverts were measured with a measuring tape. Field soil hydrophobicity tests were made by pouring water from a bottle and timed with a watch. Portable GPS units were used to mark map point locations and a digital camera was used to take pictures. Two way radios were utilized to communicate in the field.

1. Values At Risk

The values at risk identified in this assessment are the possible loss of life and property that may occur due to anticipated increases in debris flows and potential flooding as a result of runoff from the burn areas. Additionally, roads, bridges, culverts, water supply, and sewer collection systems may also be at risk due to increased flow in the creeks. Potential clogging of culverts and drainage structures by debris is also of great concern.

2. Conditions of Values At Risk

City of Anaheim

The City of Anaheim had fire damage primarily on the north side of the city. There are some concerns regarding some of the steep burned slopes but it appears that the hillsides have been reinforced with straw bales by the property owners. One location that was observed was the debris basin at the intersection of Weir Canyon Road and Santa Ana Road. The basin was severely burned and there is a significant quantity of burned vegetation (willows, grasses, large trees, etc.) that could clog the inlet culvert and cause flooding over the streets.

Burlington Northern Santa Fe (BNSF) Railroad

The BNSF Railroad is intact and is well maintained by the company. However, there are specific areas that may be severely impacted by debris flow or landslides caused from a rainfall event. Map points (62-65, 83-88) identify areas along the railroad that appear to be at risk of flooding and/or debris flow. It appears that BNSF is currently working in some of these areas to mitigate the potential problem by the use of debris basins.

City of Yorba Linda

There are several residences and streets within the City of Yorba Linda that are subject to flooding and/or debris flow. In general, homes that have back yards literally at the discharge of a watershed are extremely vulnerable to flooding. These residences typically exist along the streets of San Antonio, Black Forest, and Hidden Hills. In addition to potential flooding of low lying homes, houses at the top of hills are subject to erosion concerns, with some yards showing signs of shifting downhill.

City of Chino Hills

There are a few residences and streets within the City of Chino Hills that are subject to flooding and/or debris flow. In general, homes that have back yards that are against steep hills are extremely vulnerable to flooding due to the vegetation being burned above the homes. These residences exist along the border of Chino Hills State Park.

The community of Sleepy Hollow is under the sphere of influence of Chino Hills. Sleepy Hollow did not sustain much fire damage and was just outside the perimeter of the fire. The steep slopes around the fire are low to moderately burned and the community has utilized sand bags to direct water around properties and into steep narrow streets. Generally speaking, Sleepy Hollow does not appear to be impacted more than it was in the pre-fire condition.

City of Corona

The BART team met with the City of Corona and there were no concerns from their standpoint.

City of Brea

The City of Brea did not have concerns in their immediate city location, however, Brea also maintains the community of Olinda Village. The community of Olinda Village did not sustain much fire damage itself; however, it was surrounded by the fire. As a result, the Carbon Canyon watershed directly to the north was significantly burned. The watershed that directly affects Olinda Village is approximately 6,000 acres and ultimately discharges into Carbon Creek. A small ranch is in direct line with the discharge of this watershed and there is a very high potential for this property to be flooded and damaged. The remaining part of the community appears to be in satisfactory condition.

During a site visit in Olinda Village, the City of Brea mentioned that a 10-inch sewer collection system traverses down Carbon Canyon Creek from

Sleepy Hollow and Olinda Village. A manhole that was approximately 5 feet above the creek bed was visible and looked as though it has endured many years of erosion. If a large storm produces a high volume of water in the creek, the sewer collection system may be jeopardized, and raw sewage will impact the creek.

Chino Hills State Park

The Chino Hills State Park is generally isolated from urban areas and flood events may not impact the value of property within the park boundaries. However, erosion of dirt roads and culverts from the last storm indicates that additional road damage and debris will increase with future rainfall. Southern Cal Gas Company has a network of high pressure transmission lines that traverse the Park. Due to uneven terrain, these transmission lines tend to "daylight" or come above ground when they cross stream beds. It appears that all gas transmission lines are currently secure.

Water Quality

There are several potential sources of water quality impacts from the Freeway Complex Fire. These include runoff originating from burned residential structures, increased sediment loading in the local storm drainage courses that discharge into the Santa Ana and San Gabriel Rivers, and contamination of surface water if nearby sewer collection systems are damaged by debris flow.

Flow in the Santa Ana River is diverted into spreading basins for ground water recharge downstream from the Imperial Highway Bridge. Orange County Water District has already recognized the need for additional monitoring of River flows in response to potential water quality impacts to River water quality.

Short Term Water Quality Effects

Runoff originating from the debris remaining after a residential structure fire is a potential source of pollutants to surface waters in the Santa Ana Region. There were a total of 190 residences destroyed in the cities of Yorba Linda, Anaheim (Anaheim Hills) and Brea. The vast majority of these structures are within the Santa Ana River watershed.

There were also numerous motor vehicles (automobiles, recreational vehicles, and boats) destroyed as a result of the destruction of residential homes. These will be potential contributors of pollutants as well.

The burn areas that are tributary to the San Gabriel River watershed had very few structures damaged or destroyed by the fire.

The cities affected by the Freeway Complex Fire should strive to implement measures to minimize the potential impact of pollutants that can be attributed to runoff from burned structures. The effective use of sand bags to retard runoff from damaged home sites which have not yet been demolished and cleaned up should be encouraged (see photo exhibit A). Efforts to inform owners of destroyed homes should be mounted to increase the effectiveness of this sand bag best management practice. Increased frequency of street sweeping in those neighborhoods where there are destroyed structures should be considered to assist in minimizing pollutants in runoff.

Photo Exhibit A

Long Term Water Quality Effects

There are potential threats to both the Santa Ana River and the San Gabriel River in the event of service interruption to trunk sewer mains. A reach of the Santa Ana River Interceptor (SARI) operated by the Orange County Sanitation District (OCSD) parallels and crosses the Santa Ana River between Prado Dam and the Yorba Linda Blvd. Bridge. It is anticipated that the tributary drainage from the Aliso Canyon watershed that stretches several miles into the Chino Hills State Park (that was completely burned), along with several other smaller tributary watersheds along the Santa Ana River downstream from Prado Dam, will exhibit higher runoff volumes and sediment loads. Since a realignment of the SARI trunk sewer is being designed by OCSD due to the vulnerability of the pipeline at River crossing points, higher runoff contributions to this reach of the River may exacerbate this vulnerability.

The OCSD also operates a gravity sewer main in Carbon Canyon that parallels Carbon Creek. Again, because of the anticipated increased runoff and debris flows of the Creek due to contributions from burned watersheds, the potential exists for damage to this trunk sewer from either sediment infiltration or erosion of the pipeline trench line.

An uncontrolled discharge of sanitary sewage to either the Santa Ana River or the San Gabriel River would cause significant impacts to these river systems. Therefore, emergency mitigation measures should be considered in the event of such a catastrophic occurrence.

II. Emergency Determination

The team identified people, property, and resources as values possibly at risk. The risks are debris flows, mudslides and flooding. High potential for soil erosion and burn severity on slopes increases the threat and severity of these hazards. The risk of flooding will increase depending on number and intensity of winter storm events. Nearly all of the annual rain falls during the winter months (December, January, and February).

III. Treatments to Mitigate the Emergency

Treatment for the BNSF railroad will be difficult due to the rails being located in close proximity to the steep hillsides. Many of the threats identified by the BART team existed in the past; however, the lack of vegetation on the hillsides has greatly increased the threat of debris flow onto the access road and railroad tracks. Where possible, it is recommended that drainage basins be cleaned of debris and expanded. Adequately sized culverts should be placed within the debris basins so that flood waters can be discharged effectively. Many residents have laid down plastic sheets to protect their property. In doing so, additional and accelerated precipitation runoff will occur within the watershed.

Another recommendation would be to have a monitoring mechanism to record and transmit real time data in the event there was a land slide in the threatened areas along the railroad. This could help prevent a derailment from occurring and minimize impacts. Chino Hills State Park is currently utilizing this type of technology on unstable slopes within the park.

The ranch in the Olinda Village area will require a large soil berm, k-rail, or rip rap to direct watershed discharge around the threatened property. The diversion will need to be placed upstream of the corrals so that damage to property can be limited. Along with constructing the diversion, precautions described in the Natural Resources Specialist Report should be observed.

In general, residences located at the base of the hills in Chino Hills, Yorba Linda, and Brea should take precautions to limit impacts of future rainfall through the

use of k-rail, sandbags, or other flood prevention barriers. Additionally, keeping any existing culverts free of debris would be a priority to ensure proper drainage.

IV. Discussion/Recommendations

Expect higher than normal watershed discharges, with possible debris flow, in all rain events for the next two rain seasons at a minimum. The higher the rainfall intensity, the higher the risk for flooding and debris flow throughout all of the Freeway Complex Fire burned area, particularly the communities of Yorba Linda, Chino Hills, Olinda, Sleepy Hollow, and Brea.

1. There are specific areas along the BNSF railroad that need to be addressed, particularly, Box Canyon and Horse Shoe Bend. An early warning monitoring system with various monitoring points along the hillside above the railroad would be advised. Additionally, a minimum of three debris basins should be constructed around Horse Shoe Bend to collect debris prior to the debris flow making contact with the tracks. These basins should be at map points 62 and 63.

2. Emergency evacuation plans should be implemented for all communities within the burn area.

3. Any dead/fire burned trees and vegetation, and live standing trees that could cause damming or choking of debris in creeks or drainage basins should be removed immediately. A plan should be developed and approved by appropriate agencies to remove hazardous vegetation for any remaining downstream areas.

4. Manholes located in the Carbon Canyon Creek channel should be monitored and if necessary, protected with additional rip-rap to dissipate energy and prevent erosion of the collection system (Map point 30). Further investigation would be required to determine size of the rip-rap, extent of protection, and structural integrity of the pipeline.

5. All County, Private, and State roads and trails should be safely monitored during and after precipitation events.

6. The Chino Hills Regional Park should be monitored for safety from debris and sediment flows during and after rain events, as large amount of debris may flow into the sediment basin reservoir.

7. All other Debris/Sediment/Detention Dams should be monitored during and after rain events.

8. The Chino Hills State Park should monitor for safety from debris and sediment flows during precipitation events as large amount of debris flow can cause erosion along roads, bridges, and trails.

9. The Southern California Gas Company should make routine checks on their high pressure gas lines that pass through the Chino Hills State Park, particularly where the pipeline "daylights" when crossing streams.

V. References

United States Geological Society
Geography, Geology, Hazards and Natural History Information
http://water.usgs.gov/waterwatch/?m=flood&r=ca&w=map

United States Geological Society
Water Watch
http://education.usgs.gov/california/maps/california_precipitation2.htm

Western Regional Climate Center
http://www.wrcc.fri.edu

Water Quality Control Plan for the Santa Ana River Basin (updated Feb. 2008)
http://www.swrcb.ca.gov/santaana/water_issues/programs/basin_plan/docs/toc.pdf

Water Quality Control Plan for the Los Angeles Region
http://www.waterboards.ca.gov/losangeles/water_issues/programs/basin_plan/index.shtml

United States Department of the Interior
Geological Survey
Geologic Hazards Team
December 12, 2008 letter

DWR Rainfall Duration Frequency
ftp://ftp.water.ca.gov/users/dfmhydro/

Kaplan-Henry, Terry. 2007. "McNally Post fire Discharge and the Relationship of Sierra Nevada-Wide Flood Frequency Curves and Local Kern River Discharge Curves." In *Advancing the Fundamental Sciences. Proceedings of the Forest Service National Earth Sciences Conference, Sand Diego, CA, 18 – 22 October 2004.* Ed. Furniss, Michael J., Catherine F., Ronnenberg, Kathryn L., 2007. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, PNW-GTR-689 Volume 1.

VI. Appendices

Attachment A – Freeway Complex Post Fire Hazard Awareness Maps

Attachment B – Letter from United States Department of the Interior, Geological Survey describing debris location and volume of debris.

Attachment C – Pictures

ATTACHMENT A

Total Pop.
335,488

Freeway Complex Post-Fire Hazard Awareness Map

CA-ORC-075221

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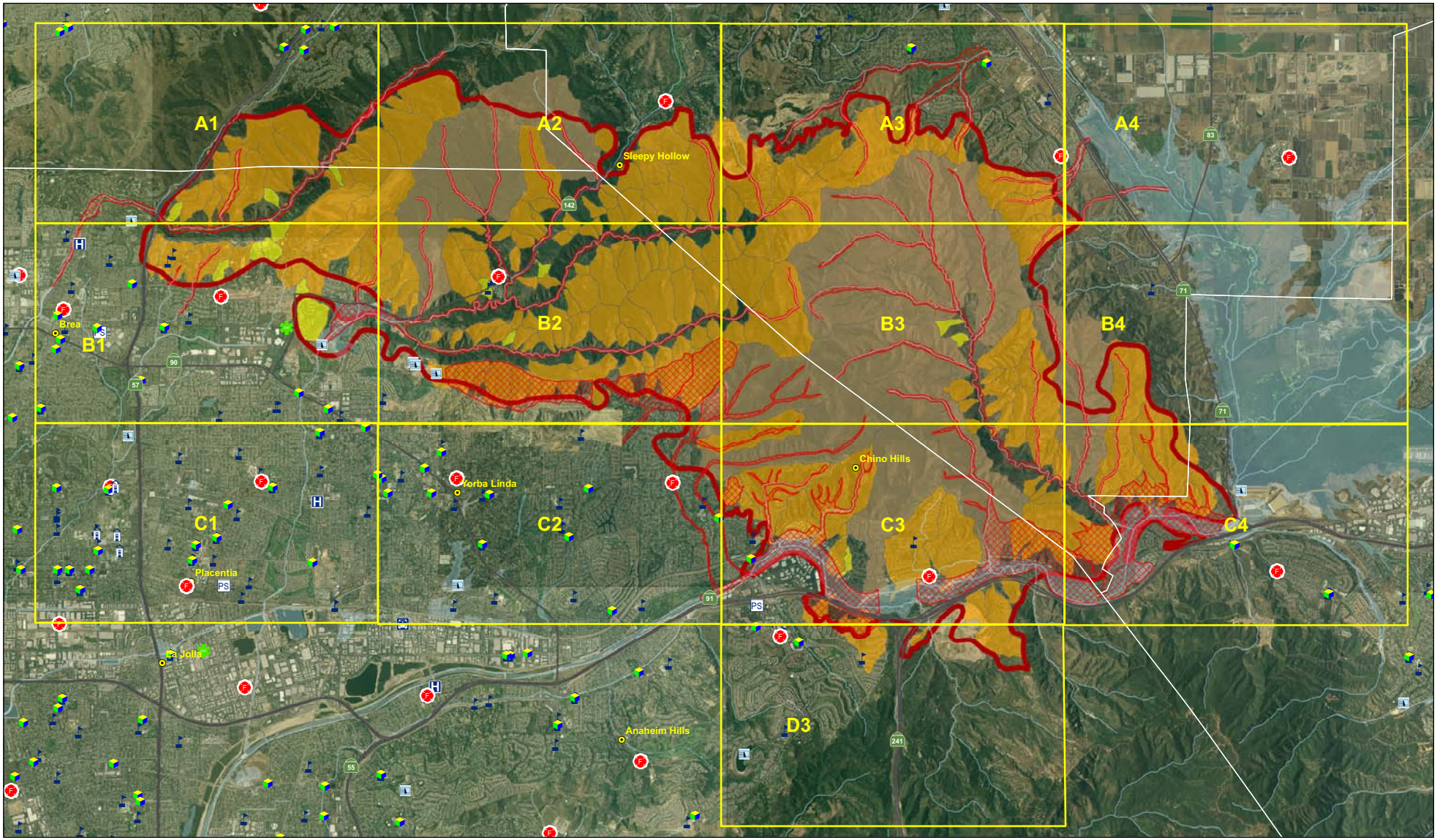


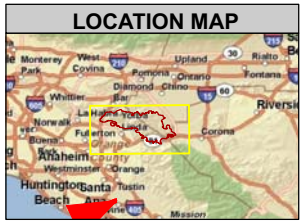
LEGEND

- Populated Places
- Bus Stations
- Daycare Facilities
- EMS
- Hospital
- School
- Fire Station
- Police
- Dam
- Red Cross
- Colleges Universities
- FEMA Flood Hazard Areas
- Fire Perimeters
- Potential Debris Flow Risk Areas

USGS Potential Debris Volume

- 0-1,000 cubic meters
- 1,001 to 10,000 cubic meters
- 10,000 to 100,000 cubic meters

LOCATION MAP



INDEX MAP

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State of California
Office of Emergency Services
Date Created: 12/06/2008
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Version: Final

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Debris flow volumes calculated in response to a 10 year recurrence based on 3 hour duration storm producing 1.75 inches of rainfall.

Volumes based on a model currently being tested. Debris flow behavior is highly unpredictable and this map shows the best available information at the time of printing.

Populations estimated using 2007 Census data and are calculated for those areas only within the grid index.

Total Pop.
23,478

Freeway Complex Post-Fire Hazard Awareness Map

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Page #
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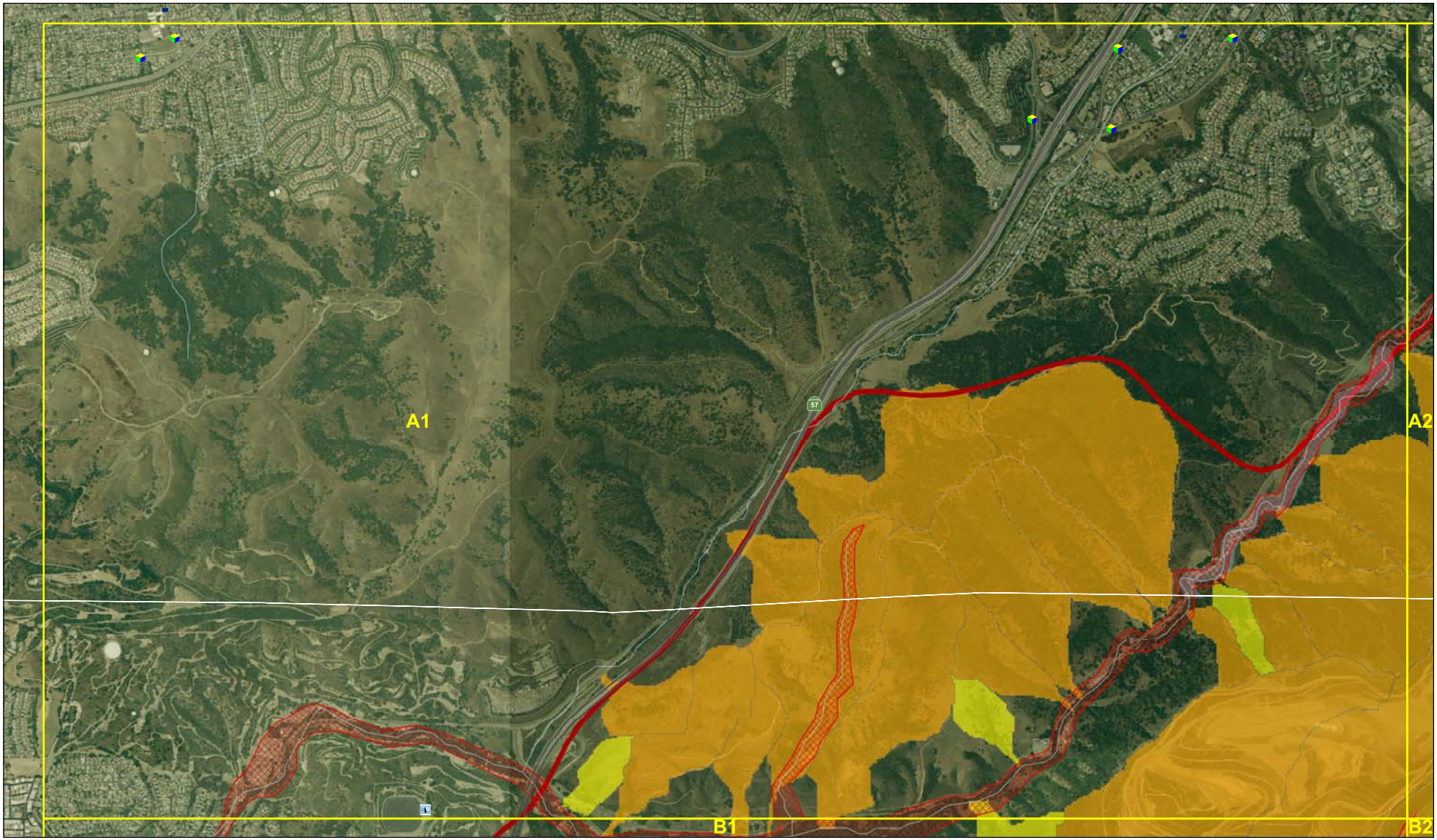

LEGEND

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USGS Potential Debris Volume

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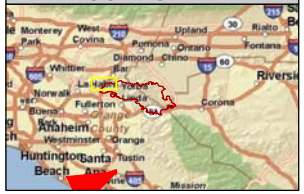
- 1,001 to 10,000 cubic meters
- 10,000 to 100,000 cubic meters

LOCATION MAP



INDEX MAP

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State of California
Office of Emergency Services
Date Created: 12/06/2008
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Total Pop.
14,290

Freeway Complex Post-Fire Hazard Awareness Map

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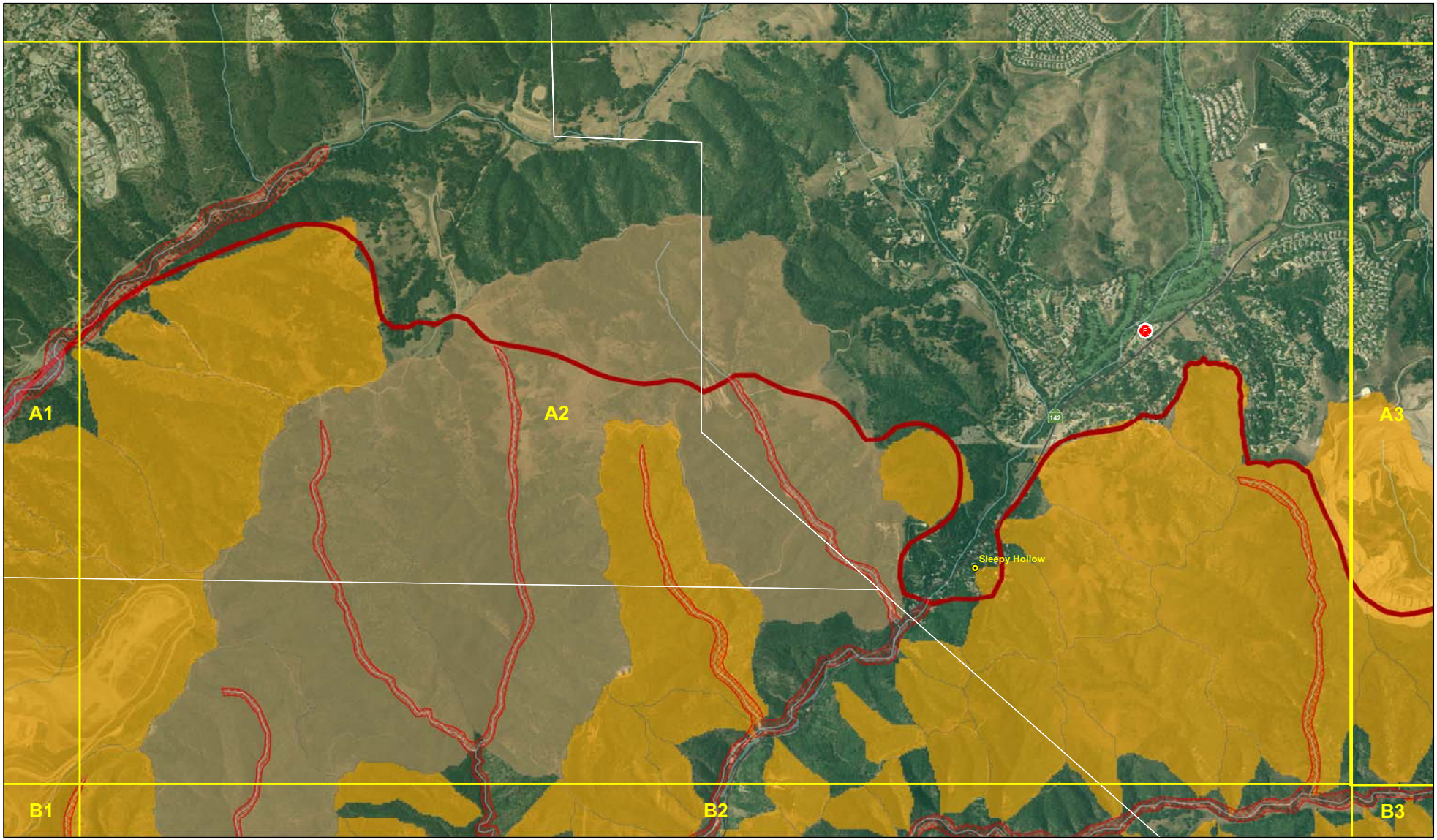

LEGEND

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USGS Potential Debris Volume

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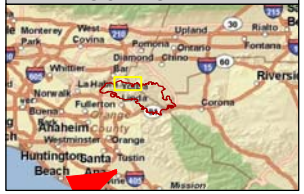
- 10,000 to 100,000 cubic meters

LOCATION MAP



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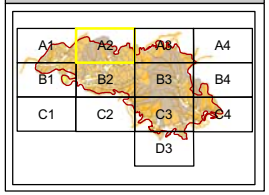

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Version: Final

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Total Pop.
25,668

Freeway Complex Post-Fire Hazard Awareness Map

CA-ORC-075221

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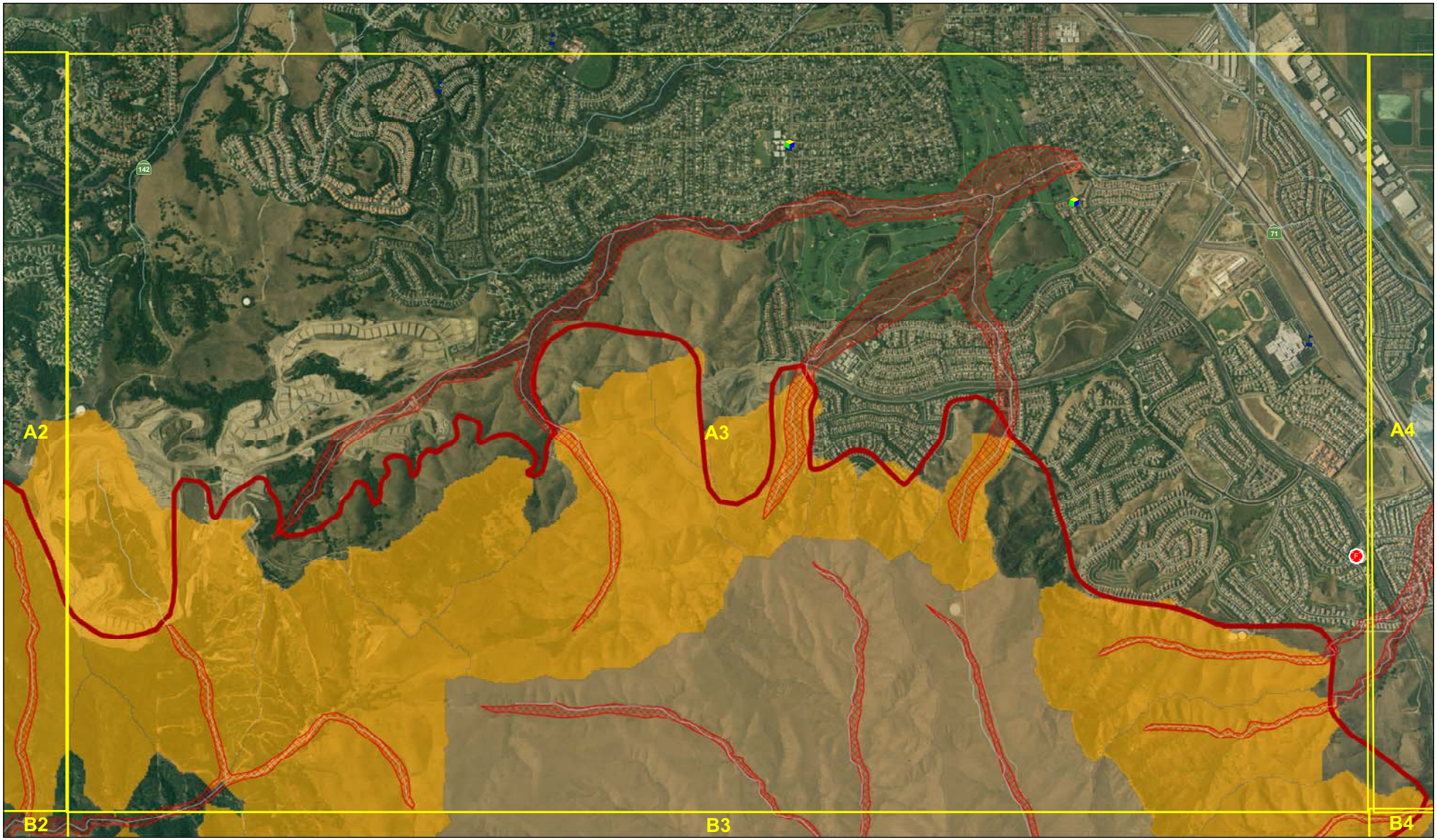

LEGEND

- Populated Places
- Bus Stations
- Daycare Facilities
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- Hospital
- School
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- Police
- Dam
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- Colleges Universities
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- Fire Perimeters
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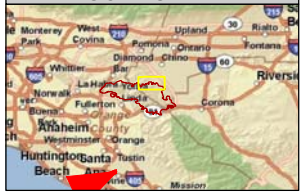
USGS Potential Debris Volume

- 0-1,000 cubic meters
- 1,001 to 10,000 cubic meters
- 10,000 to 100,000 cubic meters

LOCATION MAP



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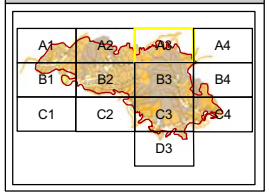

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Populations estimated using 2007 Census data and are calculated for those areas only within the grid index.

Total Pop.
11,074

Freeway Complex Post-Fire Hazard Awareness Map

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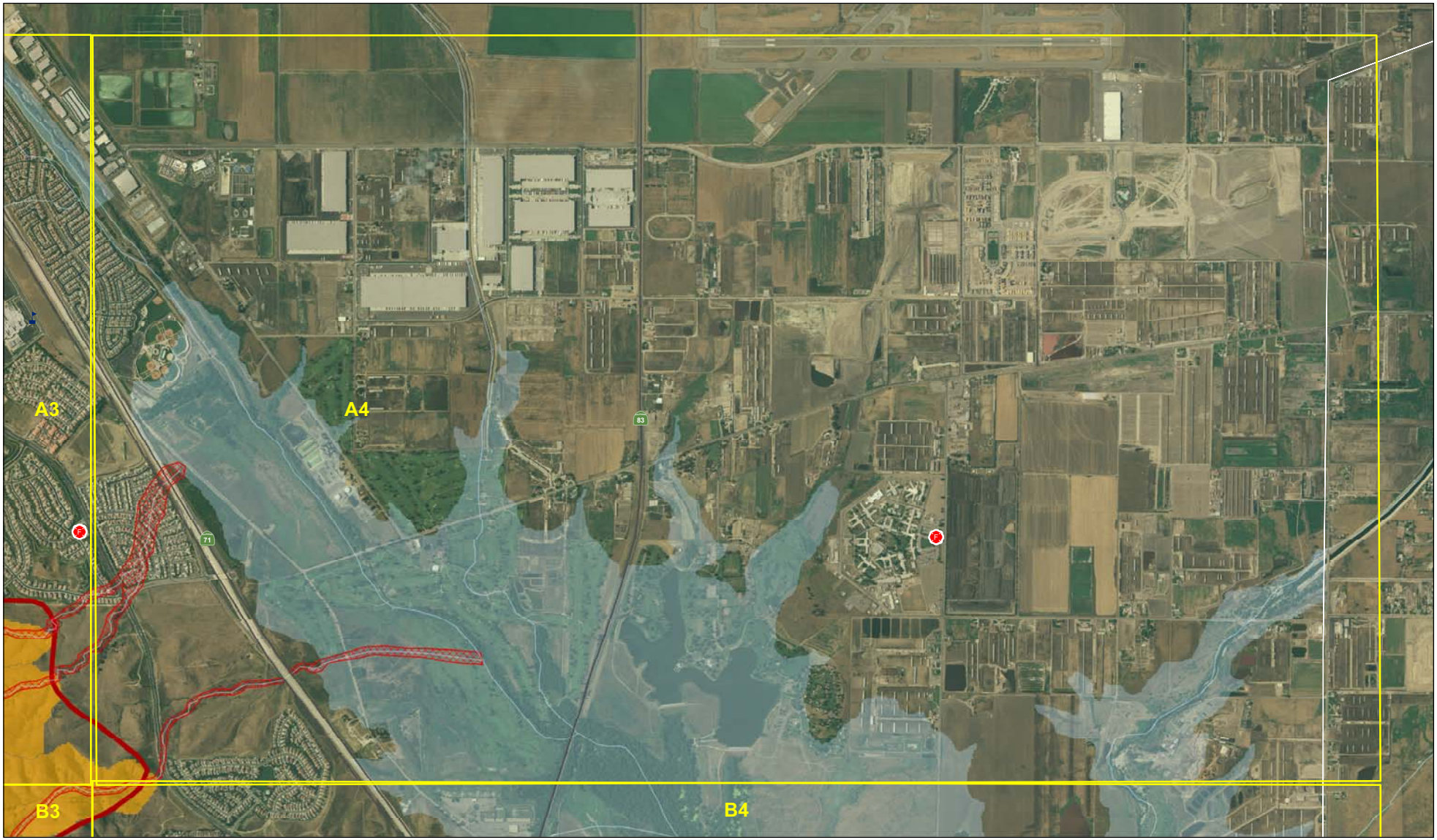

LEGEND

- Populated Places
- Bus Stations
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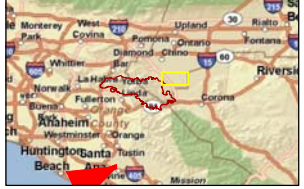
USGS Potential Debris Volume

- 0-1,000 cubic meters
- 1,001 to 10,000 cubic meters
- 10,000 to 100,000 cubic meters

LOCATION MAP



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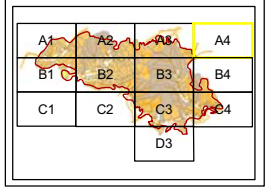

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Office of Emergency Services
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Author: DHuls - OES Gis Unit
Version: Final

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Total Pop.
42,724

Freeway Complex Post-Fire Hazard Awareness Map

CA-ORC-075221

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Page #
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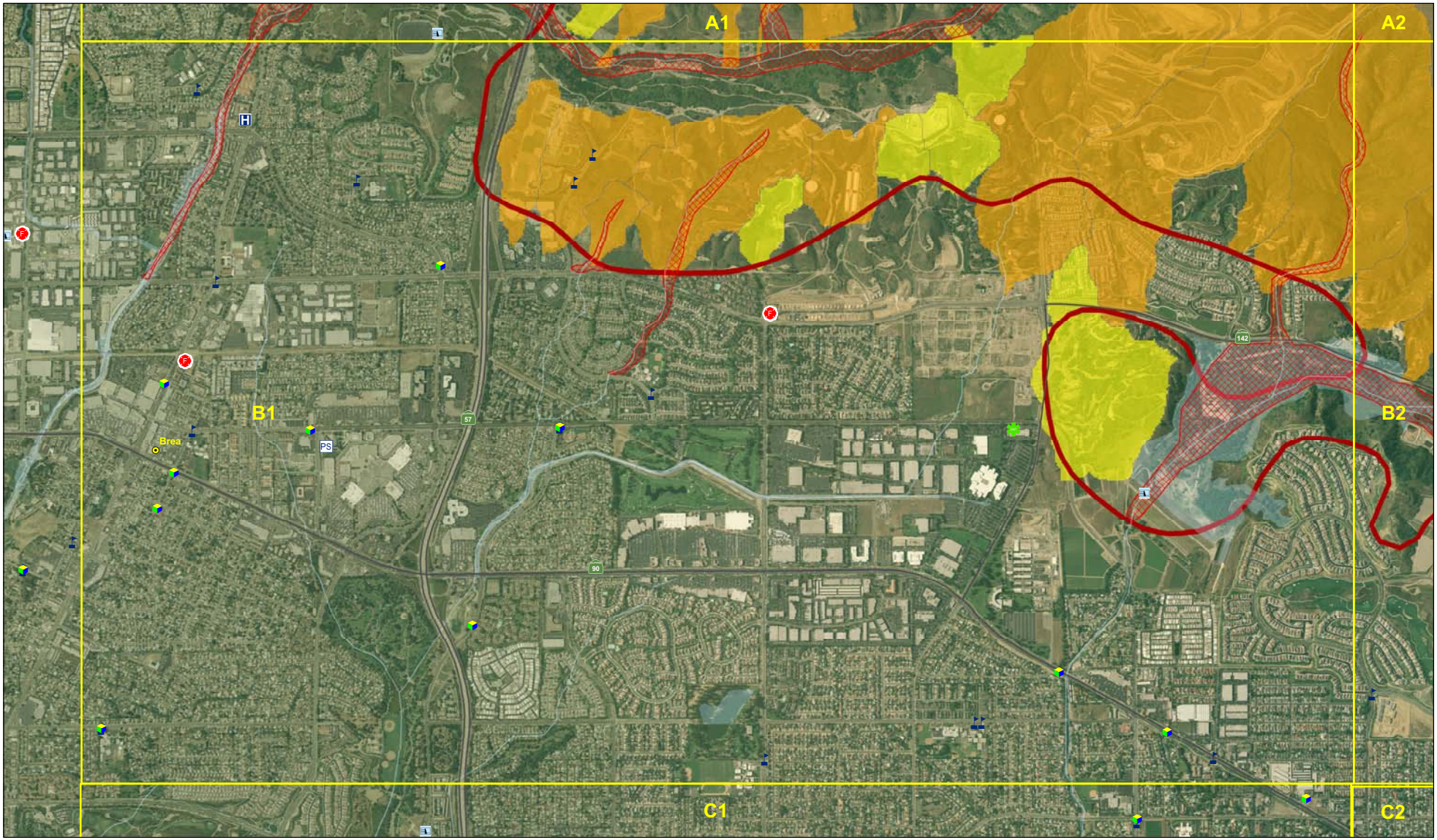

LEGEND

- Populated Places
- Bus Stations
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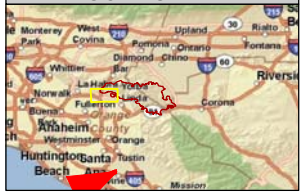
USGS Potential Debris Volume

- 0-1,000 cubic meters
- 1,001 to 10,000 cubic meters
- 10,000 to 100,000 cubic meters

LOCATION MAP



INDEX MAP

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Total Pop.
10,036

Freeway Complex Post-Fire Hazard Awareness Map

CA-ORC-075221

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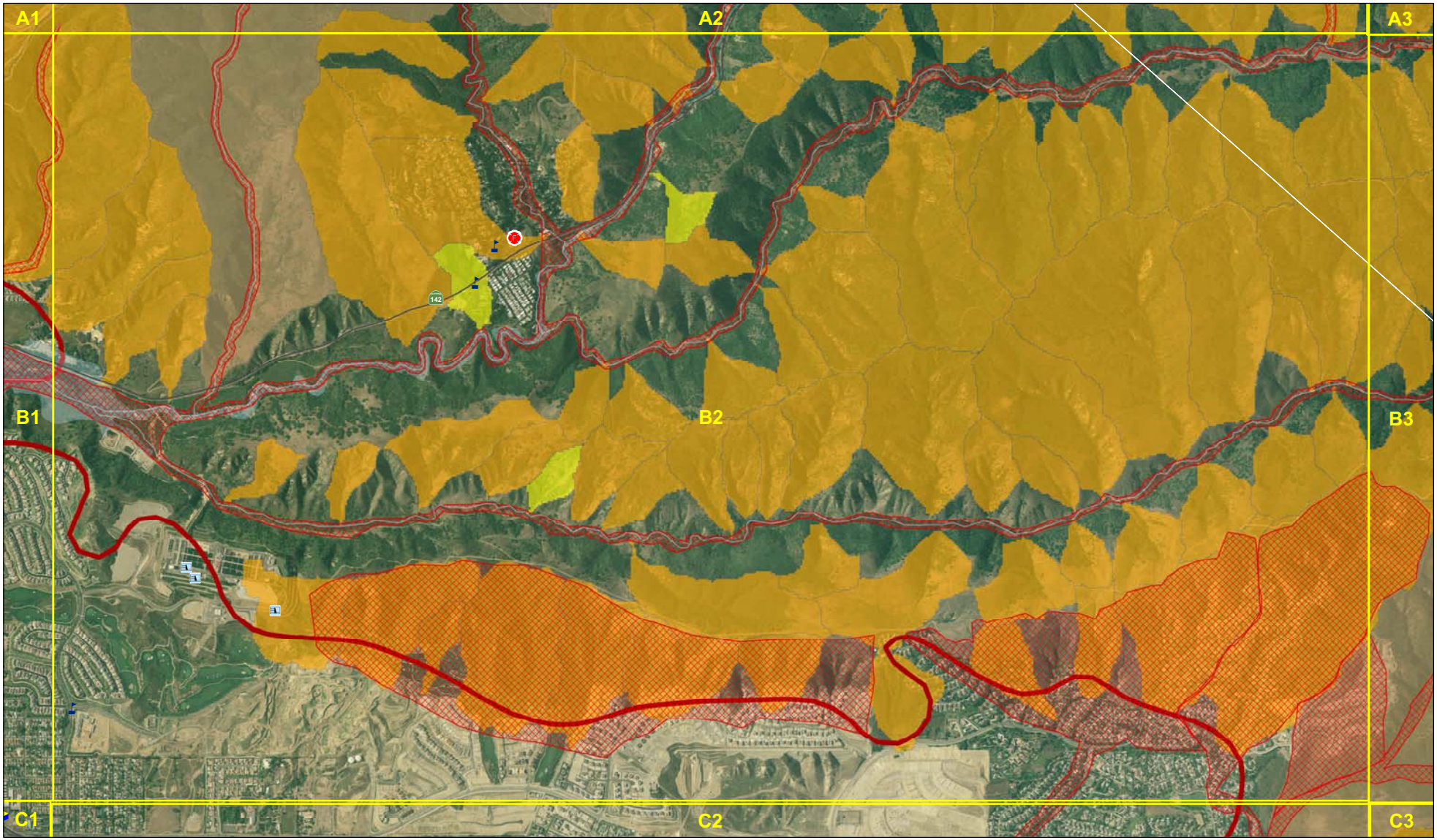

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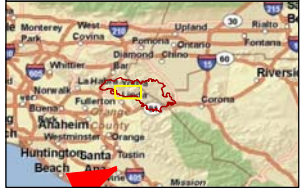

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Total Pop.
9,278

Freeway Complex Post-Fire Hazard Awareness Map

CA-ORC-075221

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Page #
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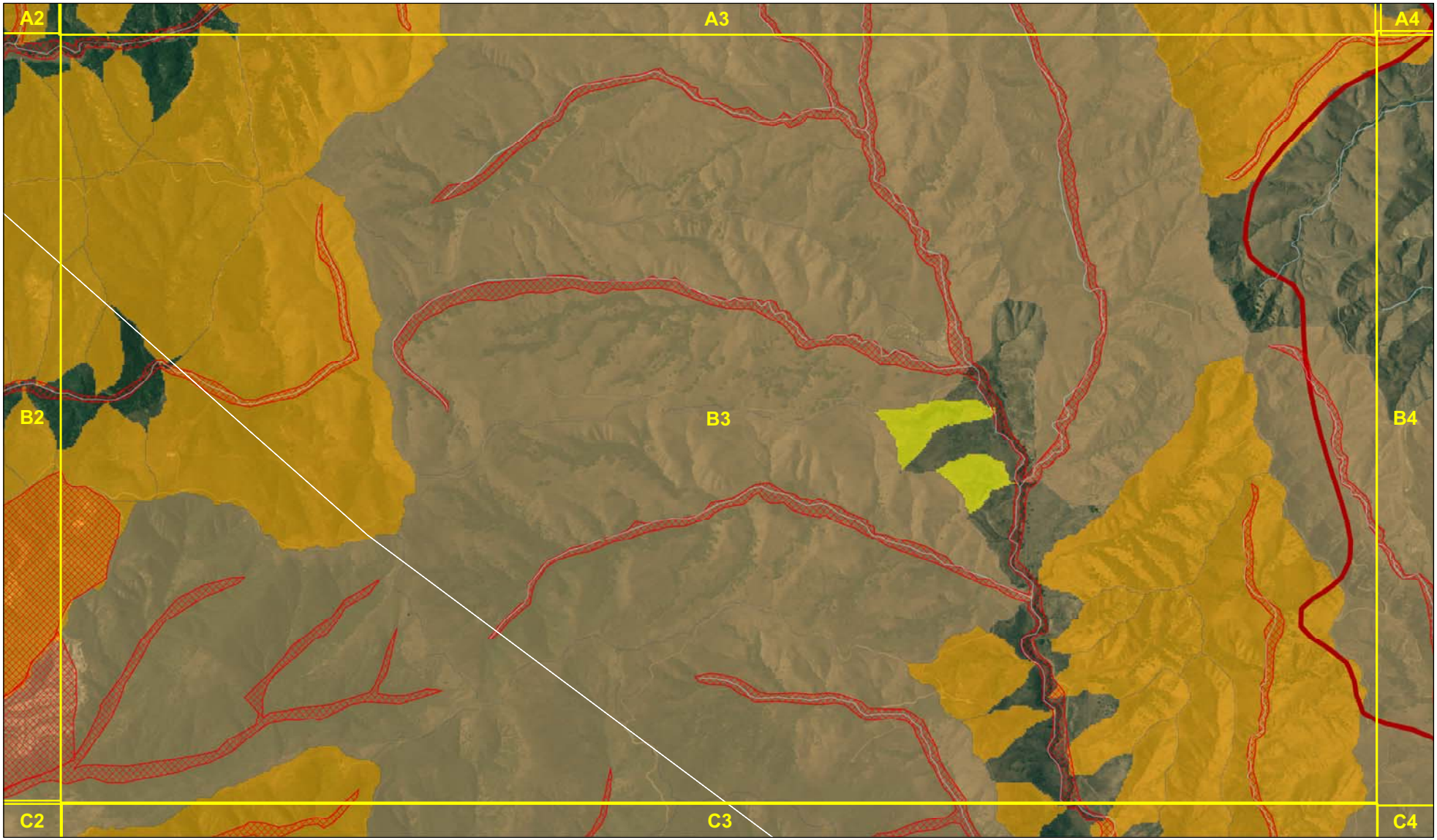

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USGS science for a changing world

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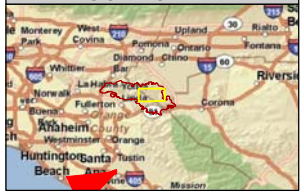

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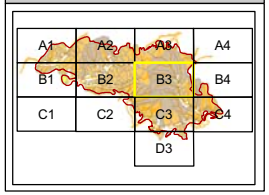

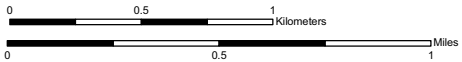

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Office of Emergency Services
Date Created: 12/06/2008
Author: DHuls - OES Gis Unit
Version: Final

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Debris flow volumes calculated in response to a 10 year recurrence based on 3 hour duration storm producing 1.75 inches of rainfall.

Volumes based on a model currently being tested. Debris flow behavior is highly unpredictable and this map shows the best available information at the time of printing.

Populations estimated using 2007 Census data and are calculated for those areas only within the grid index.

Total Pop.
17,602

Freeway Complex Post-Fire Hazard Awareness Map

CA-ORC-075221

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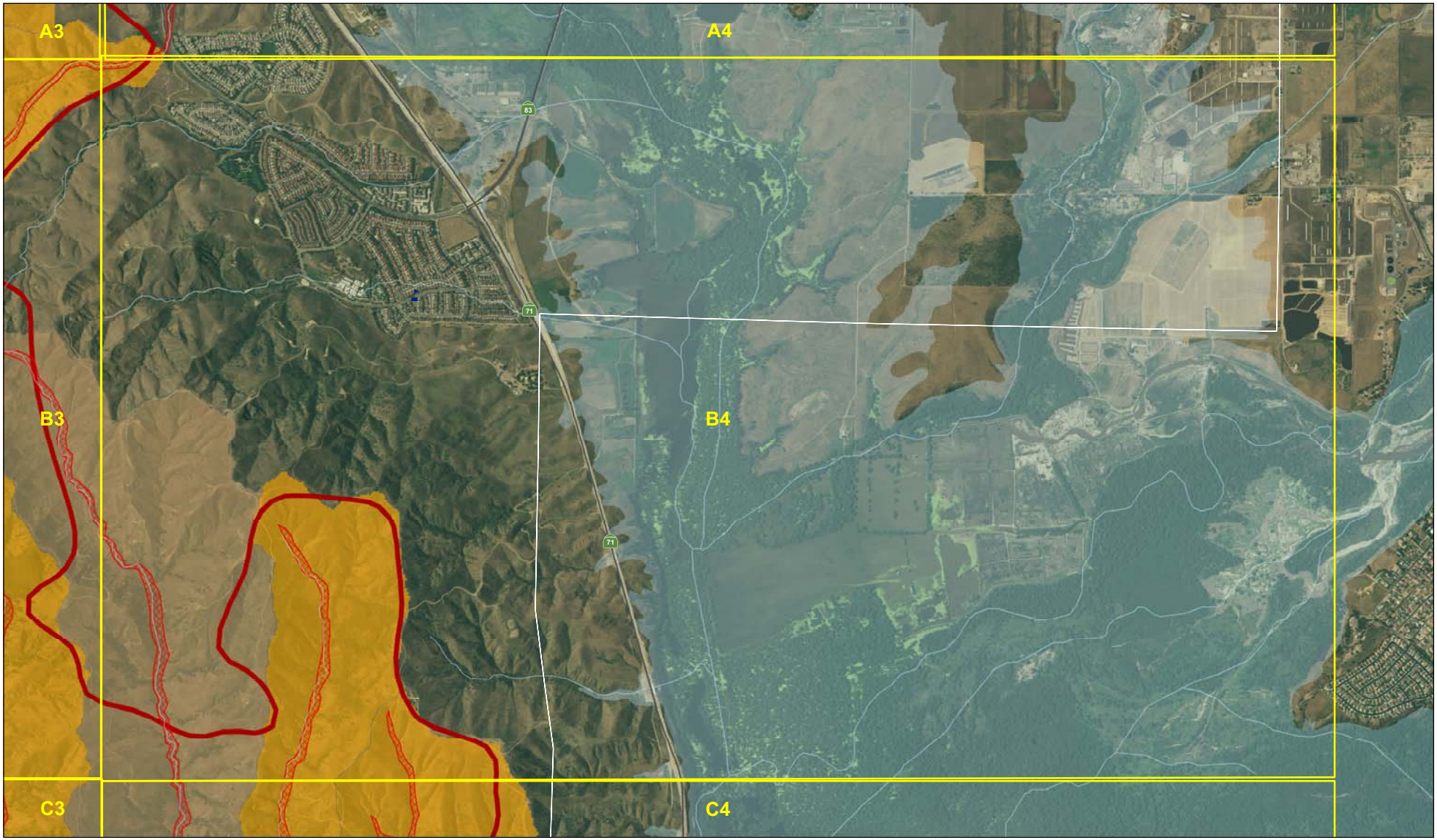
Page #
B4



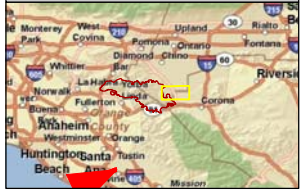
LEGEND

- Populated Places
- Bus Stations
- Daycare Facilities
- EMS
- Hospital
- School
- Fire Station
- Police
- Dam
- Red Cross
- Colleges Universities
- FEMA Flood Hazard Areas
- Fire Perimeters
- Potential Debris Flow Risk Areas

USGS Potential Debris Volume

- 0-1,000 cubic meters
- 1,001 to 10,000 cubic meters
- 10,000 to 100,000 cubic meters

LOCATION MAP



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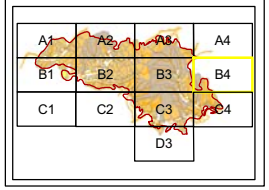

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Office of Emergency Services
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Volumes based on a model currently being tested. Debris flow behavior is highly unpredictable and this map shows the best available information at the time of printing.

Populations estimated using 2007 Census data and are calculated for those areas only within the grid index.

Total Pop.
46,998

Freeway Complex Post-Fire Hazard Awareness Map

CA-ORC-075221

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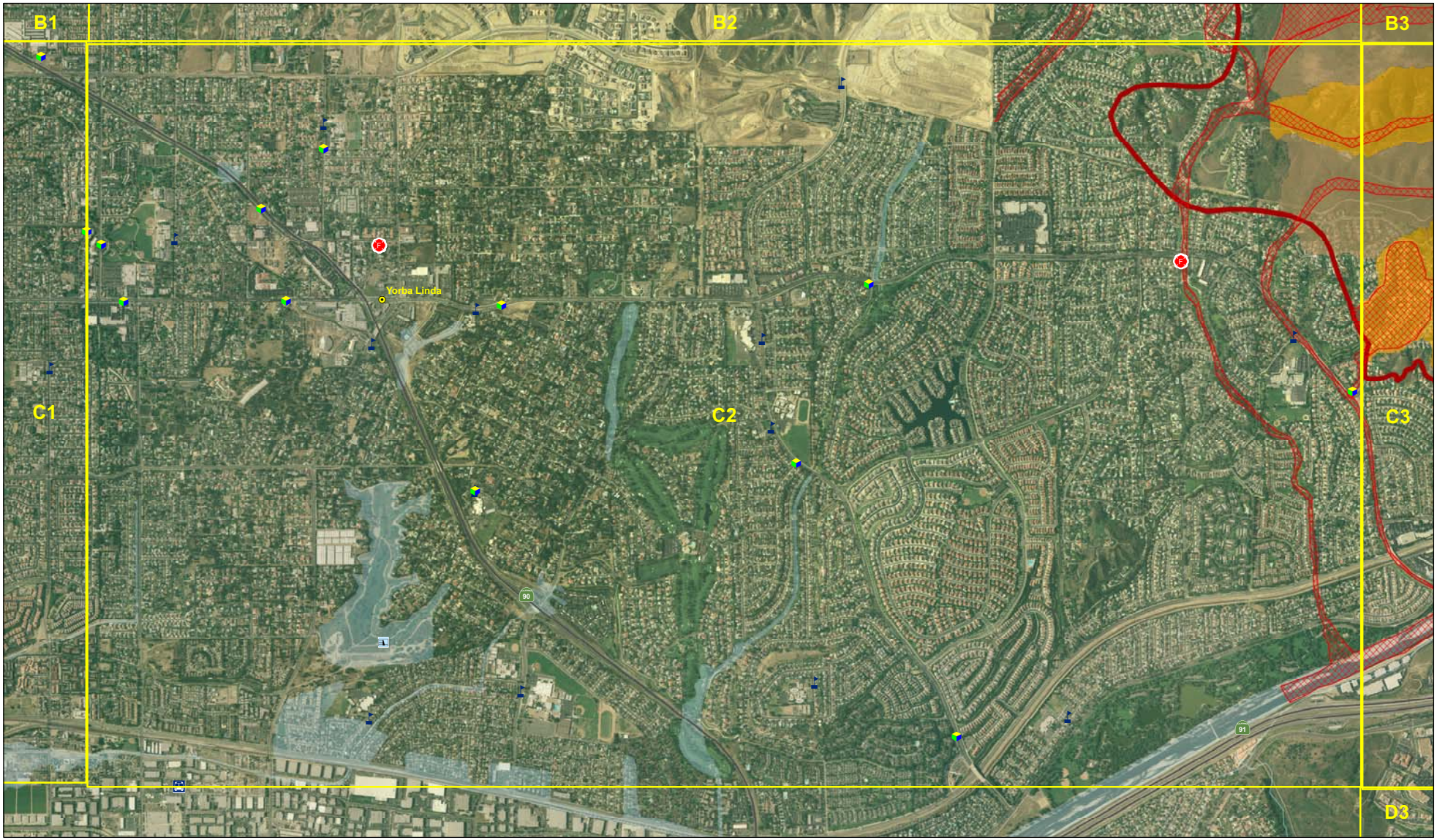

LEGEND

- Populated Places
- Bus Stations
- Daycare Facilities
- EMS
- Hospital
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- Police
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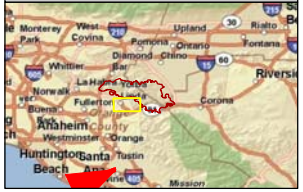
- Fire Perimeters
- Potential Debris Flow Risk Areas

USGS Potential Debris Volume

- 0-1,000 cubic meters
- 1,001 to 10,000 cubic meters
- 10,000 to 100,000 cubic meters

LOCATION MAP



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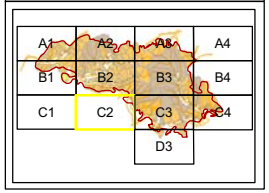

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Office of Emergency Services
Date Created: 12/06/2008
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Volumes based on a model currently being tested. Debris flow behavior is highly unpredictable and this map shows the best available information at the time of printing.

Populations estimated using 2007 Census data and are calculated for those areas only within the grid index.

Total Pop.
26,327

Freeway Complex Post-Fire Hazard Awareness Map

CA-ORC-075221

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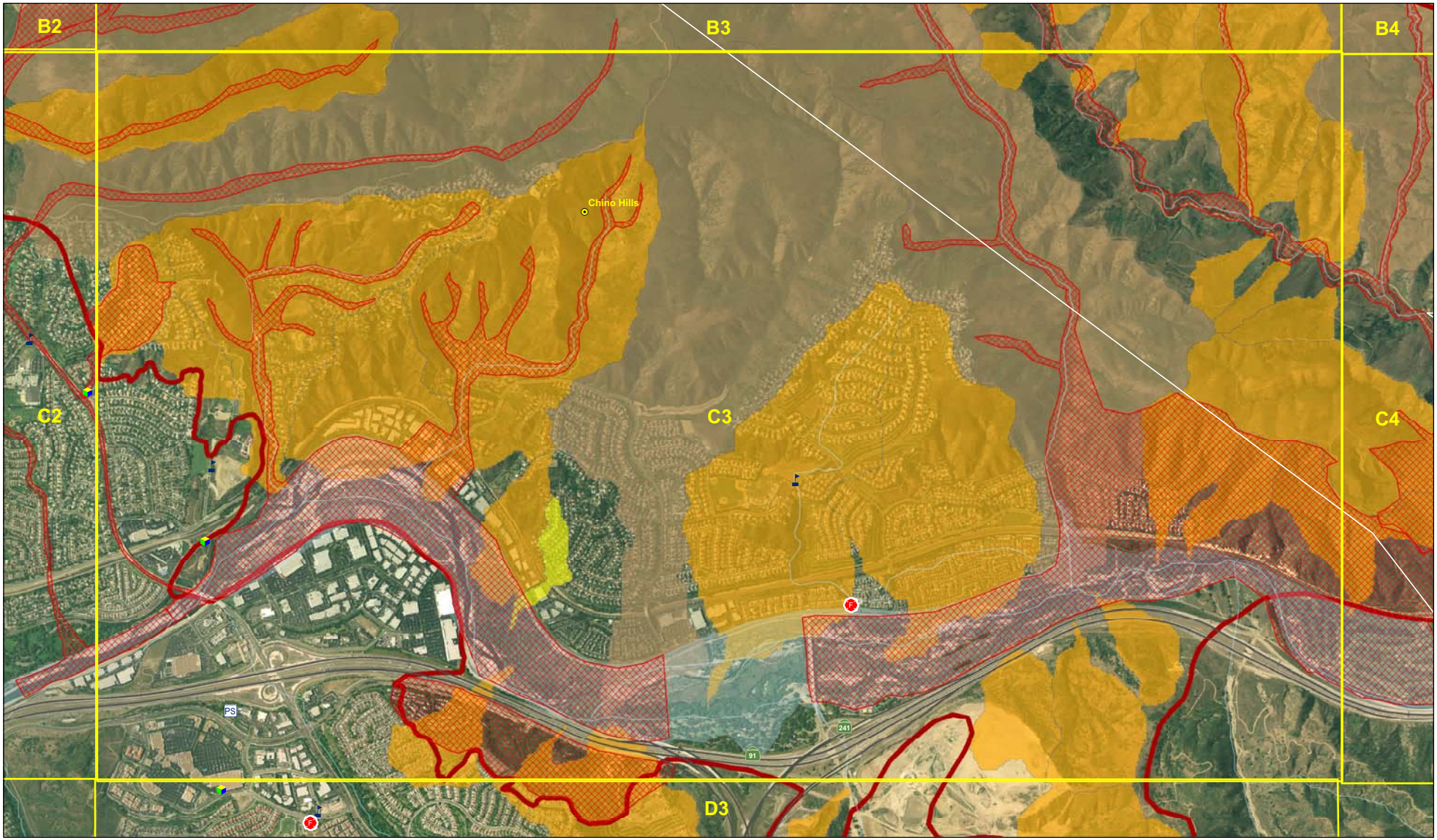
Page #
C3



LEGEND

- Populated Places
- Bus Stations
- Daycare Facilities
- EMS
- Hospital
- School
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- Police
- Dam
- Red Cross
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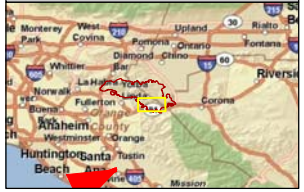
- Fire Perimeters
- Potential Debris Flow Risk Areas

USGS Potential Debris Volume

- 0-1,000 cubic meters
- 1,001 to 10,000 cubic meters
- 10,000 to 100,000 cubic meters

LOCATION MAP



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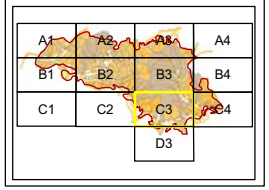

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Office of Emergency Services
Date Created: 12/06/2008
Author: DHuls - OES Gis Unit
Version: Final

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Populations estimated using 2007 Census data and are calculated for those areas only within the grid index.

Total Pop.
32,180

Freeway Complex Post-Fire Hazard Awareness Map

CA-ORC-075221

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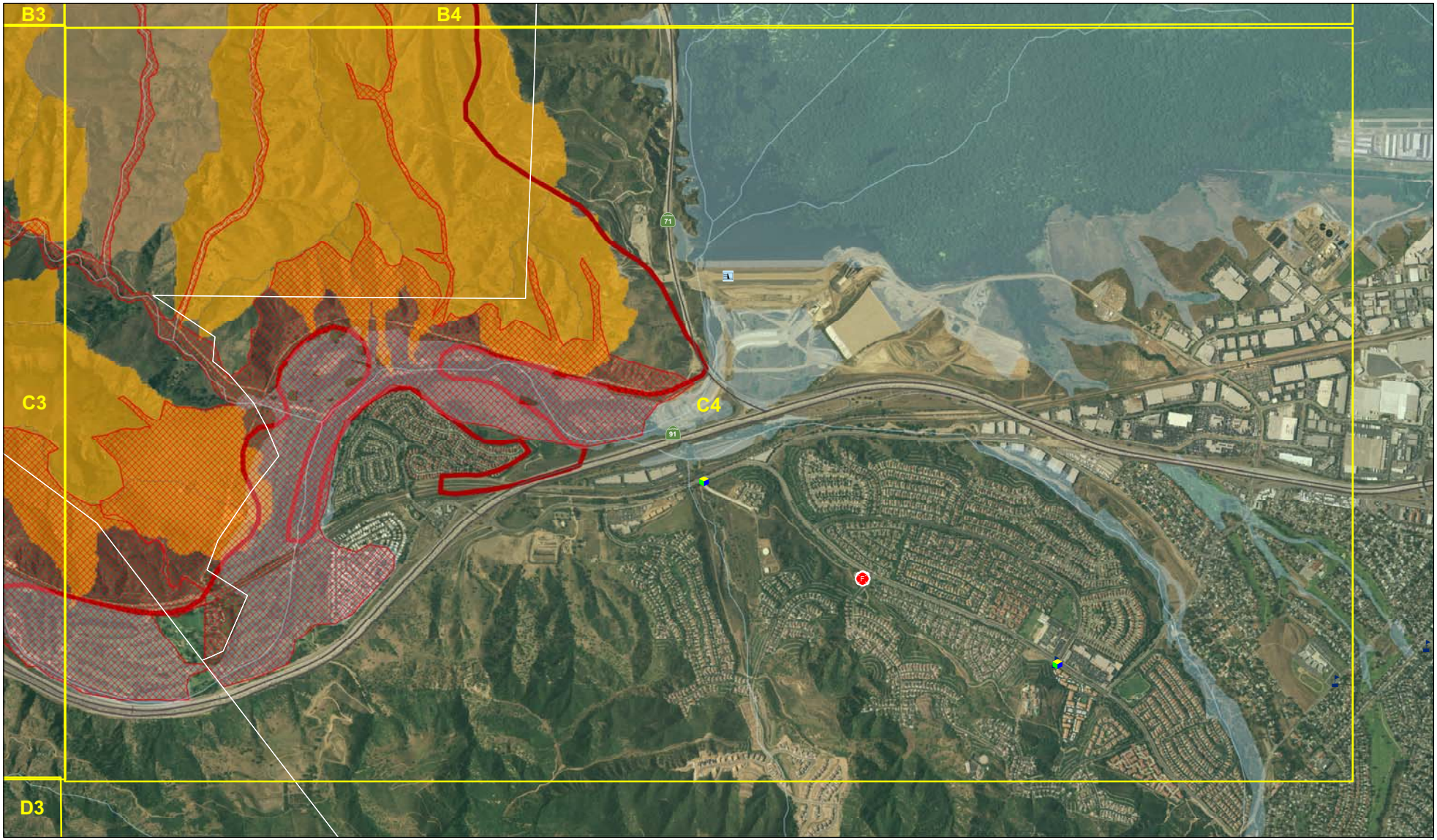
Page #
C4



LEGEND

- Populated Places
- Bus Stations
- Daycare Facilities
- EMS
- Hospital
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- Police
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- Fire Perimeters
- Potential Debris Flow Risk Areas

USGS Potential Debris Volume

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- 1,001 to 10,000 cubic meters
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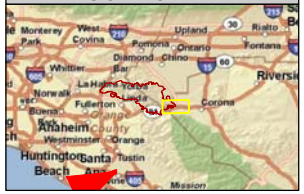
LOCATION MAP



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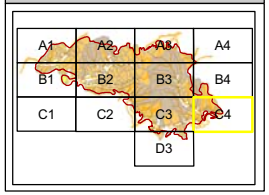

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Author: DHuls - OES Gis Unit
Version: Final

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Populations estimated using 2007 Census data and are calculated for those areas only within the grid index.

Total Pop.
15,554

Freeway Complex Post-Fire Hazard Awareness Map

CA-ORC-075221

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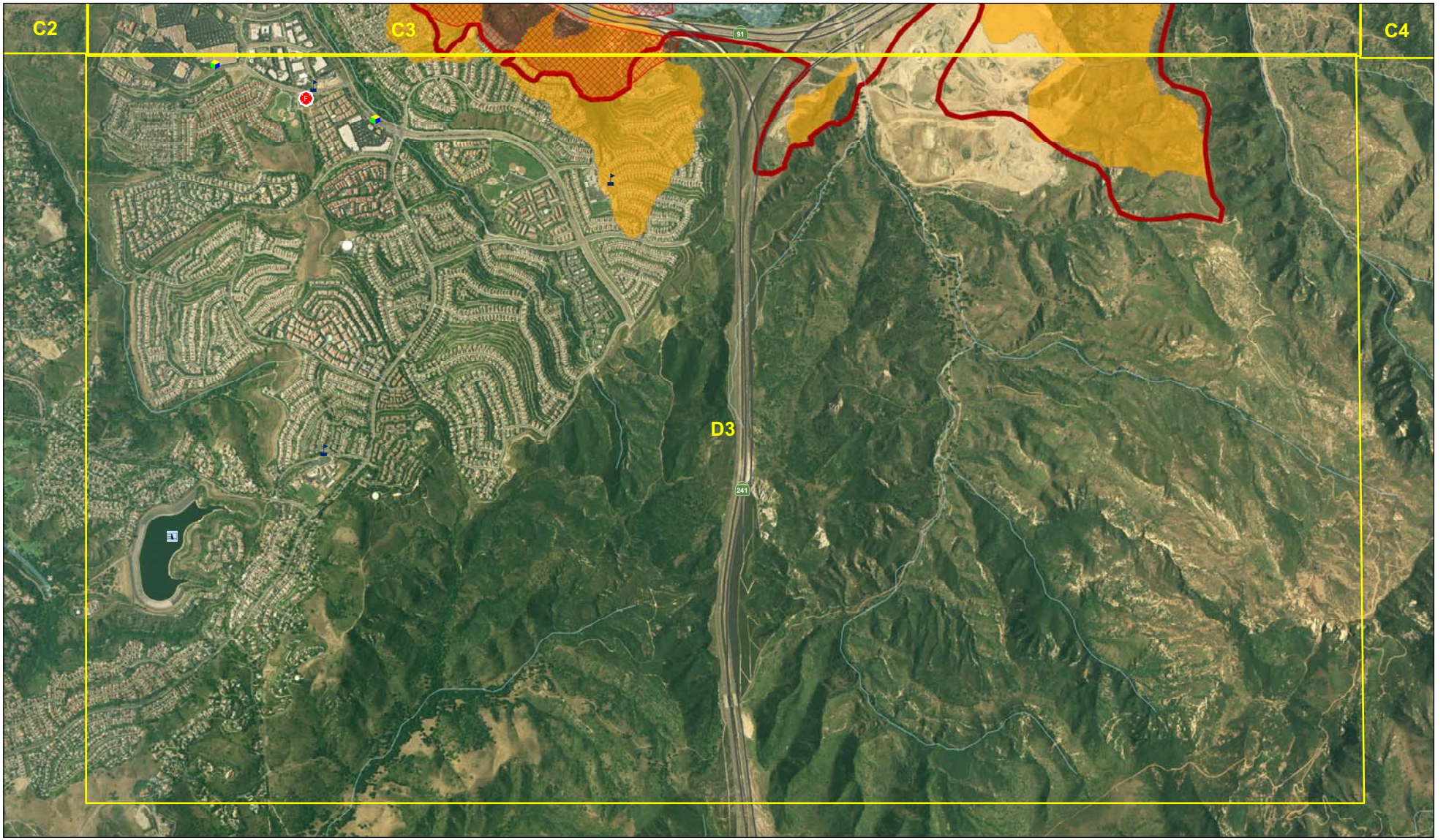
Page #
D3



LEGEND

- Populated Places
- Bus Stations
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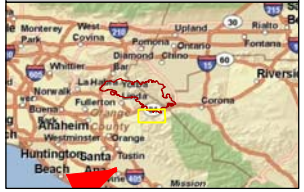
- Police
- Dam
- Red Cross
- Colleges Universities
- FEMA Flood Hazard Areas
- Fire Perimeters
- Potential Debris Flow Risk Areas

USGS Potential Debris Volume

- 0-1,000 cubic meters
- 1,001 to 10,000 cubic meters
- 10,000 to 100,000 cubic meters

LOCATION MAP



INDEX MAP

A1	A2	A3	A4
B1	B2	B3	B4
C1	C2	C3	C4
		D3	

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S

0 0.5 1 Kilometers

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State of California
Office of Emergency Services
Date Created: 12/06/2008
Author: DHuls - OES Gis Unit
Version: Final

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ATTACHMENT B

United States Department of the Interior

GEOLOGICAL SURVEY

Geologic Hazards Team

MS 966, Box 25046

Denver, Colorado 80225-0046

12 December, 2008

At the request of the State Office of Emergency Services, we performed an emergency assessment of debris-flow hazards from the area burned by the Freeway Fire of 2008. This approach uses tools developed specifically for post-fire debris flow processes, and addresses two of the fundamental questions in debris-flow hazard assessments: where might debris flows occur and how big might they be?

A statistical-empirical model was used to calculate the probability of debris-flow production from individual drainage basins in response to a given storm event. This model was developed using logistic regression analyses of a database from 337 basins located in 13 recent burned areas in southern California (Rupert and others, in press). The model describes debris-flow probability as a combined function of areal burned extent, soil properties, basin characteristics and rainfall. A similar statistical model was used to estimate the volume of material that may issue from a basin mouth in response to the same storm. This model was developed using multiple linear regression analysis of a database from 56 basins burned by eight fires throughout the intermountain west and southern California (Gartner and others, 2008), and describes debris-flow volume as a function of the basin gradient, aerial burned extent and storm rainfall. In this assessment, the probability and volume relative rankings are combined to calculate a 'Relative Hazard Ranking'. The 'Combined Relative Hazard Ranking' identifies a possible spectrum of responses that range from basins that are most prone to the largest debris-flow events to basins with the lowest probabilities of producing small events.

The models were implemented using the mapped burn severity distribution of the Freeway Fire provided by USDA Forest Service and a 10-year recurrence, 3-hour duration storm of 2.0 inches (NOAA Technical Paper No. 40) to calculate the probability that a given basin will produce debris flows, to calculate an estimated volume of the possible debris-flow response at the basin outlet, and to determine a 'Combined Relative Hazard Ranking'.

Three values are included in the shapefiles sent along with this report. PCODE provides the ranked value of the probability of debris flow calculated for each basin. Calculated probabilities between 1 and 20 percent are assigned a ranking of 1; probabilities between 21 and 40 percent receive a ranking of 2; probabilities between 41 and 60 percent are ranked as 3; probabilities between 61 and 80 percent are ranked as 4; and probabilities between 81 and 100 percent receive a ranking of 5. VCODE provides the ranked value of calculated volume of material that can potentially issue from the basin mouth. Volumes between 1 and 1000 cubic meters are assigned a ranking of 1; volumes between 1,001 and 10,000 cubic meters are ranked as 2; volumes between 10,001 and 100,000 cubic meters are ranked as 3; and volumes greater than 100,000 cubic meters are assigned a ranking of 4. COMBINED is the sum of PCODE and VCODE, where a ranking of 9 indicates an extreme relative hazard, 7 and 8 indicate a 'very high' degree of hazard, 5 and 6 indicate a 'high' degree of hazard, 3 and 4 indicate 'moderate' hazard and 1 and 2 indicate a 'low' relative hazard.

Of the 211 basins evaluated, probabilities greater than 80 percent were calculated for two basins, and probabilities between 60 and 80 percent were calculated for 82 basins. The remaining basins showed probabilities of less than 60 percent.

Calculated debris-flow volumes ranged between 400 m^3 and 32,000 m^3 in response to the 10-year recurrence, 3-hour duration storm. Debris-flow volumes greater 10,000 m^3 were calculated for 13 basins and volumes between 1,001 m^3 and 10,000 m^3 were calculated 184 of the basins evaluated. Debris flows within this range of volumes pose significant hazards to life and property.

The Combined Relative Hazard Rankings determined for each basin were either 'low', 'moderate', 'high' or 'very high'. None were classified with an 'extreme' relative ranking. The seven basins identified with a 'very high' ranking are those basins that are most likely to produce the largest events.

In addition to the hazards identified here, areas downstream from the defined basin outlets are at risk. There is a great possibility of culverts and bridges plugging or being overwhelmed, and of roads washing out. Debris flows can travel long distances over fairly gentle slopes and neighborhoods, buildings, roads and bridges located along drainages within or below the burned basins can be impacted by debris flows. Material transported in fast-moving debris flows presents a considerable hazard to residents, motorists, cyclists and pedestrians. Burned basins above identified 'values at risk' will require appropriate mitigation or warning efforts.

The potential for debris-flow activity decreases with time as revegetation stabilizes hillslopes and material is removed from canyons. A compilation of information on post-fire runoff events reported in the literature from throughout the western United States indicates that under normal rainfall conditions most debris-flow activity occurs within about 2 years following a fire (Gartner and others 2005). If dry conditions prevent sufficient re-growth of vegetation, this recovery period will be longer. We conservatively expect that the maps presented here may be applicable for approximately 3 years after the fires, given the magnitude and duration of precipitation considered in the models. Storms with greater rainfall accumulations, intensities or durations may present more severe hazards than those depicted here. Further, the assessments presented here are specific to post-fire debris flows; significant hazards from flash flooding can remain for many years after a fire.

The parameters included in the models are considered to be possible first-order effects on debris flow generation that can be rapidly evaluated immediately after a fire in southern California. Other conditions than those used in the models may also affect debris-flow production from recently burned basins in northern California. However, data necessary to evaluate these effects in this setting are not currently available.

And lastly, this work is preliminary, is subject to revision, and has not been fully reviewed and approved by the USGS Director. It is being provided due to the urgent need for timely "best science" information.

Sincerely,

Susan H. Cannon
Research Geologist

ATTACHMENT C

Freeway Complex Fire Pictures

3 ft. culvert crossing near golf course in Yorba Linda.

Construction of energy dissipater.

Upstream of energy dissipater.

Looking down into constructed energy dissipaters.
(Near Scully Hill).

Freeway Complex Fire Pictures (cont.)

Culvert with sediment. Crosses RR and discharges into small debris area near parking lot (see next picture)

Discharge side of culvert. Note sediment loaded into bins from parking lot.

Note slight rilling on hillside from last rain event.

Homes with protective plastic to protect property. This practice increases flow to base of watershed.

Freeway Complex Fire Pictures (cont.)

Banyon Rim active slide.

Sand bags in water shed west of Banyon Rim

Use of K-rail to channel future debris flow around homes.

View of Stonehaven Dr. from helicopter.

DRAFT TECHNICAL SPECIALTIST'S REPORT
BURN AREA RECOVERY TEAM (BART) Report

Resource: Geotechnical

Fire Name: Freeway Complex CA-ORC-075221 November 2008

Author Name: Quanyan Liao, Certified Civil Engineer (No. C68870)
California Department of Transportation
100 S. Main Street,
Los Angeles, CA 90012
Office (213) 620-2662

Jonathan Mulder, Certified Engineering Geologist (No. 1352)
California Department of Water Resources
2440 Main Street
Red Bluff, CA 96080

I. Resource Condition Assessment

A. Resource Setting

The Freeway Fire occurred in the area generally known as the Chino Hills. The Chino Hills are bounded on the northeast by the Chino Basin and on the southwest by the East Coastal Plain. The Chino Hills blend to the northwest into the lower lying Puente Hills. The Santa Ana River flows southwesterly from the Chino Basin along the Santa Ana River Canyon into the East Coastal Plain. A general location map of the Freeway Fire is located in Appendix III.

Brea Creek originates north of the SR 91 Freeway Fire and drains southwestwardly through the fire perimeter on the western side. Carbon Canyon Creek originates primarily in the central portion of the fire and drains southerly to the Santa Ana River. The Aliso Creek drainage occupies the majority of the eastern portion of the fire and drains directly into the Santa Ana River.

The Chino Hills State Park comprises a large bulk of the Chino Hills. The Freeway Fire encompassed 30,305 acres, with 13,400 acres burned within the park boundary. Approximately 95% of the park property was within the fire boundary.

The Chino Hills are bounded on the south by the Whittier Fault Zone and on the northeast by the Chino Fault. Both fault zones merge to the southeast into the Elsinore Fault Zone. Structurally, the area is a broad southeast-plunging anticline with progressively older formations exposed to the southeast.

The age of the formations within the Freeway Fire perimeter ranges from late Holocene to Upper Cretaceous (See Table I attached to the report). Nearly two-thirds of the burn

area is underlain by the Puente Formation, which is subdivided into four members. The age of the formation becomes progressively older from west to east as lower members of the Puente Formation are exposed in the plunging anticline.

As shown on the Geologic Map (Appendix III), over 20% of the burn area is identified as landslides or young landslides. Landslides, whether active or inactive, may be adversely affected as a consequence of the fire removing the vegetative canopy and grass cover, decreasing the reinforcing effect of roots.

This assessment is an evaluation of geotechnical conditions in burned areas upslope and downslope to buildings, public infrastructure, drainage system, and other features which may be exposed to risk after fire. The areas evaluated are located in the City of Yorba Linda, Anaheim, Brea, and Chino Hills. No geotechnical concern was noted for the City of Corona, Diamond Bar, and Industry and therefore, no geotechnical assessment was made for these areas.

B Survey Methods

A helicopter reconnaissance of the eastern and central portions of the burn area was conducted on December 4, 2008. The purpose of the flight was to identify areas of high value that were at potential risk due to the effects of the fire. High value areas are defined as locations that are at risk for possible loss of life and property due to in-channel floods, hyperconcentrated floods, debris torrents, debris flows, slope-generated landslides, rock fall, and associated slope movement. Areas that contained concentrations of homes, businesses, and public infrastructure received the greatest attention. Following the initial reconnaissance, road and foot inspections were conducted in the high value/high risk areas from December 5 to 11, 2008. Road-related features, such as culverts and bridges, were surveyed at major drainage crossings by hydrology and bridge members in this team.

II. Findings of the On-The-Ground Survey (Observations)

A. Identify Values at Risk

The principal concern with the Freeway Complex Fire is the increase of potential threat to life, property and other features which are located nearby or close to the post-fire hazards. Potential post-fire hazards include in-channel floods, hyperconcentrated floods, debris torrents, and debris flows that can occur immediately after fires in response to high intensity rainfall events. The primary mechanisms for this are the loss of mechanical support of hillslope materials that were provided by vegetation and vegetative litter and the increase in runoff resulting from reductions in interception and infiltration due to the loss of live vegetation, from the simplification of surficial runoff patterns, and from the loss of mechanical support along stream channels where riparian vegetation was burned. Where fires burn hot, such as in Box Canyon, Brush Canyon, San Antonio Road, Carbon Canyon Road, Tonner Canyon, and Santa Ana Canyon Road the reduction in interception may be affected by the development of hydrophobic soils where waxy substances released by

plant materials during hot fires follow thermal gradients into the soil and congeal as continuous surfaces.

B. Specific Observations

Houses, infrastructures (streets, highways, railways, waterlines) and other high-value sites near or within burned areas were assessed to evaluate potential risks from near-site debris flows, flooding, landslides, rock falls, and other geologic hazards. Dry ravel (downslope mobilization of loose bedrock, soils, and sediment wedges accumulated behind vegetation consumed by the fire) was observed on steep slopes at numerous locations within the burnt headwaters. This loose material may become mobilized into sediment laden masses during heavy rains (debris flows and debris torrents) that may flow downstream from the watershed headwater source areas. The magnitude of post-fire damage will be determined by the intensity and duration of storms that impact the burn area, particularly during the winter of 2008-09. It is our understanding that the USDA Forest Service, in concert with the US Geological Survey and CAL FIRE are developing models to assess the potential magnitudes of post-fire events.

Eight (8) high-value at-risk sites, some with multiple homes, are identified as having high risks to lives or property based on our visual observation and need immediate actions. They are briefly described below. Their locations are shown on Detail Map # A-01 through D-03.

1: Banyon Rim Site, Yorba Linda

Map Points: 31 on Detail Map # B-02

Of particular concern is the Banyon Rim site. The site is located above the backyards of houses at the end of Banyon Rim Road. Photographs and anecdotal evidence obtained and viewed during our visit suggest the site is subject to flooding and debris flows during heavy rains. Two exsiting landslides were observed on two of the canyons in this site posing a potential threat to the properties located below the end of Banyon Rim Road and the surrounding area. The landslide at the east side was observed to be moving after the storm rain on November 27,2008. Signs of landslide observed include crown, scarp, transverse cracks, bulging, etc. It is anticipated that the effects of the moderate to high burn severity in the headwater areas that drain to the landslide body will increase and magnify the size and intensity of landsliding, debris flows, and flooding as a function of the severity of this winter and spring rains. The slide area is approximately 150,000 square feet. The toe of the slide is about 150 feet from the backyard of the houses. It is considered unlikely that this narrow space will be able to hold down-moving debris when debris flow does occur. This suggests that houses at the end of Banyon Rim Road and the surrounding area may be impacted by debris flows and flooding during a heavy rain. The City of Yorba Linda has expressed concerns and is aware of this site.

2: Hidden Hills Site, Yorba Linda

Map Points: 42 and 51 on Detail Map # C-02

One of the biggest landslide concerns is the Hidden Hills site. Residential houses toward down-slopes along Hidden Hills Road between Green Mount Place and High Tree Circle are subject to a high potential of landslides. Three exsiting large-size landslides have developed in this site posing potential threat to properties upslope. One home's backyard was observed to have partially failed. Signs of landsliding were observed to include crown, scarp, transverse cracks, bulging, etc. This site is subject to landsliding when water from headwater areas infiltrating into the landslide body increases the driving force and reduces resistance force of the landslide body during a heavy rain. However, the effects of the burn severity in the headwaters areas in relation to the existing landsliding are judged limited. The headwater areas of these exsiting landslides appears to be mostly non-vegetated or sparsely vegetated, and the burn severity appears to be low to moderate.

In addition, the impact of possible debris flow and landsliding to the downhill community at the end of Twilight Canyon Road should be addressed as well. Its impact to this community is described below in item 3.

3: Community at the end of Twilight Canyon Road, Yorba Linda

Map Points: 52 through 55 on Detail Map # C-03

The community located at the end of Twilight Canyon Road is exposed to hazards of debris flow and flooding from slopes at its north and west side.

The community is located at the bottom of the slopes described in item 2, making it vulnerable to debris flow and flooding from these slopes. It is anticipated that the effects of the low to high burn severity in the headwater areas that drain to the bottom of the valley will increase and magnify the size and intensity of landsliding, debris flows, and flooding as a function of the severity of this winter and spring rains. A narrow basin with a dimension of approximately 30 feet by 50 feet was observed at the bottom of these slopes with a diverting earthdike and some K-rails in an attempt to divert the possible debris flow to a larger basin to the east. However, the narrow basin with the diverting earthdike and K-rails are not likely to have enough capacity to hold the down-moving mud if debris flow does occurs, considering the size of landslides upslope.

It should also be noted that the earthdike and K-rails could be blocked by another exsiting landslide right above the earthdike between the basin and the other (larger) basin to the east. The City of Yorba Linda should be made aware of this landslide and request them to implement some immediate measures to prevent this particular landslide from blocking the diverting channel.

Slopes at the community's west side were observed to be severely burned. Soil on these slopes shows high erodibility. A portion of these slopes also show signs of distress including irregular shape, tilted trees, and bulging. Erosion and flooding were observed to be severe during a storm time visit to the site in November of 2008; drop inlets were found to be blocked; PVC pipe was broken; silt fence was not continued (a 50 feet gap); the silt fence was in bad maintenance condition; no erosion control on the slopes. Impacts to the Community from increased potential of debris flow and flooding during a heavy rain appear highly likely.

4: Mission Hills Site, Yorba Linda

Map points: 50 on Detail Map # C-03

Along Mission Hills Lane between Brentwood Place and Skyline Drive, three exsiting landslides on down-slopes have developed in this area. These slides have the potential to adversely affect the house properties toward the slopes. Signs of landslide were observed to include crown, scarp, transverse cracks, bulging, etc. This site is subject to landsliding when water from surrounding area infiltrating into the landslide body increases and magnifies the size and intensity of landsliding as a function of the severity of this winter and spring rains. However, the effects of the burn severity in the headwater areas to the exsiting landsliding are judged limited. The headwater area of these exsiting landsliding appears to be sparsely vegetated, and the burn severity appears to be low to moderate.

In addition, the effect of hazards from potential debris flow and flooding to the downhill Burlington Northern Santa Fe (BNSF) railway track should be addressed as well. Its impact to the railway track is described below in item 5.

5: BNSF Railway Horseshoe Bend Section, Yorba Linda

Map Points: 62 through 65 on Detail Map # C-03

Exsiting severe erosion, medium to large landslides and rockfall potential were observed in this section that could impact the railway tracks and downhill commercial structures. A total of five exsiting landslides (including the landslides described in item 4) were observed on the upslopes of this section. It is anticipated that the effects of the moderate to high burn severity in the headwater areas that drain to this area will increase and magnify the size and intensity of flooding, landsliding, rock fall, and debris flows to the railway tracks and downhill commercial buildings when a heavy rain occurs. It should be noted that Metrolink and Amtrak passenger cars pass this railway section daily. We understand the BNSF railway has taken some temporary measures to protect the railway tracks at some in this area.

In addition, a residential house in this area located at the top of the cliff (Map points 65 on Detail Map # C-03) was observed to have developed severe erosion (deep incised gullies) and a portion of the backyard was eroded away. The house is exposed to hazards of severe erosion and potential slope instability or landsliding due to the severely erodible soil.

6: Avenida De Marcia Site, Yorba Linda

Map points: 58 and 59 on Detail Map # C-03

Approximately 26 houses toward down-slopes along Avenida De Marcia between Avenida De Kristine and Avenida De Michelle, and toward down-slopes on Avenida De Kristine and Avenida De Michelle are subject to high likelihood of rock and earth falls, severe erosion, and possible slope instability. These houses' backyards are located at the top of the exsiting slopes. The slopes are nearly vertical, approximately 100 to 200 feet high, and with high soil erodibility. The soil on the slopes appears to be very loose. Severe soil erosion (deep incised gullies and surficial sliding) was observed along the slopes affecting some of the backyards. The houses are exposed to hazards of severe erosion and potential slope instability or landsliding due to the severely erodible soil. The effects of the burn severity to the exsiting slopes are judged very limited. Only sporadically burned bushes were observed on the near-vertical slopes.

7: Santa Ana Canyon Road Site, Anaheim

Map points: 75 through 82 on Detail Map # C-03

Along Santa Ana Canyon Road between Woodcreek (approximately half a mile east of the Weir Canyon Road) and the entrance to Kindred Community Church, six exsiting and active landslides were observed that could impact Santa Ana Canyon Road and SR 91 Freeway. Signs of landslide were observed to include crown, scarp, bulging, rock falling, etc. Piles of mud and fallen rocks were observed on the eastbound side of the Weir Canyon Road. Potential hazards of debris flows and flooding to the roadways are anticipated when a heavy rain occurs. In addition, another landslide above the first bench in this area (Map points: 77 on Detail Map # C-03) was observed to block the concrete V-ditch and should be repaired. It is anticipated that the effects of the high burn severity in the headwater areas that drain to this area will increase and magnify the size and intensity of flooding, landsliding, rock fall, and debris flows when a heavy rain occurs.

8: 57 Freeway between Lambert Road and Tonner Canyon Road, Brea

Map points: 02 through 05 on Detail Map # A-01

Along the 57 Freeway on both north and southbound lanes between East Lambert Road and Tonner Canyon Road, hydroseeding has already been applied by Caltrans on slopes at both sides of the freeway. The soil on the slopes appears to be very loose. It was observed that at portions where straw check dams were applied, light erosion with shallow gullies was observed. At portions where no straw check dams were placed, severe erosion with deep gullies was observed on the hydroseeding treated slopes, or in some area shallow landslides have developed. The effect of possible mudflow and flooding to the roadway appears likely when a heavy rain occurs. However, the effects of the burn severity in the headwater areas to the exsiting landsliding are judged very limited. Sporadically burned bushes were observed on the slopes.

9: Carbon Canyon Rd (Route 142), Brea

Map Points: 11, 14, 15, 29 on Detail Map # B-01 and B-02

Exsiting severe erosion, surficial sloughing and rockfall potential were observed along Carbon Canyon Road that could impact the roadway, creek and drainage structures. It is anticipated that the effects of the moderate to high burn severity in the headwater areas that drain to road will increase and magnify the size and intensity of flooding and debris flows when a heavy rain occurs. Caltrans is aware of this road situation and has put much effort on maintaining this thoroughfare.

10: Metropolitan Water District of Southern California Waterline

Map Points: 41, 45, 46, 47 on Detail Map # C-02

Exsiting landsliding and/or severe erosion were observed at several locations along the Metropolitan Waterline that could impact the waterline. It is anticipated that the effects of the moderate to high burn severity in these areas will increase and magnify the soil erodibility when a heavy rain occurs. We understand the Metropolitan Waterline has taken some temporary measures to protect the waterline at some locations.

III. Emergency Determination

The values at risk considered in this assessment include the possible loss of life and property due to landsliding, debris flow, rock fall, debris torrents, and flooding from increased surface water runoff. In general, the risk from landslides, debris flows and rock falls are possible where roads, residences or other development are located

within and/or adjacent to canyon slopes or on alluvial fans, colluvial footslopes and debris flow deposits.

It should be noted that these hazards are part of the natural processes in this environment, and that these risks were present under pre-fire conditions. Many exsiting structures in the burn area have been and will continue to be at risk from these hazards. The potential for these processes to be exacerbated by fire is primarily dependent upon burn severity and slope steepness, both of which are highly variable in the Freeway Complex Fire area. In general, where the burn severity is moderate to high and the slopes are steep, the potential for increased hazard from flooding, debris flow and/or mudflow is greatest.

As stated before, because most of these areas are inhabited year round (Item 1 through 10 in Specific Observations described above), we believe these areas constitute an exigency, *a* ***sudden crisis involving a high risk to life that requires immediate action.***

In addition, the potential for increased hazard and need for immediate attention is also present downstream of large watersheds that experienced high and moderate burn severity throughout the majority of the headwaters of the watershed, such as the residential communities along the San Antonio Road, Box Canyon and other large watershed areas. This situation is covered in detail by the Hydrology portion in this report.

Risks to hydrological, soil and biologic assets are covered in other specialist reports. Areas with high potential risks to life and property from slope instabilities exsit elsewhere in or within the vicinity of the Freeway Complex Fire, but are not affected by the fire are beyond the scope of this assessment.

IV. Recommendations

A. General Recommendations:

1. The site-specific observations included with this review should be considered in any emergency response plan develop by emergency agencies.
2. Communities located downstream from areas where large portions of watersheds were burned, and communities affected by large landslide sites, should be notified of the potential risks of rockfall, rockslide, landsliding, debris flow and flooding.
3. The exsiting drainage systems should be inspected by the appropriate controlling agency to evaluate potential impacts from floods, hyperconcentrated floods, debris torrents, debris flows and sedimentation resulting from winter rains. It is understood that temporary erosion control has been implemented in some locations within the burnt area including spots at San Antonio Road, Fairmont Blvd, Box Canyon, Brush Canyon, Dorinda Road, BNSF railway horseshoe bend sections and Metropolitan Water District (MWD) waterlines. It is also understood that the Banyon Rim Road is a private road. Those that have juristictional control

over the Banyon Rim Road should be contacted and informed of potential risks to the residents.

4. California State Parks, Orange County Flood Control District, Department of Public Works, City and County Fire Departments, The State, County and City Offices of Emergency Services, the Natural Resources Conservation Service, the Burlington North Santa Fe Railway (BNSF Railway), the Metropolitan Water District of Southern California, impacted cities and counties and any other responsible party should be made aware of the potential hazard to lives and property within the fire area. Areas of special concern are the communities at the end of Twilight Canyon and Banyon Rim road, along San Antonio Road, Hidden Hills Road, Mission Hills Lane and the BNSF railway. Emergency response plans including ALERT (Automated Local Evaluation in Real Time) early warning systems and evacuation plans should be developed by emergency agencies.
5. Campgrounds and hiking trails should be signed and closed as needed by the responsible agencies and/or private organizations to protect those that utilize these resources.
6. The county health department and/or other similar agency should be made aware of possible increases in bacteria levels in water supplies. Potable water may have to be supplied to affected areas for extended periods of time.
7. Areas Not Assessed
   Assessment of all properties within the burn area is beyond the scope of this review. Any properties not included in this report and summary table should be visited by emergency response agencies and/or community groups in an effort to provide further assessment and advise those property owners.

B. Specific Recommendations:

The following sites have been identified based on helicopter reconnaissance, road and foot inspections. Based on field visual observations, it is our opinion that the following sites could be adversely impacted by debris flows, mudflows, landsliding, flooding and/or rockfall hazards and they require immediate attention. They should be evaluated by Professional Geologists or Professional Geotechnical Engineers with experience in slope stability and debris flow hazard identification and mitigation to fully document the scope of the problems at each site.

1: Banyon Rim Site, Yorba Linda

In order to minimize loss of life, the Banyon Rim Site should not be inhabited during winter and spring storms. Because of the high potential of debris flow and flooding, evacuation should begin well before (days before) rainfall impacts the area. Signs should be posted to warn residents of pending risks and danger. Orange County, the City of Yorba Linda, Department of Public Works, Local Fire Departments, and Office of Emergency Services, and any other responsible party should be made aware of the potential hazard to lives and property in the Banyon

Rim location. Emergency response plans, including early warning systems and evacuation plans, should be developed by emergency agencies.

We recommend that a comprehensive geotechnical investigation be conducted to determine the characteristic and geometry of the landslides. As an interim measure we recommend monitoring (visual inspection, survey points, GPS points, etc.) of the slides.

2: Hidden Hills Site, Yorba Linda

Because the high potential of landsliding and debris flow, evacuation should begin well before (days before) rainfall impacts the area. Signs should be posted to warn residents of pending risks and danger. All associated agencies should be made aware of the potential hazard to lives and property in the Hidden Hills location. Emergency response plans and evacuation plans, should be developed by emergency agencies.

We recommend that a comprehensive geotechnical investigation be conducted to determine the characteristic and geometry of the landslides. As an interim measure we recommend monitoring (visual inspection, survey points, GPS points, etc.) of the slides.

3: Community at the end of Twilight Canyon Road, Yorba Linda

This community is exposed to hazards of debris flow and flooding from slopes at its north and west side. The City of Yorba Linda is aware of this site; the capacity of the exsiting basin at its north side needs to be checked; measures needs to be taken to stabilize the exsiting landslide in the middle portion between the basin and adjacent basin to the east in order to prevent it from blocking the diverting channel.

For the east-facing slopes, we recommend that the following temporary measures be taken:

- Detailed study of the east-facing slope with irregular shape and bulging
- Apply erosion control on the slopes
- Cleaning of the clogged drop inlets and protect them
- Repair and maintenance of the silt fence and closing of the exsiting gap
- Placement of sandbags and K-rails for run-off control
- Divert water run-off

Any associated agencies should be made aware of the potential hazard to lives and property in this location. Emergency response plans, including early warning systems and evacuation plans, should be developed by emergency agencies.

4: Mission Hills Site, Yorba Linda

Four exsiting landslides have been observed in this area. The slides have the potential of landsliding to adversely affect the properties on upslopes. In addition, there is a potential of downhill mudflow that could impact the railway tracks. We also recommend that a complete geotechnical investigation be conducted at this site.

5: BNSF Railway Horseshoe Bend Section, Yorba Linda

Five exsiting landslides were observed in the upslopes in this section. The railway tracks in this section subject to high potential of debris flows and flooding. Any associated agencies or those that utilize BNSF Railway lines should be made aware of the potential hazard to lives and property in this location. Emergency response plans, including early warning systems and evacuation plans, should be developed by responsible agencies. A comprehensive geotechnical investigation needs to be performed for long-term performance, and temporary measures should be taken immediately to prevent the potential blocking of the railroad tracks and flooding of the downhill commercial structures. Temporary measures could include:

- Widening and cleaning of the exsiting basins
- Constructing new basins in portions of this area where high potential of debris flow exsit but basins are not currently built
- Diverting surface run-off
- Placing sandbag or rock check dams to catch deposit and to deflect possible mudflow or debris flow
- Applying erosion control on the slopes
- Construction of slough walls

In addition, a residential house in this area located at the top of the cliff (Map points 65 on Detail Map # C-03) was observed to have developed severe erosion (deep incised gullies and suficial sliding) and a portion of the backyard was eroded away. The house is exposed to hazards of severe erosion and potential slope instability or landsliding due to the severely erodible soil. Since the slope at this location is right above the railway, a landsliding failure could block the railway track and pose severe threat to the Metrolink and Amtrak passenger cars. Erosion control measures should be taken to prevent further erosion on the slope. We would also recommend installing slope indicators (SI's) at the top of the slope to monitor any slope movement. A detail geotechnical study needs to be performed for long-term performance.

6: Avenida De Marcia Site, Yorba Linda

Severe soil erosion (deep incised gullies and surficial sliding) was observed along the slopes adversely affecting house properties on upslopes. Erosion control measures are recommended to protect the slope face through the rainy season with

erosion control mats. We would also recommend installing slope indicators (SI's) at the top of the slope to monitor any slope movement which might occur and monitor through the rainy season into spring and summer. Initially four times a month and then once a month if no significant slope movement is detected in the first few readings. A detail geotechnical study needs to be performed for long-term performance.

7: Santa Ana Canyon Road Site, Anaheim

Piles of mud which slid to the side of the roadway should be cleaned. Protective measures such as erosion control should be taken as soon as possible to prevent the potential of mudflow, debris flow and flooding from entering the roadway. The blocked V-ditch should be cleaned. Failed slopes should be repaired or regraded to prevent further mud movement to the roadway. A detail geotechnical study needs to be performed for long-term performance.

8: 57 Freeway between Lambert Road and Tonner Canyon Road, Brea

Erosion control measures such as straw check dams, K-rails or sandbag check dams need to be applied and/or reinforced on the hydroseeding treated slopes. The failed portion should be repaired. For long-term performance, a detail geotechnical study needs to be performed and retaining walls could be a viable option.

9: Carbon Canyon Rd, Brea

Erosion control measures such as straw check dams, sandbags, rock check dams and K-rails need to be applied and/or reinforced on the slopes. For long-term performance, a detail geotechnical study needs to be performed and retaining walls could be a viable option option.

10: Metropolitan Water District of Southern California Waterline

We understand the Metropolitan Water District has taken some temporary measures to protect the waterline at some locations. Generally, erosion control measures such as sandbags, rock check dams, and erosion control mats need to be applied and/or reinforced on affected points. Specifically,

- for the waterline at the location of Map point 45 on Detail Map # C-02, sandbag check dams can be placed or a concrete v-ditch can be constructed above the landslide headscarp to divert runoff water and debris from entering the exsiting landslide body;
- for the waterline at the location of Map point 46 on Detail Map # C-02, sandbag check dams and erosion control mats can be placed to divert runoff water and debris from entering the exsiting erosion gully;
- for the waterline at the location of Map point 47 on Detail Map # C-02, exsiting sandbag check dams need to be reinforced;

- for the waterline at the location of Map point 41 on Detail Map # C-02, sandbag check dams and erosion control mats can be placed to divert runoff water and debris from entering the exsiting erosion gully.

Table I – Geologic Formations within the Freeway Fire Perimeter

Formation Name	Description	Acreage Within Fire Perimeter	Percent Of Fire Area
Artificial Fill Late Holocene)	Deposits of fill resulting from human construction, mining, or quarrying activities.	136	0.4%
Wash deposits (Late Holocene)	Unconsolidated boulder to sandy alluvium of active and recently active washes.	197	0.7%
Landslide deposits (Late Holocene)	Highly fragmented to largely coherent active landslides. Unconsolidated to consolidated. Most mapped landslides contain scarp area as well as slide deposit. Many originated in Pleistocene and all or part were reactivated during Holocene.	82	0.3%
Young wash deposits. (Holocene and latest Pleistocene)	Unconsolidated bouldery to sandy alluvium of active and recently active washes.	1	0.0%
Young Alluvial fan deposits (Holocene and latest Pleistocene)	Unconsolidated deposits of alluvial fans and headward drainages of fans. Consists predominantly of gravel, sand, and silt.	1375	4.5%
Young axial channel deposits. (Holocene and latest Pleistocene)	Fluvial deposits along canyon floors. Consists of unconsolidated sand, silt, and clay-bearing alluvium.	850	2.8%
Young landslide deposits (Holocene and latest Pleistocene)	Highly fragmented to largely coherent active landslides. Unconsolidated to consolidated. Most mapped landslides contain scarp area as well as slide deposit. Many landslides in part reactivated during late Holocene.	6161	20.3%
Old axial channel deposits (Late to middle Pleistocene)	Fluvial sediments deposited on canyon floors. Consists of moderately indurated, commonly slightly dissected gravel, sand, silt, and clay-bearing alluvium.	118	0.4%
Very old alluvial fan deposits (early Pleistocene)	Mostly well-dissected, well indurated, reddish-brown alluvial fan deposits. Grain size chiefly sand and gravel.	364	1.2%
Very old axial channel deposits (early Pleistocene)	Fluvial sediments deposited on canyon floors. Consists of moderately to well-indurated, reddish-brown, mostly very dissected gravel sand, silt, and clay-bearing alluvium.	344	1.1%
La Habra	Nonmarine mudstone, fluvial sandstone, and	77	0.3%

(Pleistocene)	conglomerate		
Fernando Formation (Pliocene)	Marine siltstone, sandstone, pebbly sandstone, and conglomerate	786	2.6%
Sandstone and conglomerate in southeastern Chino Hills (early Pliocene and Miocene)	Poorly exposed marine and nonmarine sedimentary sandstone and conglomerate in the Arena Blanca syncline area of southeastern Chino Hills.	710	2.3%
Puente Formation (Early Pliocene and Miocene	Marine, sandstone, siltstone, and shale. Divided into four members: Sycamore Canyon Member (early Pliocene and Miocene) – Predominantly sandstone and pebble conglomerate. Yorba Member (Miocene) – Silstone and sandstone; siltstone predominates. Soquel Member (Miocene) – Sandstone and siltstone; siltstone predominates. La Vida Member (Miocene) – Siltstone and subordinate sandstone.	18440	60.8%
Topanga Formation (middle Miocene)	Marine sandstone, siltstone, and shale.	283	0.9%
Vaqueros and Sespe Formation, undifferentiated (early Miocene, Oligocene, and late Eocene)	Interbedded marine and nonmarine sandstone and conglomerate assigned to the Sespe and Vaqueros Formations.	287	0.9%
Silverado Formation (Paleocene)	Nonmarine and marine sandstone, siltstone, and conglomerate.	92	0.3%
Williams Formation, Schulz Ranch Member (upper Cretaceous)	Massive-bedded, very resistant, cliff-forming sandstone.	3	0.3%

DRAFT TECHNICAL SPECIALTIST'S REPORT
BURN AREA RECOVERY TEAM (BART) Report

Resource: Bridges

Fire Name: Freeway Complex CA-ORC-075221 November 2008

Author Name: Jeff Johnson, P.E.
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I. Resource Condition Assessment

A. Resource Setting – The 30,305 acre Freeway Complex Fire burned large swaths of Chino Hills State Park and small pockets on the fringe of surrounding neighborhoods of Anaheim, Brea, Yorba Linda, Diamond Bar and Chino Hills. The geography consists of steep hills and valleys bordered by alluvial fans and the Santa Ana River and Flood plain to the South.

B. To evaluate the risk to life and property, a vehicle reconnaissance was conducted on December 2 and 3. On the first tour we traveled north on route 90 (Imperial Hwy) to route 142 (Carbon Canyon), East, to route 71 (Chino Valley Freeway), South, up Bane Canyon, down Aliso Canyon, West on Santa Ana River Trail to Green River Road, West on route 91 (Artesia Freeway) and back to Imperial Hwy. The second day was spent investigating local agency bridges crossing the Santa Ana River between Imperial Highway and Gypsum Canyon as well as the retaining wall structure for the BNSF rail just East of Gypsum Canyon road as outlined in Appendix 1.

C. Findings of the on site inspection are: 1) one wood bridge in Aliso Canyon sustained burned hand railing on the West side of the bridge. 2) There are pockets of trees along the Santa Ana river flood plain East of Yorba Linda Blvd. to Green River Road. The trees have grown up to 30' in height, and were burned in the fire. It is anticipated that over time the trees which have died in the fire will be uprooted by floods. There is no anticipation that the trees will pose a damming threat at the bridges due to the wide spacing of the piers. There is the likelihood that drift will form a debris jam by anchoring on the individual piers of the bridges. The result could cause local scour at the bridge piers.

II. Emergency Determination – The risks are very low and do not pose an emergency.

III. Discussion/Summary/Recommendations – 1) The railing on the wood bridge in Aliso Canyon should be replaced. The estimated cost is $ 1600.00. 2) The bridges along the Santa Anna River should be periodically monitored for the build up of jam debris. Gideon Werrede with the California Department of Transportation, Office of Structures Maintenance Investigation, was contacted on December 4, 2008, and notified of the situation. He is responsible for the FHWA mandated biannual inspections for local agency bridges in the area. He can be reached at (213) 897-2018.

IV. References – Debris Control Structures Evaluation and Countermeasures - Hydraulic Engineering Circular No. 9
Chapter 2 – Debris Characterization

V. Appendices – Appendix 1- Burn Site Evaluation Summary for Bridges 12/03/2008

BURN SITE EVALUATION SUMMARY FOR BRIDGES IN FIRE AREA
FIRE: FREEWAY COMPLEX
12/03/2008

SITE NUMBER	STREER ADDRESS	GPS LOCATION	AT-RISK FEATURE	HAZARD	RISK
1.	Bridge @ Imperial and Santa Ana River	33 51 28.3 N 117 47 24.5 W	Pier	Drift/Damming	Low-Property
2.	Bridge @ Bike Path	33 51 28.3 N 117 47 00 W	Pier	Drift/Damming	Low-Property
3.	Bridge @ Yorba Linda Blvd.	33 52 29.5 N 117 44 59.9 W	Pier	Drift/Damming	Low-Property
4.	Bridge @ Gypsum Canyon	33 52 25.7 N 117 42 45.1 W	Pier	Drift/Damming	Low-Property
5.	Sheet Pile Retaining Wall @ BNSF Rail Road	33 52 31.0 N 117 41 10.9	Structure	Fire Damage	No Visible Damage

DRAFT TECHNICAL SPECIALIST'S REPORT
BURN AREA RECOVERY TEAM (BART) Report

Resource: Soils

Fire Name: Freeway Complex CA-ORC-075221 November 2008

Author Name: Neil Rambo, Soils Specialist
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I. Resource Condition Assessment

A. Setting

The 30,305 acre Freeway Fire Complex burned public and private lands. This assessment is an evaluation of soil conditions in burned areas upslope to the values at risk. The areas evaluated are located in Chino Hills, northeast and east portions of Yorba Linda, northwest corner of Riverside County, Tonner Canyon, Soquel Canyon and Horseshoe Bend.

B. Survey Methods

This report focuses on soils located in state, county, city and private lands. The Burn Area Recovery Team (BART) evaluated values at risk using soil hydrophobicity tests, slope measurements, vegetation loss estimates and measuring ash depth. The site evaluations were supplemented by reviewing Burned Area Reflectance Classification (BARC) maps, State Park maps, County Soil Survey documents and other specialized reports and maps.

II. Findings of the On-The-Ground Survey (Observations)

A. Identify Values at Risk

The values at risk in this assessment are potential loss of life, property and resources due to mudslides, debris flows and flooding from the steep hillsides The values are located nearby or close downstream of the hazards. Eroding soils, combined with burn severity, and slope steepness, accelerate, intensify and increases the risk from these hazards.

a. Erodible Soils

The erodibility of a soil type influences erosion potential from a sloping area. A soil association is an area that has a specific combination of soil types. Almost all of the burn area is a Soper-Fontana-Calleguas-Balcom-Anaheim Association. There are two narrow strips of Urban land-Sorrento-Hanford Association on the southeast edge and a small area of Zamora-Urban land-Ramona Association at the southwest corner of the burn area.

Map Unit	Map Unit Name	Acres	Percent
s1026	Urban land-Sorrento-Hanford	501	1.7%
s1030	Soper-Fontana-Calleguas-Balcom-Anaheim	29,678	97.9%
s1013	San Miguel-Friant-Exchequer	126	0.4%
	Total	**30,305**	

Association Name	Soil Texture
Urban land-Sorrento-Hanford	clay loam to sandy loam
Soper-Fontana-Calleguas-Balcom-Anaheim	gravelly loam to clay loam
San Miguel-Friant-Exchequer	sandy loam to silt loam

The Orange County and Western Part of Riverside County Soil Survey shows no highly erodible soils in the burn area.

b. Soil Hydrophobicity

BARC maps provided by the United States Geological Survey (USGS) indicated the level of burn severity within the fire boundaries. The levels are no effect, low, moderate and high burn soil severity. High severity burns will alter the way water infiltrates into the soil and can cause an increase in soil erosion. Moderate burn severity can also alter water soil infiltration. Rainfall and runoff carry the eroded soil downhill into water channels, thus increasing the potential for debris flows, mudslides, flooding and rockfall risks.

Burn Intensity	Acres	Percent
No Effect	7,221	23.8%
Low	10,226	33.7%
Moderate	11,856	39.1%
High	1,002	3.3%
Total	**30,305**	

All of the extensive high severity and most of the moderate severity burn areas are distant from values at risk and away from water channels in populated areas.

The intense heat of a fire can form a water-repelling (hydrophobic) layer in the soil. A waxy substance, from burning plant material, penetrates the soil as a gas and solidifies around the soil particles after it cools. This layer forms during extended periods of intense heat where there is abundant plant material to burn. The hydrophobic layer is generally one-half to three inches beneath the soil surface, and is usually an inch or more thick. In the high and moderate-to-high burn severity areas the soil hydrophobicity usually measured high. High hydrophobicity reduces water infiltration into the soil and increases mudslide, debris flow, and flooding risks. Please refer to Appendix IV for more information.

Plant canopies and plant debris on the ground protect the soil from rainfall impact and slow down water runoff. Fire burns off the vegetation and plant litter. This speeds up and increases soil erosion from rain and water runoff compared to pre-fire conditions. Plant roots hold the soil in place and help rain to infiltrate into the soil. Fires can be hot enough to burn the roots, reducing and/or eliminating root function. The severity of erosion and runoff is influenced by frequency, intensity and amount of rainfall, slope steepness and length.

III. Emergency Determination

The team identified people, property, and resources as values possibly at risk. The risks are debris flows, mudslides and flooding. These hazards are close to or near upstream of the identified values at risk. High soil erodibility and burn severity, on slopes, increases the possibility and severity of these hazards. The risk of flooding will increase depending on number and intensity of winter storm events. Nearly all of the annual rain falls during winter.

IV. General Recommendations

The homes and businesses designated as high risk should not be occupied during storm events. Structures with a moderate risk should have an individual emergency plan and be part of a local evacuation plan. Locations with any risk to human life and safety should be followed up with site-specific investigations by the appropriate licensed professionals.

Mudslides, debris flows, flooding and rock fall – Please refer to the California Department of Conservation CGS Notes for a discussion of these hazards. Refer to County of San Diego Homeowners' Guide and the USDA Natural Resources Conservation Service Fire Restoration Information for site treatment and protection recommendations. The references are listed in the BART report.

V. References

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DRAFT TECHNICAL SPECIALIST'S REPORT
BURN AREA RECOVERY TEAM (BART) Report

Resource: Natural Resources

Fire Name: Freeway Complex Fire CA-ORC-075221 December 2008

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I. Resource Condition Assessment

A. Setting

The 30,305 acre Freeway Complex Fire started in the area of the westbound 91 Freeway on November 15, 2008 and was fully contained on November 20, 2008. The fire burned State, County, and Private land in Los Angeles, San Bernardino, Riverside, and Orange Counties. Forty four percent of the fire occurred in Chino Hills State Park (13,400 Ac), of which 94.7% of the park burned (Appendix III, Map #2). Burn area elevations span from 312 feet at Horseshoe Bend along the Santa Ana River to 1781 feet at San Juan Hill within Chino Hills State Park. This report will focus on direct and indirect impacts of the fire to threatened and endangered species and several California species of special concern that occur within the fire perimeter on State Responsibility Lands (State, County, local, and Private ownership).

B. Survey Methods

The California Natural Diversity Data Base (CNDDB) was used as an initial research tool to search for sensitive biological resources (threatened, endangered, and species of special concern) potentially impacted by the fire within the 4 quadrangles: Yorba Linda, Black Star Canyon, La Habra, and Prado Dam. A pre-fire vegetation map and the Burned Area Reflectance Classification (BARC) map were used in conjunction with the CNDDB map to identify areas to evaluate in the field (Appendix III, Map #2, #7-B). Areas that were possibly disturbed during the fire, subject to moderate and high intensity burn, all dozer lines, downstream areas that may incur sediment flow and flooding, or potentially subject to disturbance during post-burn treatments and after-effects were inspected. Field

visits were conducted on December 2-10 2008 to assess possible impacts to selected species and sensitive natural communities.

II. Findings of the On-The-Ground Survey (Observations)

A. Identify Values at Risk

The fire burned 25 separate vegetation types, which represent 5 major categories: shrubland (29% of the area within the fire perimeter), hardwood forest/woodland (15%), mixed conifer hardwood/woodland (<1%), grassland (47%), and Urban/Bare Rock (9%) (Table 1 and Appendix III, Map #7-A, #7-B). Federally or state listed species have been reported to occur in the region of the Freeway Complex Fire area: 4 wildlife and 2 plant species. In addition 4 sensitive vegetation communities occur in the area (Table 2). Listed species within the fire disturbance perimeter include Braunton's milk-vetch (*Astragalus brauntonii*), least Bell's vireo (*Vireo bellii pusillus*), coastal California gnatcatcher (*Polioptila californica californica*), southwestern willow flycatcher (*Empidonax traillii extimus*), Santa Ana sucker (*Catostomus santaanae*), and Santa Ana River Woollystar (*Eriastrum densifolium ssp. Sanctorum*). Sensitive vegetation communities within the fire disturbance perimeter include California walnut woodland, southern coast live oak riparian forest, southern cottonwood willow riparian forest, and southern sycamore alder riparian woodland (CNDDB, 2008).

The ecological integrity of natural communities in the Freeway Complex Fire impact area is a value at risk because disturbance can allow encroachment of invasive weeds. Weeds compete with native plants for moisture, nutrients, sunlight, and can alter vegetation structure. This can create unsuitable habitat for native wildlife and contribute to unnaturally high fire frequency, which may result in type-conversion (permanent changes in vegetation type, diversity and species composition). Forty two percent of the fire area burned at a moderate or high intensity and it is certain that a number of wildlife and plants perished in the fire. Many plants and animals have evolved to live in fire-adapted ecosystems, and it is likely that many of the sensitive species will recover post fire. However, six fires have occurred within portions of the Freeway Complex Fire perimeter within the last six years and very few "fire-adapted" species are adapted to a fire interval of this frequency.

Table 1. Vegetation Communities within the Freeway Complex Fire Impact Area.

Urban/Bare Rock	**Acreage**	Percentage
Barren/Rock	5.8	0.02%
Urban/Developed	2126.2	7.02%
Undefined	786.5	2.60%
Hardwood Forest Woodland		
Black Walnut	957.9	3.16%
California Sycamore	25.3	0.08%
Coast Live Oak	2017.5	6.66%

Coastal Mixed Hardwood	759.9	2.51%
Eucalyptus	21.6	0.07%
Fremont Cottonwood	106.7	0.35%
Mixed Riparian Hardwoods	330.0	1.09%
Non-native Hardwood	19.0	0.06%
Willow	290.5	0.96%
Grasses		
Annual Grass/Forbs	14002.1	46.20%
Giant Reed/Pampas Grass	31.7	0.10%
Non-native/Ornamental Grass	73.1	0.24%
Mixed Conifer Hardwood/Woodland		
Non-native/Ornamental CON/HDW	83.7	0.28%
Shrubs		
Baccharis (riparian)	14.8	0.05%
Buckwheat (White Sage)	152.1	0.50%
California Sagebrush	3754.5	12.39%
Chamise	0.1	0.00%
Coastal Cactus	125.9	0.42%
Foothill Mixed Chaparral	15.5	0.05%
Non-native Shrub	45.7	0.15%
Northern Mixed Chaparral	58.0	0.19%
Scrub Oak	371.9	1.23%
Soft Scrub-Chaparral	105.1	0.35%
Sumac Shrub	3961.4	13.07%
Willow (riparian scrub)	62.4	0.21%
Total	**30305.0**	

Table 2. Threatened, Endangered, and Species of Special Concern potentially known to occur in the Freeway Complex Fire Impact Area.

Scientific Name	**Common Name**	**Location within Fire**	**Status**
Astragalus brauntonii	Braunton's milkvetch	Documented within burn impact area Coal Canyon.	FE, 1B.1
Vireo bellii pusillus	least Bell's vireo	Chino Hills State Park and riparian areas within the burn perimeter	FE, SE
Polioptila californica californica	coastal California gnatcatcher	Chino Hills State Park and Coastal Sage Scrub sites within the burn perimeter.	FT, CSC
Empidonax traillii extimus	southwestern willow flycatcher	Documented migrant within the burn perimeter	FE, SE

Catostomus santaanae	Santa Ana sucker	Documented within Santa Ana river.	FT, CSC
Eriastrum densifolium ssp. sanctorum	Santa Ana River woollystar	Documented within Santa Ana river.	FE, SE, 1B.1
Coccyzus americanus occidentalis	western yellow-billed cuckoo	Not documented within the burn perimeter	CSC
Gila orcutti	Arroyo Chub	Documented within Aliso Creek	CSC
Icteria virens	yellow-breasted chat	Riparian areas within burn perimeter.	CSC
Actinemys marmorata pallida	southwestern pond turtle	Creeks within burn perimeter.	CSC
Campylorhynchus brunneicapillus sandiegensis	coastal cactus wren	Cactus patches within the burn area.	CSC
Phrynosoma coronatum	coast horned lizard	Sandy areas within burn perimeter and Chino Hills State Park	CSC
Southern Coast Live Oak Riparian Forest	Southern Coast Live Oak Riparian Forest	Northwest section of the burn perimeter	N/A
Southern Cottonwood Willow Riparian Forest	Southern Cottonwood Willow Riparian Forest	Santa Ana River within burn perimeter.	N/A
Southern Sycamore Alder Riparian Woodland	Southern Sycamore Alder Riparian Woodland	Aliso Creek watershed in Chino Hills State Park	N/A
California Walnut Woodland	California Walnut Woodland	North facing slopes within Chino Hills State Park, California Fish and Game Preserve, and other sites within the burn perimeter.	N/A

FE= Federally Endangered, FC= Federal Candidate, SE= State Endangered, CSC= California Species of Special Concern, California Native Plant Society (2008) Lists:

1B= rare, threatened, endangered in California and elsewhere
2= rare, threatened, or endangered in California, but more common elsewhere
4= limited distribution (watch list)
0.1= seriously endangered in California
0.2= fairly endangered in California
0.3= not very endangered in California

B. Condition of Values at Risk

Sensitive Species Assessments

Least Bell's vireo

Least Bell's vireo (LBVI) was listed as a state endangered species in 1980 and as a federally endangered species in 1986. LBVI primarily inhabit riparian woodlands, scrub, and nest in low, dense, scrubby vegetation in areas of early succession (Kus, 2002). One hundred territories have been documented in several of the drainages within the fire perimeter (Aimar, personal communication). However, while one hundred territories are known within the burn perimeter, not the entire available LBVI habitat was consumed by fire. Because LBVI are spring migrants, no direct impacts to the species occurred during the fire. Riparian vegetation within the fire perimeter was directly impacted by the fire and the length of time it will take for vegetation to reestablish along the creeks may indirectly affect vireo's returning spring of 2009. Non-fire related threats to the species include brood parasitism by brown-headed cowbirds (*Molothrus ater*), habitat fragmentation, and exotic species encroachment (Kus, 2002).

Southwestern Willow flycatcher

The Southwestern Willow Flycatcher (SWWF) breeds in dense riparian habitats along rivers, streams, or other wetlands (Finch, Stoleson, Scott, eds., 2000). The bird has been documented in the Park as an incidental migrant (Ing, personal communication). There will be similar effects from the fire to SWWF, as there will be to the least Bell's vireo which has many of the same habitat requirements.

Santa Ana sucker and Santa Ana River woollystar

Santa Ana sucker and Santa Ana River woollystar have been documented in the Santa Ana River. Small areas along the river burned at low to moderate intensity. It is unknown whether either species was directly affected by the fire. Santa Ana River woollystar require sandy floodplain areas and is threatened by invasive plant species like *Arundo donax*. Santa Ana sucker favor cool flowing water where gravel, rubble, and boulder substrates are present. Fertilized eggs stick to gravel and incubate for approximately 36 hours (California Fish Website, 2003). Excessive sediment, debris, and pollutants resulting from winter storm events may reach the river and indirectly affect the water quality and populations of both species along the river.

Coastal California gnatcatcher

Coastal California gnatcatcher (CAGN) was listed as federally threatened in 1993 and is a species of special concern in California. They prefer open sage scrub with California sagebrush (*Artemisia californica*) as a dominant or co-dominant species (Mock, 2004). A significant amount of the coastal sage scrub community burned within the fire perimeter. The CAGN is non-migratory and was directly affected by the fire. Indirect effects to CAGN will occur from invasion of exotic vegetation and increased fire frequency (Mock, 2004). Several areas within the fire perimeter that were established for CAGN recovery burned. For example, North Yorba Linda Estates, a 20 acre coastal sage scrub mitigation

site, was at its full potential at the 5 year review in the fall of 2008 and burned at low to moderate intensity. CAGN were observed foraging within the site, however breeding had not been documented. The 2600 acre Shell/MWD Habitat Conservation Plan area burned at moderate to high intensity. Seventeen CAGN territories existed on the site prior to the fire however only seven territories remain unburned after event (Ing, personal communication).

Braunton's milkvetch

Braunton's milkvetch is a post disturbance pioneer species occurring in open light-intensive environments that are most likely needed for seedling establishment and growth. It is a fire-adapted species with a fire frequency of 20 to greater than 100 years, with an average of 70 years (Sclafani, 2006). Two other fires have occurred in the Braunton's milkvetch habitat within the last 6 years, which may impact the plants ability to recover. Known areas of occurrence within Coal Canyon were evaluated for impacts from dozer lines. None of the plant areas were affected directly by the suppression efforts. Continued use of heavy equipment to construct fire lines and fuel breaks in Braunton's milkvetch habitat may disturb the soil seed bank as well as encourage the spread of nonnative species.

Southwestern pond turtle

Southwestern pond turtles are found in ponds, lakes, rivers, streams, creeks, marshes, and irrigation ditches with abundant vegetation. They may be active all year, but also may estivate during summer droughts in the muddy bottom of a pool (Lemm, 2006). Southwestern pond turtles may have been directly impacted by the fire within the creeks and drainages. They may also be indirectly impacted by increased sediment in the creeks.

Yellow breasted chat

Yellow breasted chat (YBCH) is a species of special concern in California and occurs within riparian areas in the fire perimeter. In California, chats require dense riparian thickets of willows, vine tangles, and dense brush associated with streams, swampy ground and the borders of small ponds (Ricketts and Kus. 2000). YBCH's are spring migrants and were not directly affected by the fire. Similar to the LBVI and SWWF, they will be indirectly affected by the amount of riparian re-growth when they return for nesting in the spring.

Arroyo Chub

The arroyo chub is a small (typically < 4 inches), chunky minnow found in slow moving mud or sand bottomed sections of streams. They occur in the Santa Ana River watershed and have been documented in Lower Aliso Creek. They are a species of special concern and any remaining natural streams are recommended for protection. They may be indirectly affected by the fire due to debris and sediment in the creek from erosion on the adjacent hillsides.

Coastal Cactus Wren

Coastal populations of the Cactus Wren (CACW) are obligate inhabitants of coastal sage scrub and nest almost exclusively in prickly pear (*Opuntia littoralis* and *O. oricola*) and coastal cholla (*O. prolifera)* (Solek and Szijj 2004). While our focus was on listed species, it is important to note that coastal cactus wrens may have been severely impacted due to much of their prickly pear habitat burning within the fire perimeter. Cactus Wrens may have difficulty recolonizing burned areas of coastal sage scrub, since the species requires cactus of at least 1 meter tall. Adult birds are highly sedentary and return to the same breeding territory each year (Solek and Szijj 2004). Surveys during the week of November 17, 2008 within Chino Hills State Park revealed 7 of 18 known cactus wren territories remained occupied (Kietzer, personal communication). However, there are no assurances how long, or if these birds will remain in the area.

Coast horned lizard

Coast horned lizards inhabit open areas of sandy soil and low vegetation along dirt roads frequently near ant hills. They have been documented along sandy areas near the Santa Ana River and in the Sonome Canyon area. Possible direct effects of mortality may have occurred along the dozer line near the Santa Ana River. They are unlikely to be affected by debris flow or erosion.

Sensitive Vegetation Communities

The primary concern for all of the sensitive vegetation communities inside the fire impact assessment area is damage from human efforts to control debris flows, flooding, and associated hazards in the aftermath of the fire. Trees and shrubs may be cut or removed to avoid debris dams. Native trees will take many years to become established and reach the size of the trees that are cut down, and shading for fish and other aquatic organisms will be reduced in the interim. Conversely, invasive species will spread into burned areas. The invasive Arundo (*Arundo donax*), was observed re-sprouting in Carbon Canyon two weeks after the fires containment.

Much of the Freeway Complex burn area was of low to moderate burn intensity. Research has shown that California walnut trees have demonstrated good recovery post fire, even when top killed, due to the morphology of having large woody platforms at the soil surface which protect the growing tissue from fire and allow re-sprouting around the platforms (Esser, 1993). However, this area has experienced multiple fires within the last decade, which may affect the plants ability to set seed. Portions of Coal Canyon burned in the Green Fire in 2002 and then again in the Sierra fire in 2006. Sections of the interior of Chino Hills State Park burned in the Blue Gum Fire in 2002, the Carbon fire in 2004, and the Yorba Linda Fire in 2005 (Appendix III, Map #8).

At least 15 species of invasive weeds occur in and adjacent to the Freeway Complex Fire impact area (Table 3). Thus, there is an existing seed source for invasive weeds to invade burned areas and dozer lines. An area of concern for invasive weed encroachment, resulting from post fire mitigation by public and private landowners, is the perimeter of Chino Hills State Park. Seeding/hydroseeding of the burn area should not be conducted. Studies show that native vegetation recovers rapidly after fires without any further treatment (Keeley, 1977). Plants genetic information is not transported over long distances as readily as that of wildlife; as such "native" nonlocal seeds may have significantly different genetics and therefore have a negative impact on the genetics of local native plants if introduced as part of a hydroseed mix (Keeler-Wolf, 1995). Seed free hydromulching is a preferred alternative if spray on erosion protection is recommended by erosion specialists.

Table 3. Invasive Weeds Observed In and Adjacent to the Freeway Complex Fire

Scientific Name	**Common Name**
Centaurea solstitialis	Yellow Star Thistle
Arundo donax	Giant Reed
Foeniculum vulgare	Wild Fennel
Erodium cicutarium	Red-stemmed Filaree
Eucalyptus spp.	Eucalyptus
Salsola tragus	Russian Thistle
Schinus molle	Peruvian Pepper
Nicotiana glauca	Tree Tobacco
Ailanthus altissima	Tree of Heaven
Silybum marianum	Milk Thistle
Cynara cardunculus	Artichoke Thistle
Ricinus communis	Castor Bean
Avena fatua.	Oat
Brassica nigra	Black Mustard
Bromus spp	Annual Grasses

III. Emergency Determination

The fire burned a significant amount of native habitats that are vital to survival of sensitive and listed species. Emergencies to wildlife and botanical resources related to the Freeway Complex Fire fall into three major categories: 1) Threats from the fire itself and from post-fire treatments implemented to protect other values 2) potential post-fire treatments inhibiting native plants and spreading invasive weeds 3) debris flow and sediment in streams and creeks known to be occupied by sensitive species.

IV. Treatments to Mitigate the Emergency

A. Treatment Objectives

Treatment objectives are to monitor sensitive wildlife and plant species, protect sensitive natural communities from human-caused disturbance, promote native plant re-

colonization of burned areas, and avoid spreading invasive weeds into currently unoccupied areas.

B. Treatment Types

- Minimize invasive weeds and further degradation of native habitats by limiting public access to burn areas until vegetation can recover.
- Restoration of endangered species habitat, where appropriate, in disturbed and high intensity burn areas.
- Invasive species suppression, surveys, and monitoring for a minimum of five years.
- Monitor vegetation recovery in burned and unburned fire disturbance impact areas to assess long term health or possible decline of sensitive natural communities.
- Coordinate with local agencies regarding maintenance activities to avoid, minimize, and mitigate additional species impacts.
- Conduct post-fire surveys for rare, threatened, endangered, or species of special concern. Monitor and survey locations and habitats burned or indirectly impacted by the fire.
- Preserve natural stream bottoms and size all culverts (bottom-less preferred) to allow for fish/amphibian/reptile/mammal and 100 year flood water movement through culverts. This measure is recommended for both temporary and permanent repairs to streams.

C. Treatment Descriptions

<u>General Recommendations</u>

- Control of fill material for permanent and emergency repairs should come from the local drainage areas as close as possible to the site. This will help to prevent/contain the spread of exotic weeds and help maintain the composition of native vegetation communities that currently exist.
- Propagate plants from the closest possible stands, using a local seed source, when restoring sensitive wildlife habitat.
- Avoid using hydroseed and hydromulch within the fire impact perimeter. If mulching is essential, biodegradable matting such as jute netting or wood fiber is preferred.
- If clearing channels is necessary to reduce risk to life and property, only the minimum amount of vegetation should be cleared that accomplishes the desired effect.
- Do not plant or seed invasive species. Refer to the CalEPPC List: Exotic Pest Plants of Greatest Ecological Concern in California, October 1999.
- Conduct invasive weed surveys during the 2009-2010 growing seasons.
- When detected, control weed populations and follow up with monitoring for at least 5 years.
- For areas along and abutting Chino Hills State Park, where emergency treatments are needed to protect values at risk, efforts should be taken to consult with park

staff to evaluate potential impacts to the park (Chino-Citrus Sector office 951-780-6222).

Specific Recommendations

- At Pepper Tree Ranch minimize use of machinery within channel, for berm creation use native fill material collected within close proximity of the site to avoid introducing non-native plants, and leave standing trees on the bank above the channel. Avoid collecting soils from the toe of the slope so as not to de-stabilize the slope.
- In Carbon Canyon Dam/Regional Park drainage, minimize use of machinery when removing fallen vegetation in the channel, finish work prior to March 15, 2009 to avoid LBVI breeding season, and conduct surveys for known LBVI locations.
- At the Weir Canyon and Santa Ana Canyon Road drainage use hand crews rather than heavy equipment to remove fallen debris and trash.
- The Anaheim Wetland area should recover naturally, although it may need invasive species control in the short term.
- The Habitat Conservation Plan site at the corner of La Palma Ave. and Weir Canyon Rd. was assessed for effects from the fire. Since it has not been completed and signed off by Fish and Wildlife Service, it is recommended that the permittee seek recommendations from the Service on how to proceed.
- Drainages that are known habitat for the southwestern pond turtle and arroyo chub should be surveyed and monitored for effects from sedimentation resulting from rainfall events.
- Monitor and survey known coastal cactus wren territories, including but not limited to, areas within Chino Hills State Park, slopes near Black Gold Golf Course and slopes surrounding the Diemer Water Treatment Plant to assess direct mortality and indirect effects of habitat loss. In addition, monitor long term recovery of cactus patches throughout the burn area and if possible create and implement a cactus wren habitat restoration plan.
- Survey and monitor known coastal California gnatcatcher populations to determine direct mortality and recovery of the species as its habitat recovers.
- Make coastal sage scrub mitigation sites that existed prior to the fire the highest priorities for future restoration efforts. Known sites within the fire perimeter include but may not be limited to the North Yorba Linda Estates restoration site and the Shell/MWD Habitat Conservation Plan restoration site.
- Monitor Braunton's milkvetch populations in the Coal Canyon/Gypsum Canyon area for direct and indirect effects from the fire and fire suppression efforts. Fire frequency will likely impact this population as portions of the Coal Canyon/Gypsum Canyon site have burned three times since 2002.
- Coast horned lizard populations along dozer lines near Santa Ana River and known locations in Sonome Canyon should be monitored.
- Recovery of Walnut woodlands occurring in Sonome Canyon, north facing slopes in Telegraph Canyon, and on the Department of Fish and Game Walnut Woodland Preserve should be monitored and if necessary for long term recovery a restoration plan should be created and implemented.

D. Treatment Cost

Costs will not be incurred if seeding, mulching, and similar measures are avoided as recommended. Biological consultants may charge $100 or more per hour to survey for rare plants, weeds, and wildlife. To reduce fees for surveying some non-profit organizations and local universities can be utilized.

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DRAFT TECHNICAL SPECIALIST'S REPORT
BURN AREA RECOVERY TEAM (BART) Report

Resource: Public Assistance

Fire Name: Freeway Complex CA-ORC-075221 December 2008

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Public Assistance

The 2008 wildfires (FEMA-1810-DR-CA) affected 30,305 acres in Orange, Los Angeles, Riverside and San Bernardino Counties. These fires, which generally occurred on the slopes of hills and mountains destroyed vegetation and caused "hydrophobic" soils to form, a condition causing the soil to repel water rather than absorb it. The affected watersheds were consequently subject to conditions under which rain could cause significant erosion and runoff, leading to mudflows, debris flows, and flooding. The purpose of this survey was to identify projects that may reduce or eliminate immediate threats posed by erosion and other effects of storms in burned watersheds. They are categorized as short and long term projects with comments as follows:

I. Short Term Project

A. City of Yorba Linda - Construction of emergency protective projects

a) CALTRANS provided materials, labor and equipment. CALTRANS was mission tasked (# 2008-SOU6052) by OES (Governor's Office of Emergency Services) to provide technical advisory engineering work for flood mitigation to reduce liability for Department of Parks and Recreation (DPR) lands and reduce danger to homes and private property.

K-rails	26 ea
Sandbags	12,900 ea
Dirt removed	117 cubic yards

Equipment	127 pieces
Maintenance	567 hrs
Engineering	414 hrs

b) OES provided materials to be placed by City of Yorba Linda at various locations.

K-rails	250 ea
Sandbags	100,000 ea

c) City of Yorba Linda provided labor, material and equipment. The work was accomplished by both force account labor and contractor.

K-rails	280 ea
Sandbags	400,000 ea

Comments: The above remedial actions (if the work performed does not fall within the exclusive authority of another Federal agency) are necessary because the debris may be deposited on public roads, preventing the use of these roads for traffic.

B. Yorba Linda – Eastside basins and major drainage facilities clearing

The City of Yorba Linda identified approximately 23 debris basins and 45 small inlets (headwall/ riser) in the San Antonio and Fairmont general areas that required clearing on an Emergency Basis. The locations of these basins and inlets are identified on City of Yorba Linda GIS maps.

Comments: The above remedial actions may be necessary because the debris basins, flood control channels and small inlet (headwalls or risers), may be partially or completely filled by sediment, rock, timber, and other debris, compromising their effectiveness to provide protection during the future storms. Only measures necessary to provide protection for a flood associated with a five-year storm event (that is a flood that has a 20 percent chance of occurring in any given year) may be implemented. By visual inspection, the capacity and maintenance of the surface water collection and drainage system of pipes, culverts and manholes appeared to be inadequate for flood flow conveyance, and need to be addressed by the City.

C. Emergency Operation Centers (EOC)

a) The City of Anaheim

This EOC operates from the City of Anaheim's Vermont Utility Yard located at 909 Vermont Street, Anaheim. The City of Anaheim will activate their EOC in advance of a measurable rainfall event. The EOC notifies those residing in identified areas subject to potential mud/debris flows. This is performed directly through an established phone tree. Additionally, the City of Anaheim has recently begun using the AlertOC (often known as "Reverse 911"). This mass notification system is a joint County/City program.

b) City of Brea

The City of Brea EOC operates from the Brea Civic Center located at 1 Civic Center Circle, Brea. The City's EOC was activated during the fire and is positioned to re-activate should a post-fire mud/debris flow pose an eminent threat. Brea has begun using the AlertOC.

c) City of Chino Hills

Their EOC operates out of the new Civic Center, located at 14000 City Center Drive, Chino Hill. It is from that location that issuance of a mandatory evacuation of over 1500 residents from areas of Carbon Canyon and Los Serrano's Ranch was issued, in response to the fire. The City of Chino Hill has a mass notification system in place.

d) The City of Yorba Linda

The City of Yorba Linda operates their EOC out of the Yorba Linda Community Center located at 4501 Casa Loma Drive, Yorba Linda. This community also uses AlertOC to notify the residents who are located in the path potential mud/debris flows. In addition, Yorba Linda enlists volunteers to physically go door-to-door handing out a flyer that identifies exigent threat levels and educates those who are at highest risk.

Comments: Local Emergency Operations Centers are opened in direct response to a specific event for the coordination of efforts to protect life, property, and infrastructure. The costs of an activation must be associated with a time frame related to the circumstances justified by the nature of the emergency.

D. Local Assistance Centers (LAC) & Evacuation Centers.

a) Anaheim and Yorba Linda

In response to the Freeway Fire Complex, The City of Anaheim opened the East Anaheim Gymnasium to meet the needs of affected residents from both Anaheim and Yorba Linda. It is located at 8165 East Santa Ana Canyon Road, Anaheim. Among other emergency services rendered, this LAC serves as an informational hub for assistance from American Red Cross, OES, FEMA and the SBA. Should evacuations be ordered for post-fire mud/debris flow threats, this LAC is positioned to respond appropriately. In Yorba Linda, the Tommy Lasorda Jr. Field House located at 4701 Casa Loma Drive was made available to displaced residents when the Orange County Fire District issued a mandatory evacuation for three areas of the Yorba Linda. Other evacuation centers throughout Orange County will be available should future evacuations be issued.

b) Chino Hills

The evacuated residents of Chino Hills were directed to the Ayala High School, where the gymnasium had been transformed into a makeshift Red Cross shelter where donated food, water, baby supplies and cots had been made available.

Comments: Generally, supplies, durable medical equipment, security, cleanup, minor repairs, and increased utility costs might be considered. This does not include the leasing costs.

E. Infrastructure

a) Railways

Three sets of railroad tracks owned and maintained by Burlington Northern Santa Fe, pass through an area known as "Horseshoe Bend." Located in Santa Ana Canyon, Horseshoe Bend lies at the bottom of multiple small watersheds. As a result of the recent wildfire, these watersheds are now void of vegetation and could become inundated with mud and debris flows. Should these flows spill onto the tracks, passage on them could be disrupted. Twenty percent of all consumer goods transported in the United States pass along these rails, making this network a critical artery of commerce and subject to significant economic ramifications should there be an interruption in rail service. Additionally, Amtrak and Metrolink, a commuter rail system that links Orange County with surrounding areas including Los Angeles, Riverside, and San Bernardino Counties operates trains on those lines. These too would share exposure to potential disruption in service. Contingencies for such an occurrence are in place (i.e. busing). However, an interruption to passenger rail service at Horseshoe Bend could add burden to an already taxed freeway system.

Comments: The use of the economic recovery criterion is normally restricted to the removal of disaster-related debris from large commercial areas when a significant percentage of the commercial sector of a community is impacted and the debris removal is necessary to expedite restoration of economic viability to the affected community.

b) Southern California Gas

Three high pressure transmission lines pass through the fire affected Chino Hills State Park. In addition to supplying gas to meet the residential and business demands in Orange County, these lines also supply gas to power regional steam generating electric plants.

The gas transmission lines within the affected area have limited exposure to mud and debris flows; as most of the line runs under ground. In-depth inquiries with the utility's engineers regarding the system's integrity, have gained the confidence of Burn Area Recovery Team. Routine aerial inspections are flown after each significant rainfall event. In addition to the robust wall-thickness of these lines, auto-fault detection and auto shut-off mechanisms are in place should a breech occur. Back-up measures including alternate supply lines and drawing from storage fields have minimized the threat of disruption.

c) AT&T

Should telephone poles or cellular sites succumb to the forces of a mud or debris flow, AT&T is prepared to deploying a mobile unit known as a "COW" (cellular on wheels). They service vehicles operating 24/7 with additional emergency crews to be deployed as needed. A disruption, if any should be minimal.

II. Long Term Project

A. Potential Landslides Site

According to the Geotechnical Report contained herein, signs of landslide were observed including crown, scarp, transverse cracks and bulging at the following locations:

a) Banyon Rim Site, Yorba Linda

Map Points: Two existing active landslides were observed on two of the canyons in this site posing a potential threat to the public and private properties in the vicinity of Banyon Rim Road.

b) Hidden Hills Site, Yorba Linda

Map Points: Residences located towards the slopes along Hidden Hills Road between Green Mount Place and High Tree Circle appears to be at risk due to potential earth movement in this general area.

c) Twilight Canyon Road, Yorba Linda

Map Points: The Twilight Canyon Road at the west end is visibly vulnerable to debris flow and flooding from slopes at its Northern and Western sides. These slopes are adjacent to public and private properties.

d) Mission Hills Site, Yorba Linda

Map Points: Four existing landslides were observed in the general area between Brentwood Place and Skyline Drive along Mission Hills. The public and private properties located along the slopes appear to be at risk in the event of a landslide.

e) Santa Ana Canyon Road Site, Anaheim

Map Points: Six existing landslides, along Santa Ana Canyon Road between Wood creek (approximately half a mile east of Weir Canyon Road) and the entrance to Kindred Community Church, appear to pose a potential threat to the Santa Ana Canyon Road traffic and public safety.

f) Freeway 57 between Lambert Road and Tonner Canyon Road, Brea

Map Points: Along Freeway 57 on both north and southbound between E. Lambert Road and Tonner Canyon Road, existing shallow landslides pose a potential threat to the freeway traffic and public safety.

Comments: The respective City Officials are fully aware of these potential threats to the public and private properties in the event of a landslide. There is no information available indicating if these existing landslides are active and or dormant. Under Public Assistance Program generally certain and specific facility and integral ground restoration, emergency protective measures and debris removal might be considered. Only the ground necessary to physically support a facility is considered integral to its function. Slope or hill stabilization exceeds these limits and is not considered integral ground restoration. *Essential Assistance:* Under sections 403 and 502 of the Stafford Act, emergency protective measures to stabilize slopes and hills that were damaged by a disaster may be eligible only if necessary to eliminate or lessen immediate threats to life, public health, safety, or significant additional damage to improved public or private property.

Freeway Complex Assets At Risk Summary Table

Asset locations are shown on Detail Maps
and referenced my Asset Number.

Asset Number	Asset Name	GPS Locations (WGS84) Latitude	Longitude	Hazard	Likeli-hood	Risk to lives Fire	Pre-exist	Risk to property Fire	Pre-exist
# 31	Residences	33.907531	-117.773056	Reactivation of existing slide -- debris flow, flooding	High	High	High	High	High
# 01	School	33.929566	-117.874766	Surficial sloughing, erosion, flooding.	High	Low	Low	Medium	Medium
# 02	57 Freeway	33.930241	-117.879895	Sliding, potential mudflow and flooding on both sides of freeway.	High	Moderate	Moderate	High	High
# 03	57 Freeway	33.932458	-117.879232	Sliding, potential mudflow and flooding on both sides of freeway.	High	Moderate	Moderate	High	High
# 04	57 Freeway	33.936913	-117.877832	Sliding, potential mudflow and flooding on both sides of freeway.	High	Moderate	Moderate	High	High
# 05	Road	33.939333	-117.874972	Sloughing, flooding	High	Low	Low	Medium	Medium
# 06	State Park	33.953667	-117.850500	Erosion	High	Low	Low	Medium	Low
# 07	Horse Ranch	33.932099	-117.804546	Flooding	High	Low	Low	Medium	Low
# 08	State Park	33.930444	-117.800750	Heavily burned -- erosion problem.	High	Low	Low	Medium	Low
# 09	Residence	33.932278	-117.801667	Debris flow, flooding	High	Low	Low	Medium	Low
# 10	Road	33.929861	-117.797222	Surficial sloughing, debris flow, flooding	High	Low	Low	Medium	Medium
# 11	Road	33.940861	-117.787528	Surficial sloughing, debris flow, flooding	High	Low	Low	High	Medium
# 12	Creek	33.942583	-117.786278	Surficial sloughing, debris flow, flooding	High	Low	Low	High	Medium
# 13	Creek	33.942889	-117.785944	Surficial sloughing, debris flow, flooding, rockfall	High	Low	Low	High	Medium
# 14	Road	33.943583	-117.784139	Surficial sloughing, debris flow, flooding	High	Low	Low	Medium	Medium
# 15	Road	33.945309	-117.782258	Debris flow, flooding	High	Low	Low	Medium	Medium
# 16	Residence	33.946444	-117.777611	Debris flow, flooding; no drainage from back yard.	High	Low	Low	Medium	Low
# 17	Residence	33.946306	-117.776889	Debris flow, flooding	High	Low	Low	Medium	Low
# 18	Residence	33.947644	-117.775722	Debris flow, flooding	Moderate	Low	Low	Medium	Medium
# 19	Residences	33.953806	-117.713889	Reactivation of existing slide -- debris flow, flooding	High	Low	Low	Medium	Medium
# 20	Residences	33.953425	-117.712670	Street flooding.	Moderate	Low	Low	Low	Low
# 21	Road	33.954028	-117.707639	Debris flow, flooding	High	Low	Low	Medium	Low
# 22	Residence	33.956861	-117.703250	Surficial sloughing, flooding	High	Low	Low	Medium	Low
# 23	State Park	33.954861	-117.702889	Debris flow into culvert	Moderate	Low	Low	Low	Medium
# 24	Catch basin	33.954278	-117.701500	Surficial sloughing, debris flow, flooding	High	Low	Low	Medium	Low
# 25	Residences	33.951722	-117.699778	Reactivation of existing slide -- debris flow, flooding	High	Low	Low	Medium	Medium
# 26	Residence	33.951306	-117.699472	Slope stability, flooding.	Moderate	Moderate	Moderate	Medium	Low
# 27	Residence	33.947694	-117.695167	Erosion	Moderate	Low	Low	Low	Low
# 28	Box culvert	33.927399	-117.801241	Flooding; undersized culvert	Moderate	Low	Low	Medium	Low
# 29	Road	33.927333	-117.802194	Surficial sloughing, debris flow, flooding	High	Low	Low	Medium	Medium
# 30	Sewer line	33.926222	-117.801750	Erosion, sedimentation	Moderate	Low	Low	Medium	Low
# 31	Residences	33.907531	-117.773056	Reactivation of existing slide -- debris flow, flooding	High	High	High	High	High

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Asset locations are shown on Detail Maps
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Asset Number	Asset Name	GPS Locations (WGS84) Latitude	Longitude	Hazard	Likeli-hood	Risk to lives Fire	Pre-exist	Risk to property Fire	Pre-exist
# 32	Culvert	33.909182	-117.766932	Sedimentation	Moderate	Low	Low	Medium	Low
# 33	Critical Infrastructure	33.896389	-117.766191	Debris flow, flooding may impact fire station	Moderate	Moderate	Low	Medium	Medium
# 34	Culvert	33.909884	-117.764861	Sedimentation	Moderate	Low	Low	Medium	Low
# 35	Residence	33.910418	-117.757929	Debris flow, flooding	Moderate	Low	Low	Medium	Low
# 36	Culvert	33.909281	-117.763942	Sedimentation	Moderate	Low	Low	Medium	Low
# 37	Residence	33.905528	-117.760083	Erosion	High	Low	Low	Medium	Low
# 38	Critical Infrastructure	33.894409	-117.765305	Debris flow, sedimentation	Moderate	Low	Low	Medium	Low
# 39	Water Line	33.894348	-117.765032	Debris flow, flooding.	High	Low	Low	Medium	Low
# 40	Critical Culvert	33.892995	-117.758549	Debris flow, flooding.	Moderate	Low	Low	Medium	Low
# 41	Water Line	33.893318	-117.749298	Erosion; pre-existing 15' deep gully	High	Low	Low	High	High
# 42	Residence	33.891472	-117.733944	Landsliding, erosion	High	High	High	High	High
# 43	Residence	33.892056	-117.732139	Surficial sloughing, erosion	High	Low	Low	Medium	Low
# 44	Residence	33.895556	-117.728917	Surficial sloughing, erosion	High	Low	Low	Medium	Low
# 45	Water Line	33.903683	-117.711085	Landsliding, erosion	High	Low	Low	Medium	Low
# 46	Water Line	33.904149	-117.710488	Erosion	High	Low	Low	Medium	Low
# 47	Water Line	33.905749	-117.707623	Erosion	High	Low	Low	Medium	Low
# 48	Water Line	33.904320	-117.699800	Erosion and debris flow; creek is currently blocked by slide material.	High	Low	Low	Medium	Medium
# 49	Culvert	33.888046	-117.745758	Fooding; filled siltation basin.	Moderate	Low	Low	Medium	Low
# 50	RR	33.887389	-117.740361	Debris flow, flooding, erosion	High	High	High	High	High
# 51	Residence	33.889278	-117.736750	Landsliding, erosion	High	High	High	High	High
# 52	Residence	33.887444	-117.736639	Surficial sloughing, erosion	High	Low	Low	Medium	Low
# 53	Residence	33.887944	-117.735722	Landsliding, debris flow, flooding, erosion	High	High	High	High	High
# 54	Diversion Dike	33.888111	-117.735139	Debris flow, flooding; diversion dike and channel may be impacted by existing landslide upslope.	High	Moderate	Low	High	High
# 55	Residence	33.885472	-117.734972	Landslides, flooding, debris flow, erosion; blocked drainage system	High	High	High	High	High
# 56	Road	33.883722	-117.731472	Debris flow, erosion, flooding; drop inlet clogged	High	Low	Low	High	Medium
# 57	Residence	33.882306	-117.731417	Debris flow, erosion, flooding	High	Low	Low	Medium	Low
# 58	Residence	33.883389	-117.729639	Erosion, questionable slope stability	High	High	High	High	High
# 59	Residence	33.880222	-117.729917	Erosion, questionable slope stability	High	High	High	High	High

Freeway Complex Assets At Risk Summary Table

Asset locations are shown on Detail Maps
and referenced my Asset Number.

Asset Number	Asset Name	GPS Locations (WGS84) Latitude	Longitude	Hazard	Likeli-hood	Risk to lives Fire	Pre-exist	Risk to property Fire	Pre-exist
# 60	Road	33.883696	-117.723299	Flooding	Moderate	Low	Low	Medium	Low
# 61	RR	33.880222	-117.744833	Debris flow, flooding, erosion, rockfall	High	High	High	High	High
# 62	RR	33.883746	-117.741000	Flooding, failure; 18" culvert with no debris basin	Moderate	Low	Low	Medium	Low
# 63	RR	33.884333	-117.739083	Debris flow, landsliding, erosion, flooding	High	High	High	High	High
# 64	RR	33.884111	-117.736778	Debris flow, rockfall, erosion, flooding	High	High	High	High	High
# 65	Residences and railroad	33.883417	-117.735250	Debris flow, surface sloughing, erosion, flooding	High	High	High	High	High
# 66	RR	33.880119	-117.732224	Flooding, failure; holding basin with no outlet. KRail to the top.	Moderate	Low	Low	Medium	Low
# 67	RR	33.879528	-117.731694	Debris flow, surface sloughing, erosion, rockfall	Moderate	Low	Low	Medium	Low
# 68	RR	33.878647	-117.730708	Flooding, failure; holding basin with no outlet.	Moderate	Low	Low	Medium	Low
# 69	RR	33.878583	-117.730611	Debris flow, flooding, erosion	High	Low	Low	Medium	Medium
# 70	Holding basin	33.877627	-117.730116	Flooding, failure; holding basin with no outlet.	Moderate	Low	Low	Medium	Low
# 71	RR	33.876306	-117.729306	Flooding	Moderate	Low	Low	Medium	Low
# 72	Access road and railroad	33.875413	-117.713776	flooding; drainage silted up.	Moderate	Low	Low	Medium	Medium
# 73	Residences	33.880685	-117.703315	Sedimentation	Moderate	Low	Low	Medium	Low
# 74	Debris basin	33.867806	-117.742056	Erosion, sedimentation	High	Low	Low	Medium	Low
# 75	Road	33.869333	-117.733806	Landsliding, debris flow, flooding, erosion	High	Low	Moderate	High	Medium
# 76	Road	33.868917	-117.732417	Landsliding, debris flow, flooding, erosion	High	Low	Moderate	High	Medium
# 77	Road	33.868000	-117.731722	Landsliding, debris flow, flooding, erosion	High	Low	Moderate	High	Medium
# 78	Road	33.868306	-117.729972	Landsliding, debris flow, flooding, erosion	High	Low	Moderate	High	Medium
# 79	Road	33.868333	-117.727222	Landsliding, debris flow, flooding, erosion	High	Low	Moderate	High	Medium
# 80	Road	33.867167	-117.727167	Rockfall	High	Moderate	Low	Medium	Low
# 81	Road	33.866806	-117.725500	Rockfall	High	Moderate	Moderate	Medium	Medium
# 82	Residence	33.865611	-117.730083	Erosion.	High	Low	Low	Medium	Low
# 83	Access road and railroad	33.875413	-117.713825	Flooding	Moderate	Low	Low	Medium	Low
# 84	Access road and railroad	33.877673	-117.692264	Flooding, debris flow	Moderate	Low	Low	Medium	Low
# 85	Access road and railroad	33.876793	-117.687216	Flooding; drop inlet silted to top.	Moderate	Low	Low	Medium	Low

Freeway Complex Assets At Risk Summary Table

Asset locations are shown on Detail Maps
and referenced my Asset Number.

Asset Number	Asset Name	GPS Locations (WGS84) Latitude	Longitude	Hazard	Likeli-hood	Risk to lives Fire	Pre-exist	Risk to property Fire	Pre-exist
# 86	RR	33.875278	-117.686250	Rockfall	Moderate	Moderate	Moderate	Medium	Medium
# 87	Access road and railroad	33.874501	-117.680808	Flooding; culvert may be undersized.	Moderate	Low	Low	Medium	Medium
# 88	Access road and railroad	33.874164	-117.678956	Moderate threat to RR.	Moderate	Low	Low	Medium	Medium
# 89	Residences	33.902479	-117.761814	Flooding; partially blocked culvert.	Moderate	Low	Low	Medium	Low
# 90	Channel	33.890310	-117.765441	Flooding; may not accomodate drainage from 1534 acres.	Moderate	Low	Low	Medium	Low

Appendix IV

High Severity

a. Hydrophobicity—soils are strongly water repellant; they will repel water for greater than 40 seconds. Very strongly hydrophobic soils may repel water for several minutes or longer. Hydrophobicity may be from the soil surface downward, from about 1/8 of an inch in depth to many inches, or it may begin below surface.
b. Organic Ground Cover Density—less than 20% cover of litter, duff, or woody debris remains. Often fully consumed in very high severity burns.
c. Vegetation—Trees: crowns fully burned, no needles or leaves remaining. Some or many branches may be consumed. Brush: crowns partially or fully volatilized; no leaves remaining. Herbaceous plants: usually fully consumed, often including roots and sometimes, residual seed.

Moderate Severity

a. Hydrophobicity—soil will repel water for 10-40 seconds. Longer than that is strong hydrophobicity; less than that is weakly hydrophobic.
b. Organic Ground Cover Density—Approximately 20-50% density.
c. Vegetation—Trees: crowns remain but needles/leaves are singed to the extent that more than 50% of the crown is discolored (i.e., the crown of a pine tree has more than half to all the needles browned by fire). Brush: crowns remaining but leaves mostly discolored by burn. Herbaceous plants: mostly consumed, but patches remain.

Low Severity

a. Hydrophobicity—soil will repel water for less than 10 seconds. Often water will infiltrate within a second or two.
b. Organic Ground Cover Density—greater than 50% density. Often the fire will consume only fine woody debris and scorch the surface of a duff layer.
c. Vegetation—Trees: crowns remain. Fire will often only scorch the tree bole and perhaps a few lower branches on smaller trees. All or nearly all the crown will remain green. Shrubs: mostly unburned, but some scorching may be present on lower parts. Herbaceous plants: usually singed or partially burned, but will recover.

Derived from (FRAZIER 1989). (See Parsons (2003) for more detailed descriptions.)

APPENDIX III

GIS DATA

MAPS

MAPS

Map # 1	General Location Map
Map # 2	Burned Area Reflectance Classification (BARC) Map
Map # 3	Fire Protection Responsibility Areas Map
Map # 4	Geology Map & Legend
Map # 5	Watershed Map
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Map # 7-A	Vegetation Map Delineated by Vegetation Covertype
Map # 7-B	Vegetation Map Delineated by Vegetation Type
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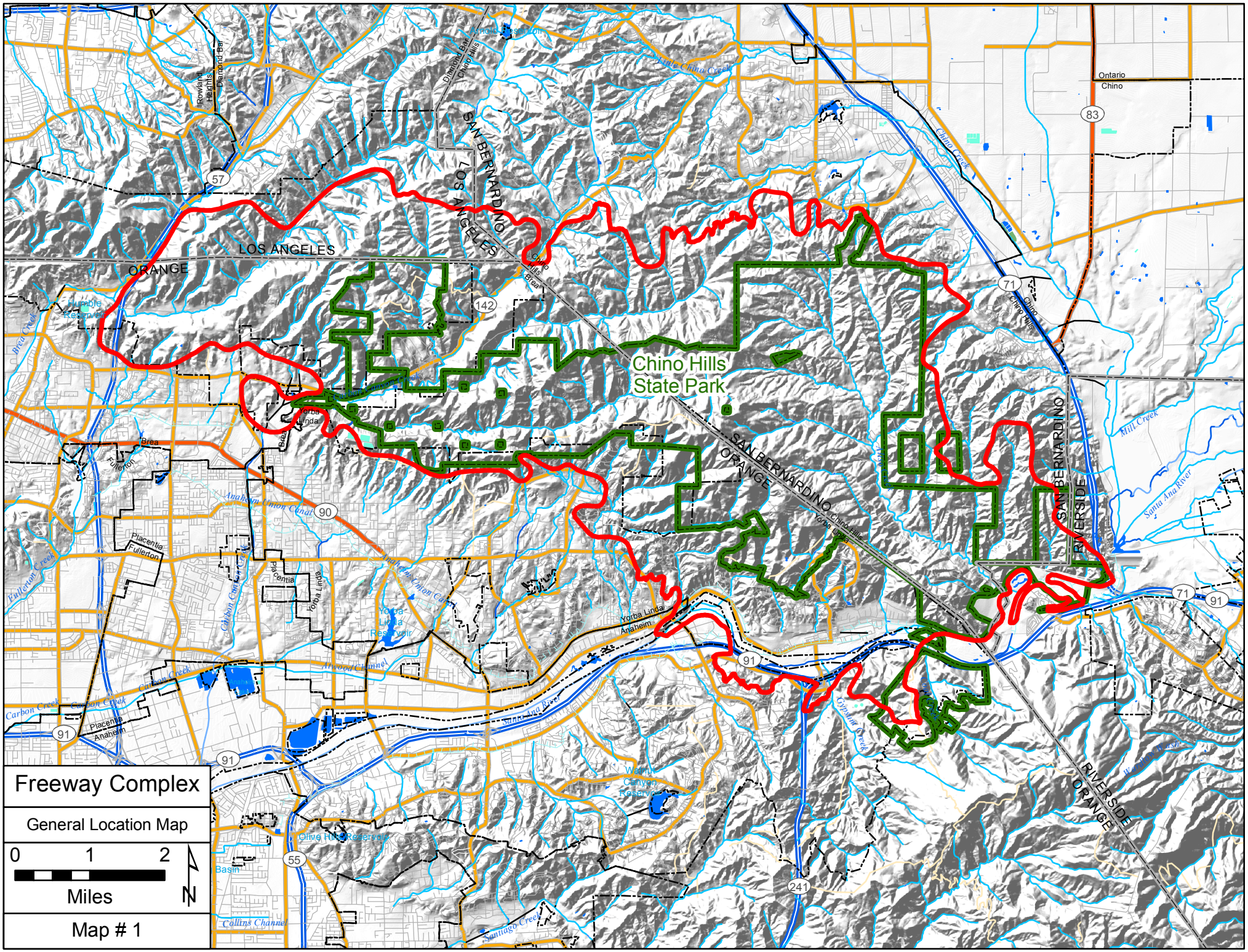
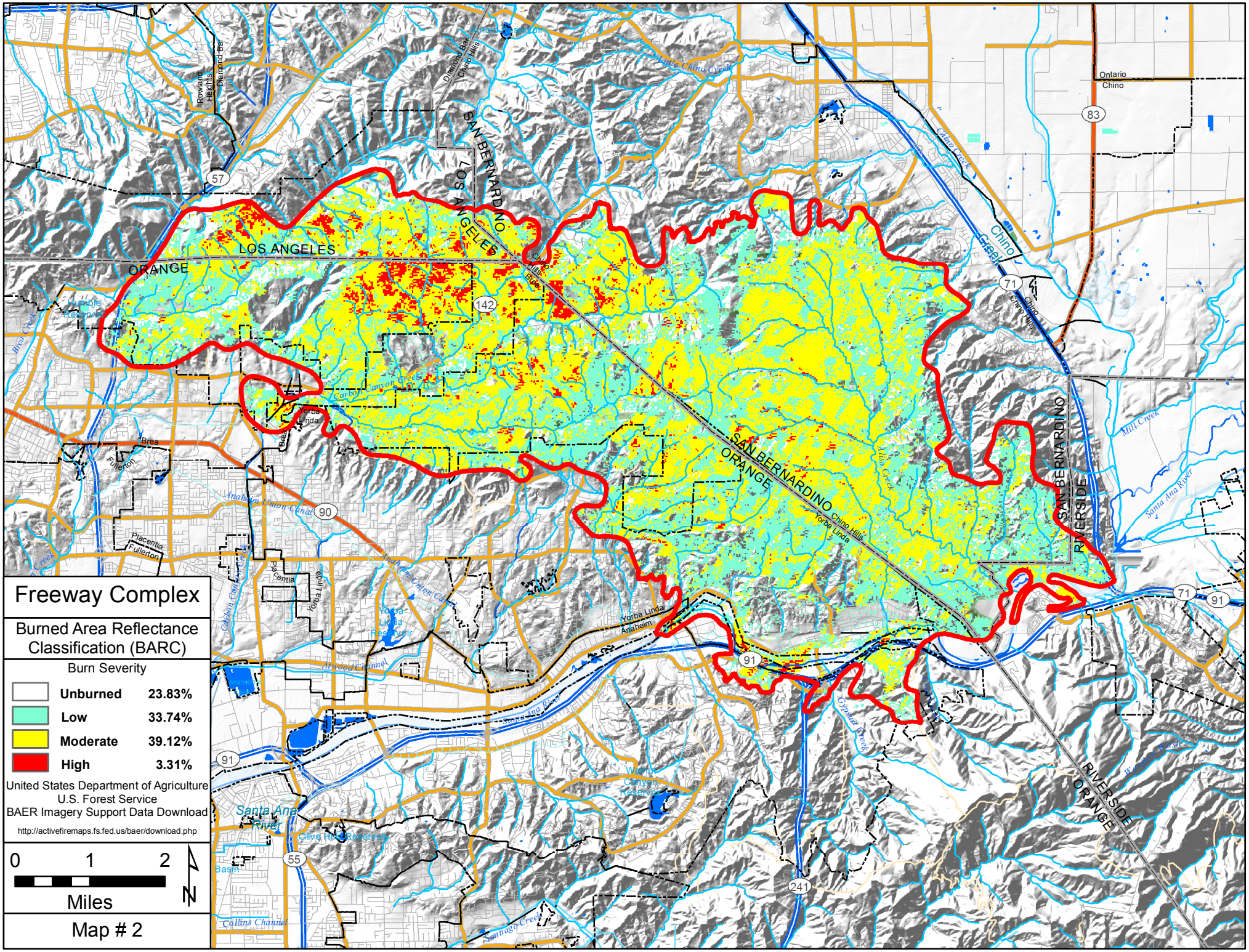
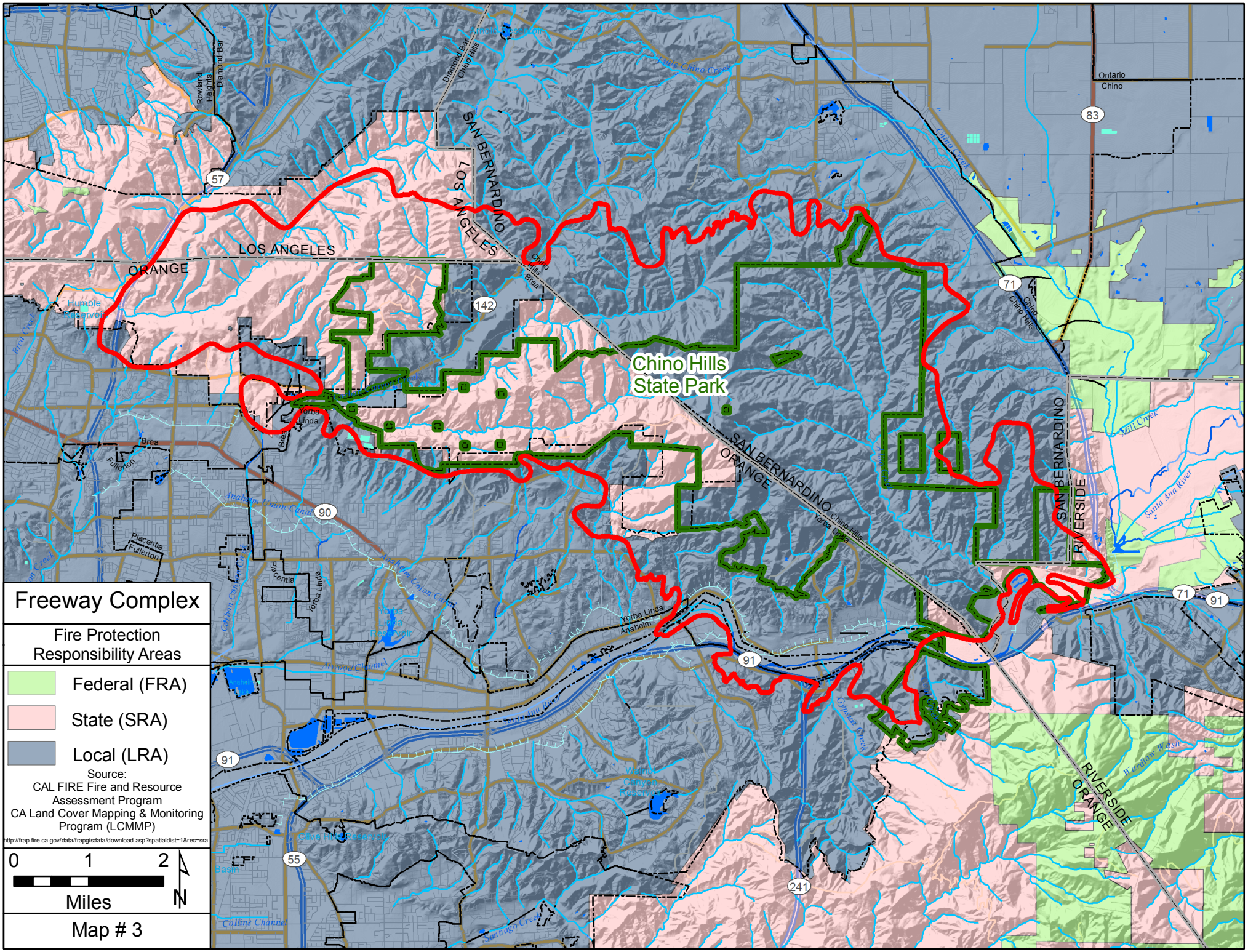
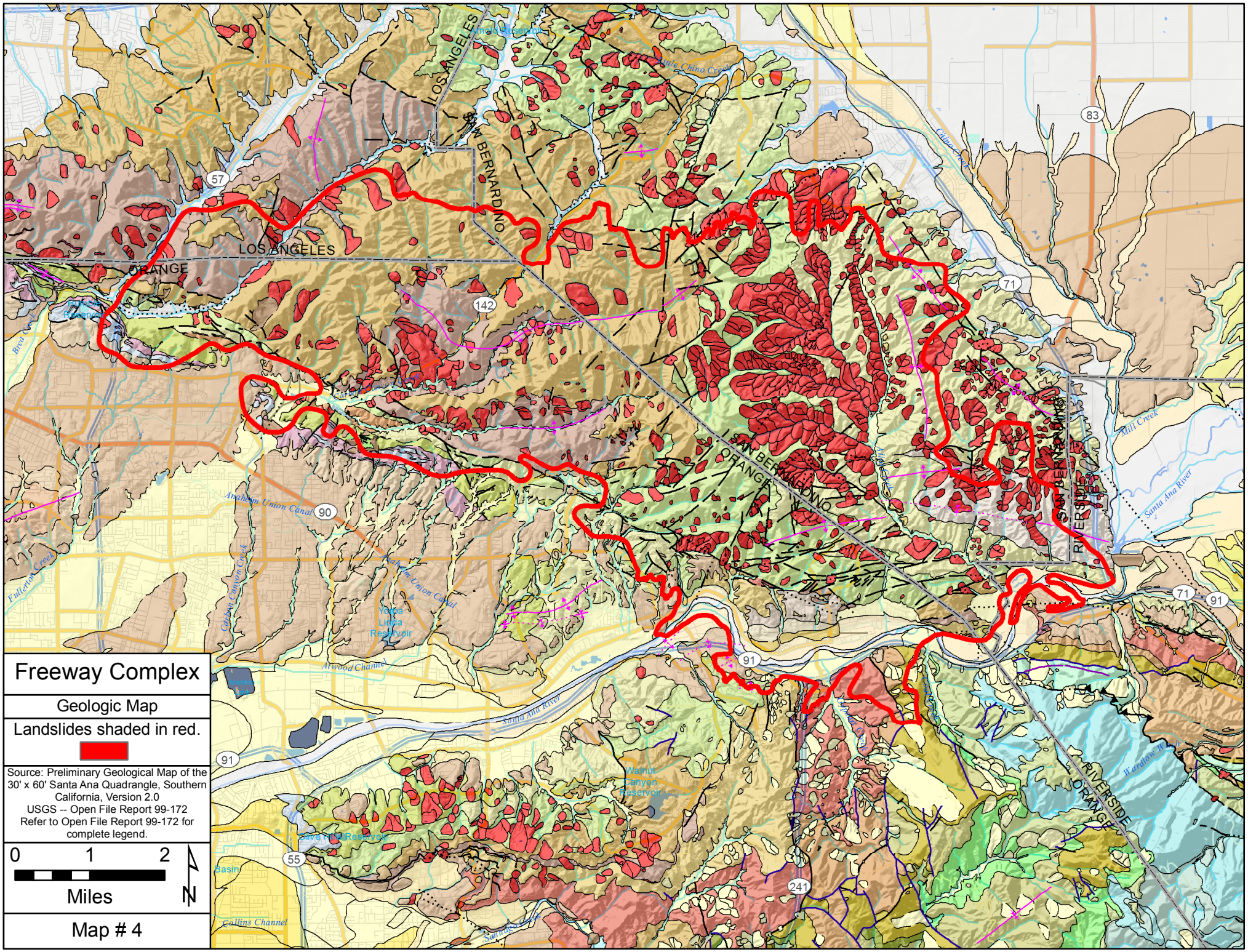
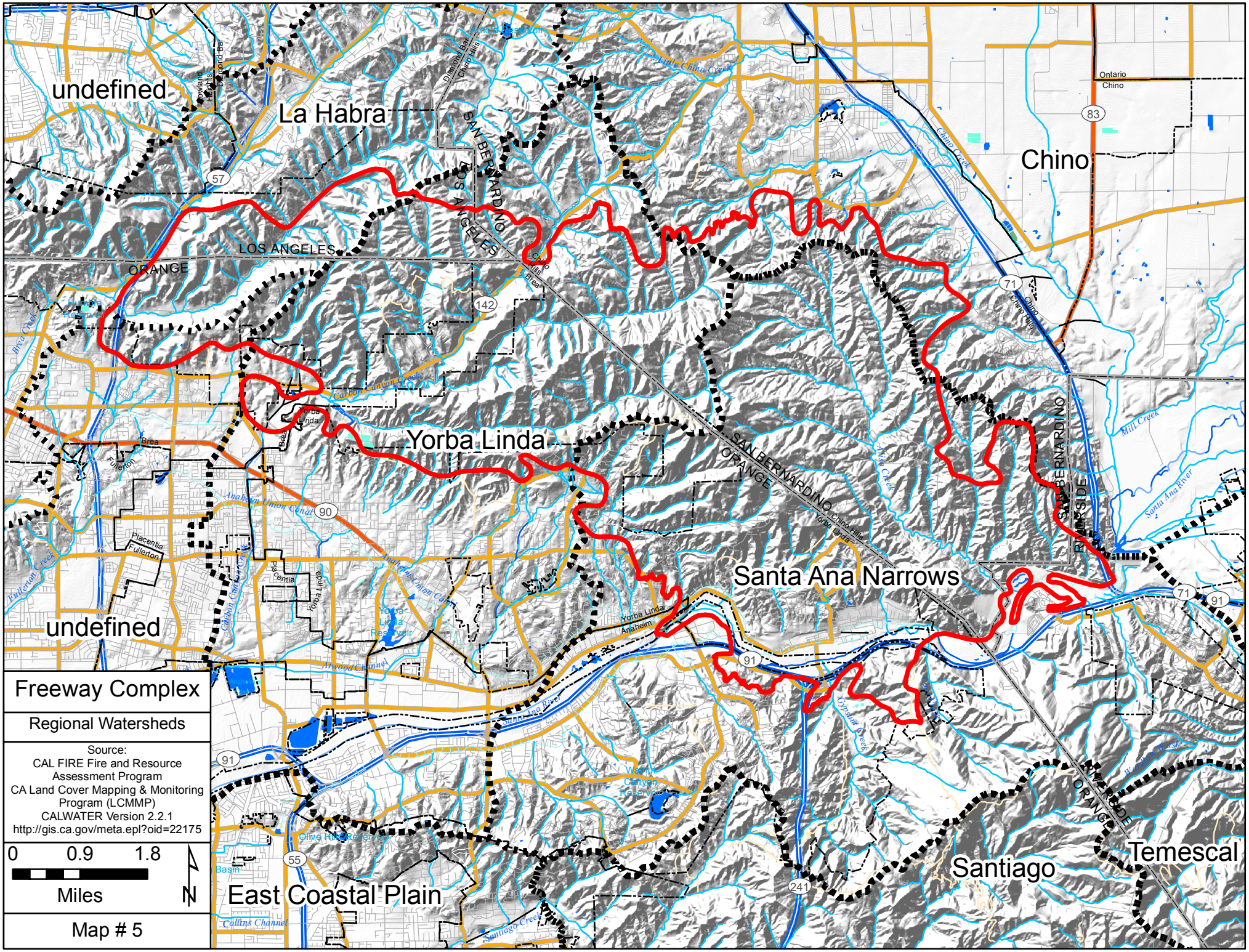
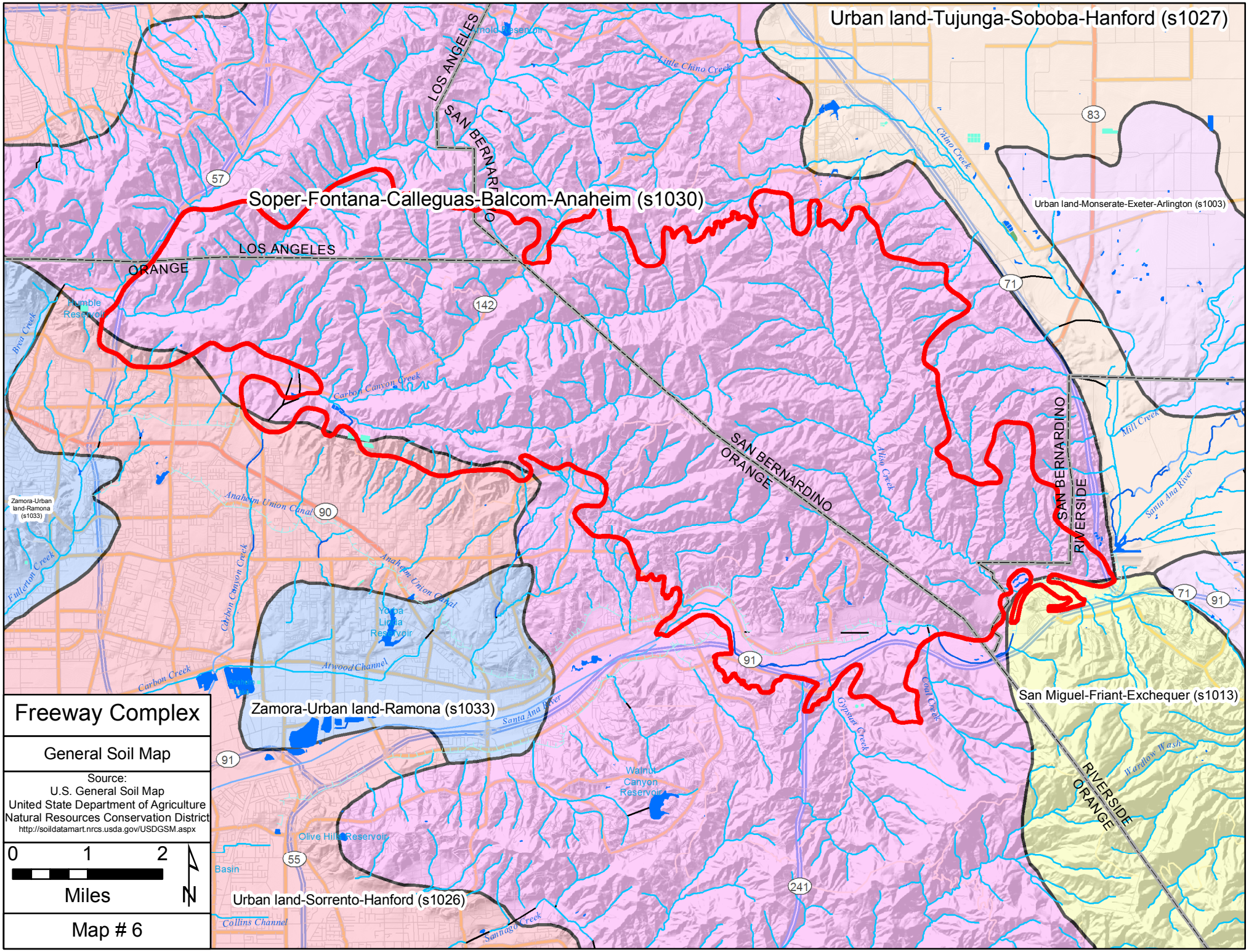

Chino Hills State Park
LOS ANGELES
ORANGE
SAN BERNARDINO
RIVERSIDE
Freeway Complex
General Location Map
0 1 2
Miles
Map # 1

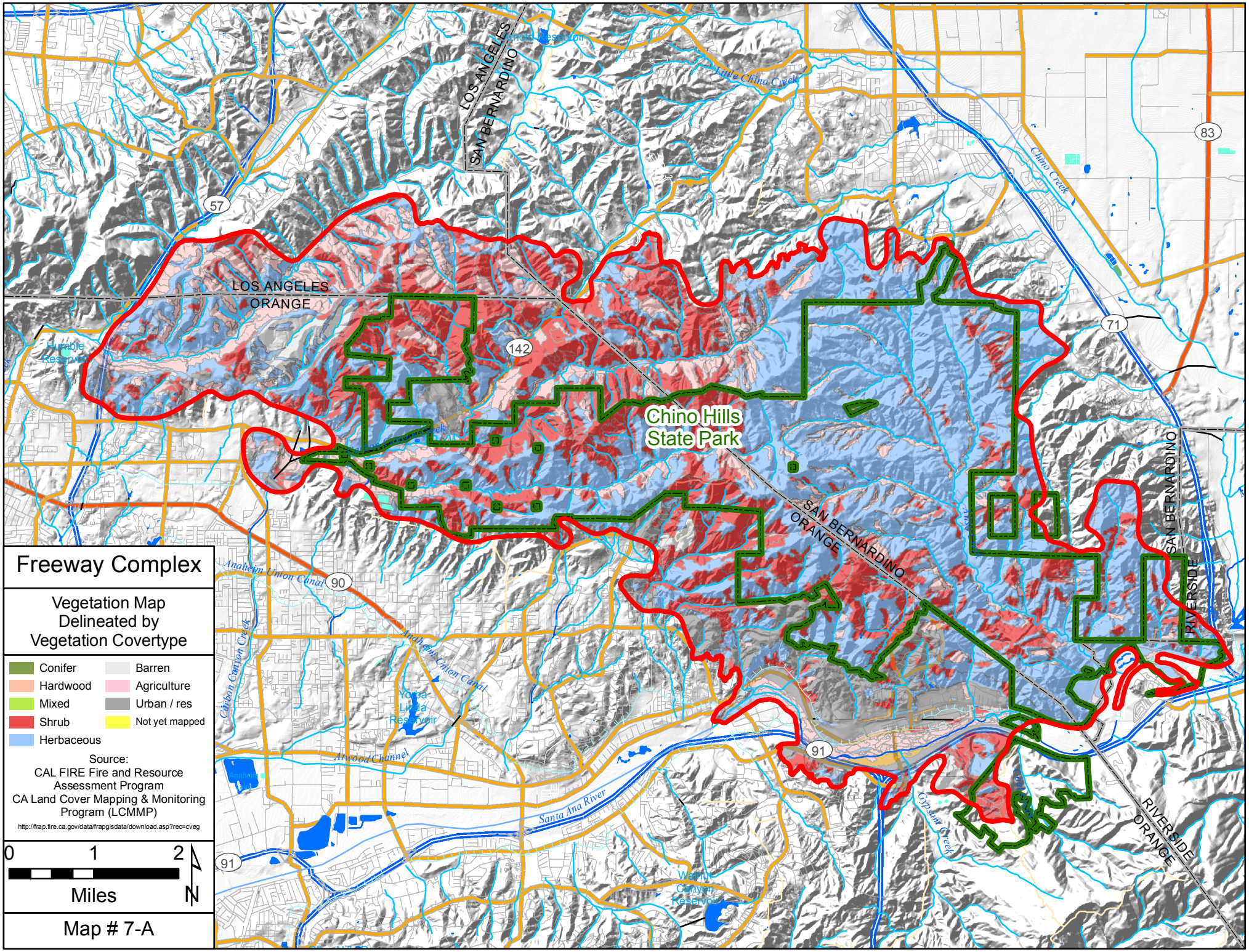

Freeway Complex
Burned Area Reflectance Classification (BARC)
Burn Severity
Unburned 23.83%
Low 33.74%
Moderate 39.12%
High 3.31%
United States Department of Agriculture
U.S. Forest Service
BAER Imagery Support Data Download
http://activefiremaps.fs.fed.us/baer/download.php
0 1 2
Miles
N
Map # 2
LOS ANGELES
ORANGE
SAN BERNARDINO
RIVERSIDE
Ontario
Chino
Yorba Linda
Brea
Fullerton
Placentia
Anaheim
Chino Hills
Rowland Heights
Diamond Bar
Santa Ana River
Prado Basin
Collins Channel
Olive Pit Reservoirs
Yorba Linda Reservoir
Weir Canyon Reservoir
57
142
71
83
90
91
55
241

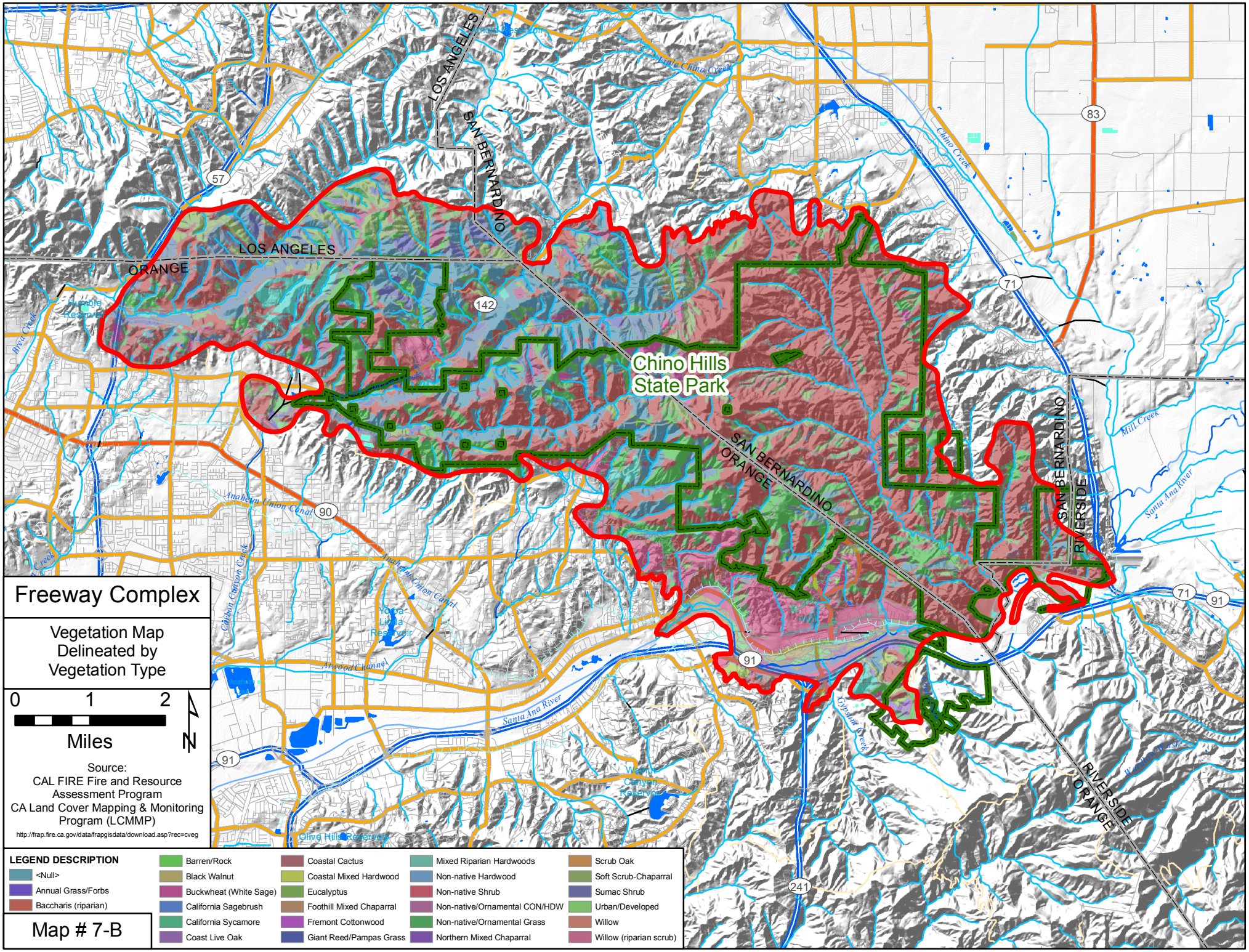

Freeway Complex
Fire Protection Responsibility Areas
Federal (FRA)
State (SRA)
Local (LRA)
Source:
CAL FIRE Fire and Resource Assessment Program
CA Land Cover Mapping & Monitoring Program (LCMMP)
http://frap.fire.ca.gov/data/frapgisdata/download.asp?spatialdist=1&ec=sra
0 1 2
Miles
N
Map # 3
Chino Hills State Park
LOS ANGELES
ORANGE
SAN BERNARDINO
RIVERSIDE
Ontario
Chino
Chino Hills
Brea
Yorba Linda
Placentia
Fullerton
Anaheim
Rowland Heights
Diamond Bar
57
83
71
142
90
91
55
241

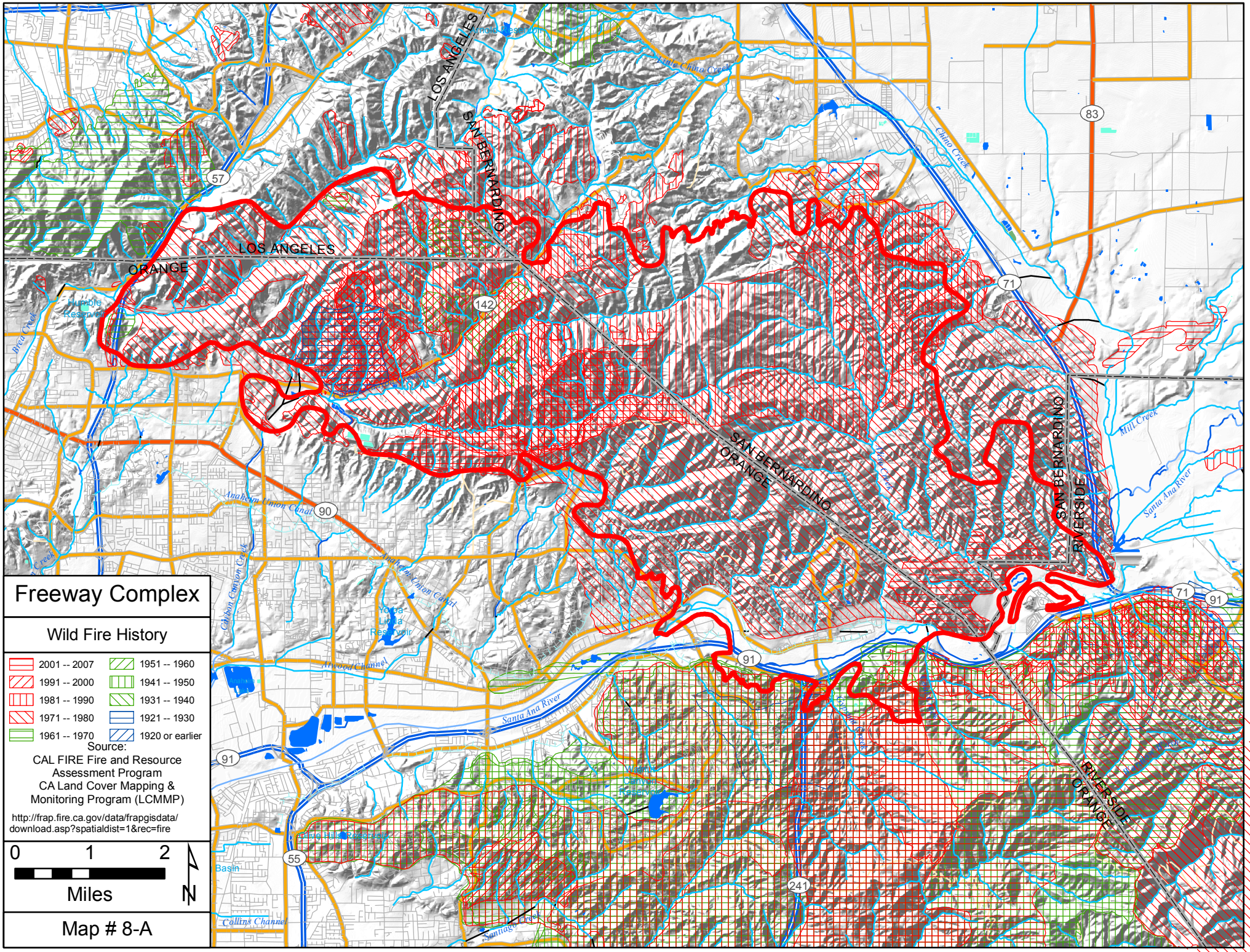

Freeway Complex
Geologic Map
Landslides shaded in red.
Source: Preliminary Geological Map of the 30' x 60' Santa Ana Quadrangle, Southern California, Version 2.0
USGS -- Open File Report 99-172
Refer to Open File Report 99-172 for complete legend.
0 1 2
Miles
N
Map # 4
LOS ANGELES
SAN BERNARDINO
ORANGE
RIVERSIDE
57
142
71
83
90
91
55
241
Santa Ana River
Mill Creek
Warm Creek
Carbon Canyon Creek
Fullerton Creek
Arroyo Channel
Collins Channel
Anaheim Union Canal
Yorba Linda Reservoir
Walnut Canyon Reservoir
Olive Park Reservoir
Basin

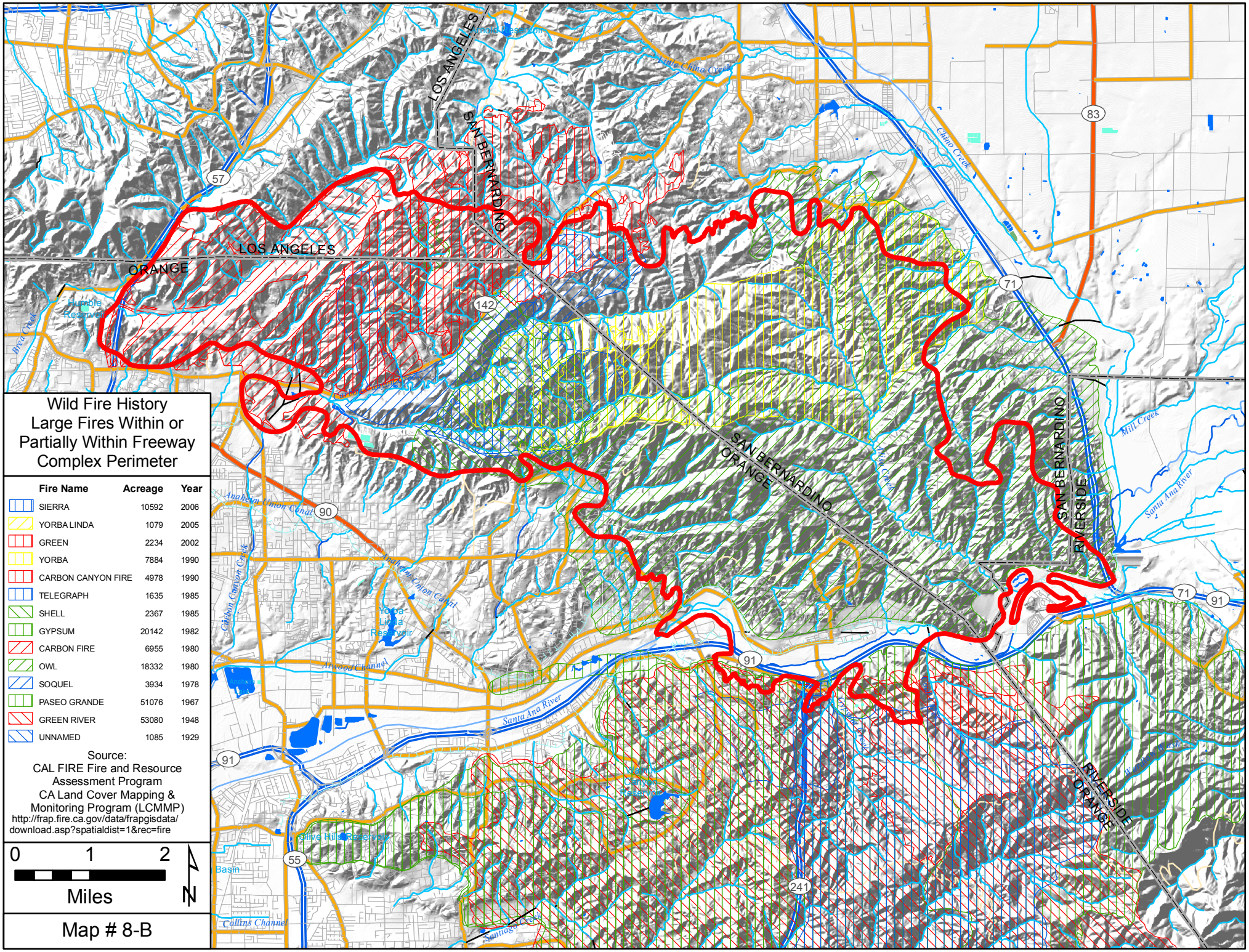

undefined
La Habra
Chino
Yorba Linda
Santa Ana Narrows
undefined
East Coastal Plain
Santiago
Temescal
LOS ANGELES
ORANGE
SAN BERNARDINO
RIVERSIDE
Freeway Complex
Regional Watersheds
Source:
CAL FIRE Fire and Resource Assessment Program
CA Land Cover Mapping & Monitoring Program (LCMMP)
CALWATER Version 2.2.1
http://gis.ca.gov/meta.epl?oid=22175
0 0.9 1.8
Miles
N
Map # 5


Urban land-Tujunga-Soboba-Hanford (s1027)
Soper-Fontana-Calleguas-Balcom-Anaheim (s1030)
Urban land-Monserate-Exeter-Arlington (s1003)
LOS ANGELES
ORANGE
SAN BERNARDINO
RIVERSIDE
Zamora-Urban land-Ramona (s1033)
San Miguel-Friant-Exchequer (s1013)
Urban land-Sorrento-Hanford (s1026)
Freeway Complex
General Soil Map
Source:
U.S. General Soil Map
United State Department of Agriculture
Natural Resources Conservation District
http://soildatamart.nrcs.usda.gov/USDGSM.aspx
0 1 2
Miles
N
Map # 6


Freeway Complex
Vegetation Map
Delineated by
Vegetation Covertype
Conifer
Hardwood
Mixed
Shrub
Herbaceous
Barren
Agriculture
Urban / res
Not yet mapped
Source:
CAL FIRE Fire and Resource
Assessment Program
CA Land Cover Mapping & Monitoring
Program (LCMMP)
http://frap.fire.ca.gov/data/frapgisdata/download.asp?rec=cveg
0
1
2
Miles
N
Map # 7-A
Chino Hills
State Park
LOS ANGELES
ORANGE
SAN BERNARDINO
ORANGE
SAN BERNARDINO
RIVERSIDE
RIVERSIDE
ORANGE
SAN BERNARDINO
LOS ANGELES
57
142
71
83
90
91
91
Anaheim Union Canal
Carbon Canyon Creek
Yorba-
Linda
Reservoir
Atwood Channel
Santa Ana River
Gypsum Creek
Walnut
Canyon
Reservoir
Little China Creek
Chino Creek


Freeway Complex
Vegetation Map
Delineated by
Vegetation Type
0 1 2
Miles
N
Source:
CAL FIRE Fire and Resource
Assessment Program
CA Land Cover Mapping & Monitoring
Program (LCMMP)
http://frap.fire.ca.gov/data/frapgisdata/download.asp?rec=cveg
LEGEND DESCRIPTION
<Null>
Annual Grass/Forbs
Baccharis (riparian)
Barren/Rock
Black Walnut
Buckwheat (White Sage)
California Sagebrush
California Sycamore
Coast Live Oak
Coastal Cactus
Coastal Mixed Hardwood
Eucalyptus
Foothill Mixed Chaparral
Fremont Cottonwood
Giant Reed/Pampas Grass
Mixed Riparian Hardwoods
Non-native Hardwood
Non-native Shrub
Non-native/Ornamental CON/HDW
Non-native/Ornamental Grass
Northern Mixed Chaparral
Scrub Oak
Soft Scrub-Chaparral
Sumac Shrub
Urban/Developed
Willow
Willow (riparian scrub)
Map # 7-B
Chino Hills
State Park
LOS ANGELES
ORANGE
SAN BERNARDINO
RIVERSIDE
57
142
71
83
90
91
241
Santa Ana River
Chino Creek
Mill Creek
Carbon Canyon Creek
Coyote Creek
Brea Creek
Anaheim Union Canal
Yorba-Linda Reservoir
Olive Hills Reservoir
Walnut Canyon Reservoir
Arroyo Channel


Freeway Complex
Wild Fire History
2001 -- 2007
1991 -- 2000
1981 -- 1990
1971 -- 1980
1961 -- 1970
1951 -- 1960
1941 -- 1950
1931 -- 1940
1921 -- 1930
1920 or earlier
Source:
CAL FIRE Fire and Resource Assessment Program
CA Land Cover Mapping & Monitoring Program (LCMMP)
http://frap.fire.ca.gov/data/frapgisdata/download.asp?spatialdist=1&rec=fire
0 1 2
Miles
N
Map # 8-A
LOS ANGELES
SAN BERNARDINO
ORANGE
RIVERSIDE
57
142
71
83
90
91
55
241
Chino Creek
Mill Creek
Santa Ana River
Anaheim Union Canal
Yorba-Linda Reservoir
Arroyo Channel
Carbon Canyon Creek
Brea Creek
Collins Channel



Wild Fire History
Large Fires Within or Partially Within Freeway Complex Perimeter

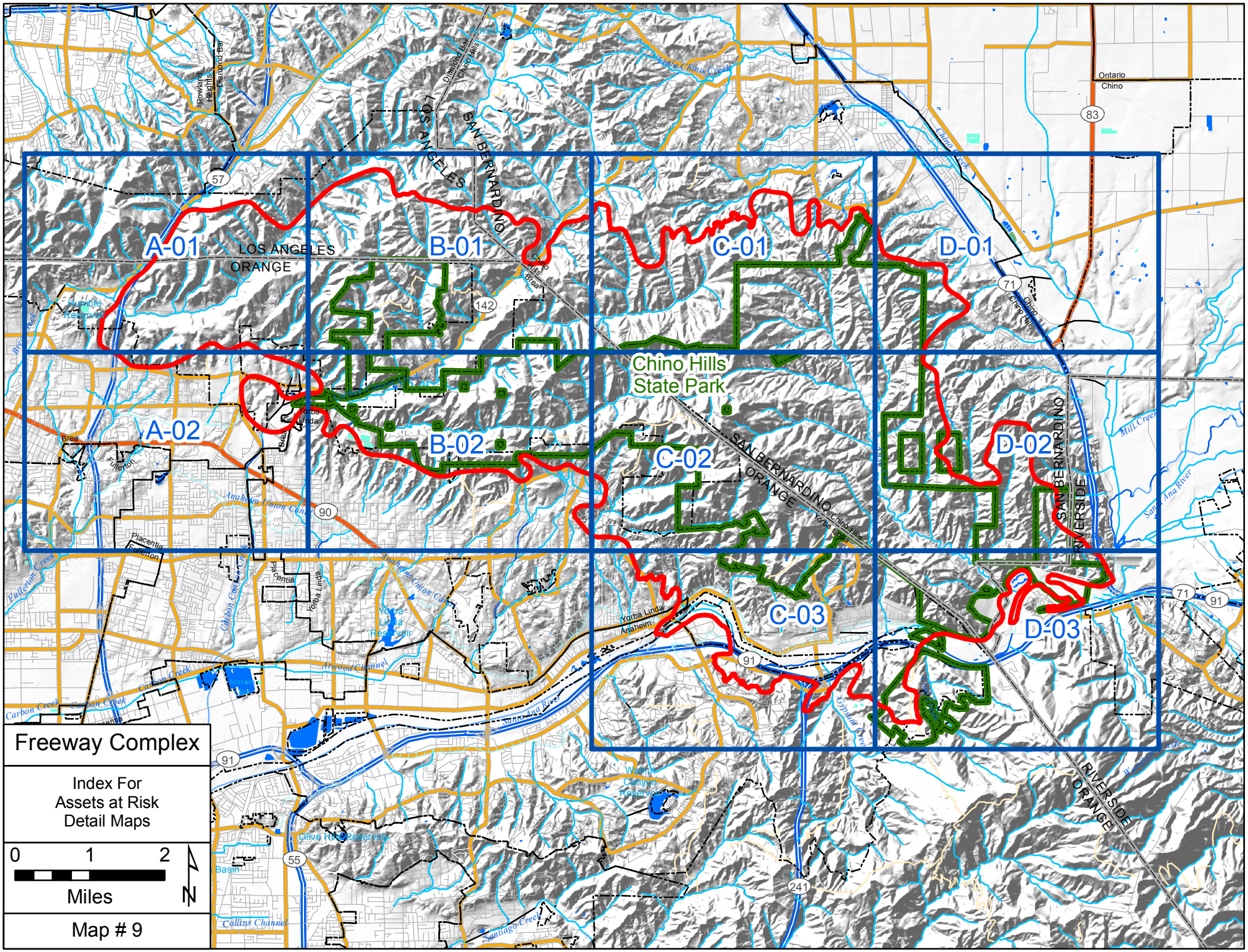
Fire Name	Acreage	Year
SIERRA	10592	2006
YORBA LINDA	1079	2005
GREEN	2234	2002
YORBA	7884	1990
CARBON CANYON FIRE	4978	1990
TELEGRAPH	1635	1985
SHELL	2367	1985
GYPSUM	20142	1982
CARBON FIRE	6955	1980
OWL	18332	1980
SOQUEL	3934	1978
PASEO GRANDE	51076	1967
GREEN RIVER	53080	1948
UNNAMED	1085	1929

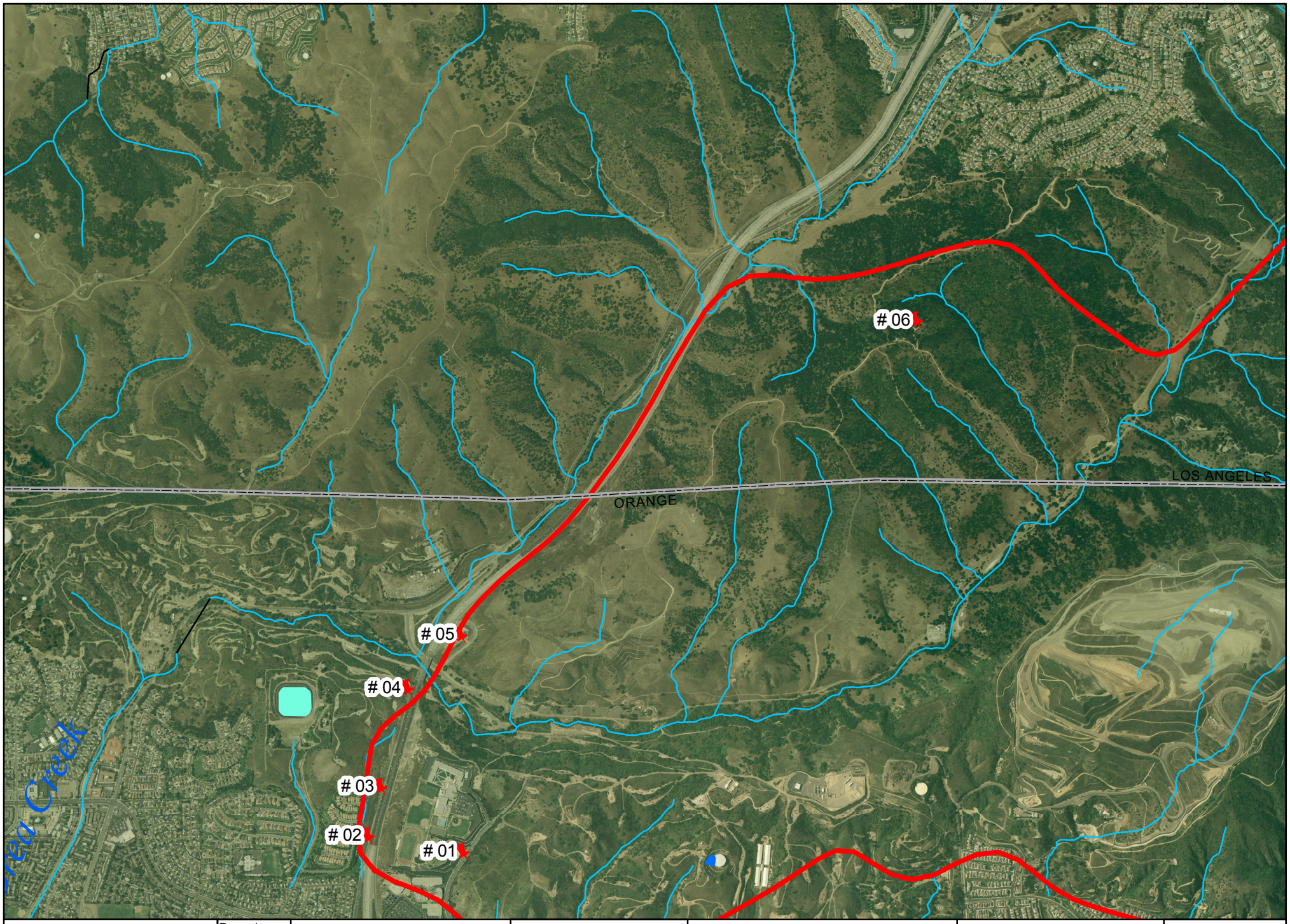
Source:
CAL FIRE Fire and Resource Assessment Program
CA Land Cover Mapping & Monitoring Program (LCMMP)
http://frap.fire.ca.gov/data/frapgisdata/download.asp?spatialdist=1&rec=fire

0 1 2
Miles

N

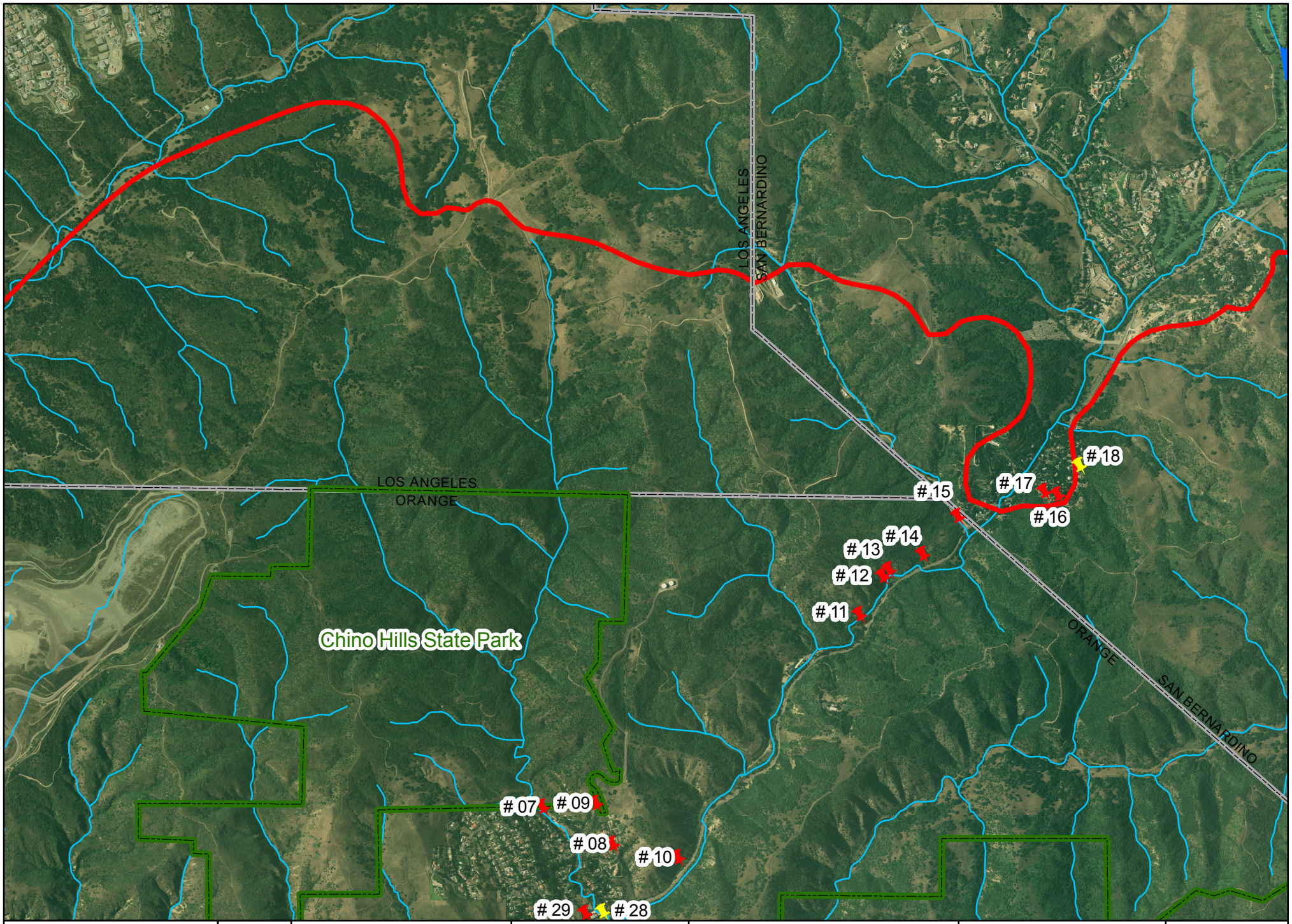
Map # 8-B


A-01
B-01
C-01
D-01
A-02
B-02
C-02
D-02
C-03
D-03
LOS ANGELES
ORANGE
SAN BERNARDINO
RIVERSIDE
Chino Hills
State Park
Freeway Complex
Index For
Assets at Risk
Detail Maps
0 1 2
Miles
N
Map # 9

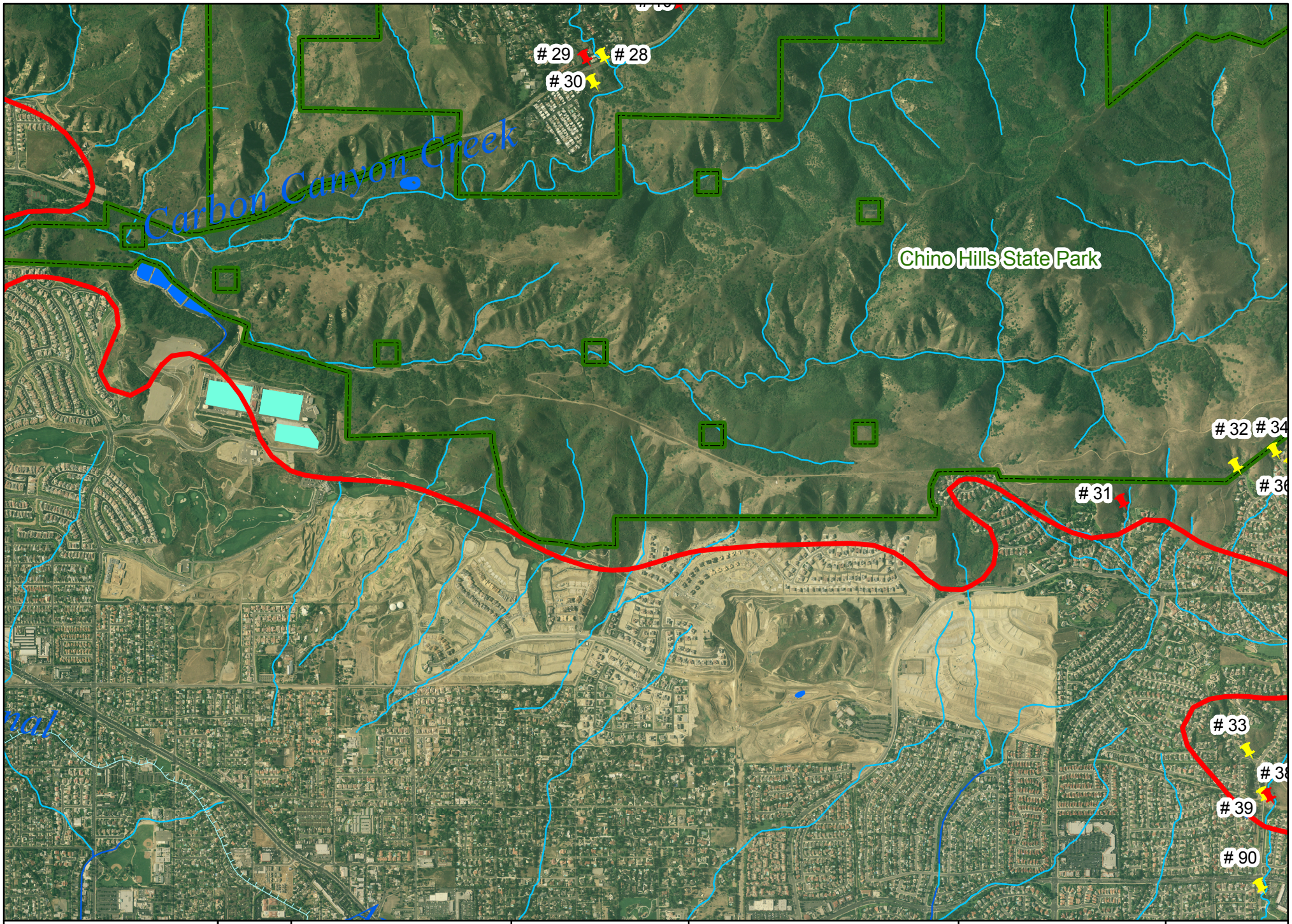


Freeway Complex	Burned Area Recovery Team	Assets at Risk	Liklihood of Occurence: High, Moderate	Freeway Complex Perimeter	0 0.1 0.2 0.3 0.4 0.5 Miles, N	Detail Map #A-01

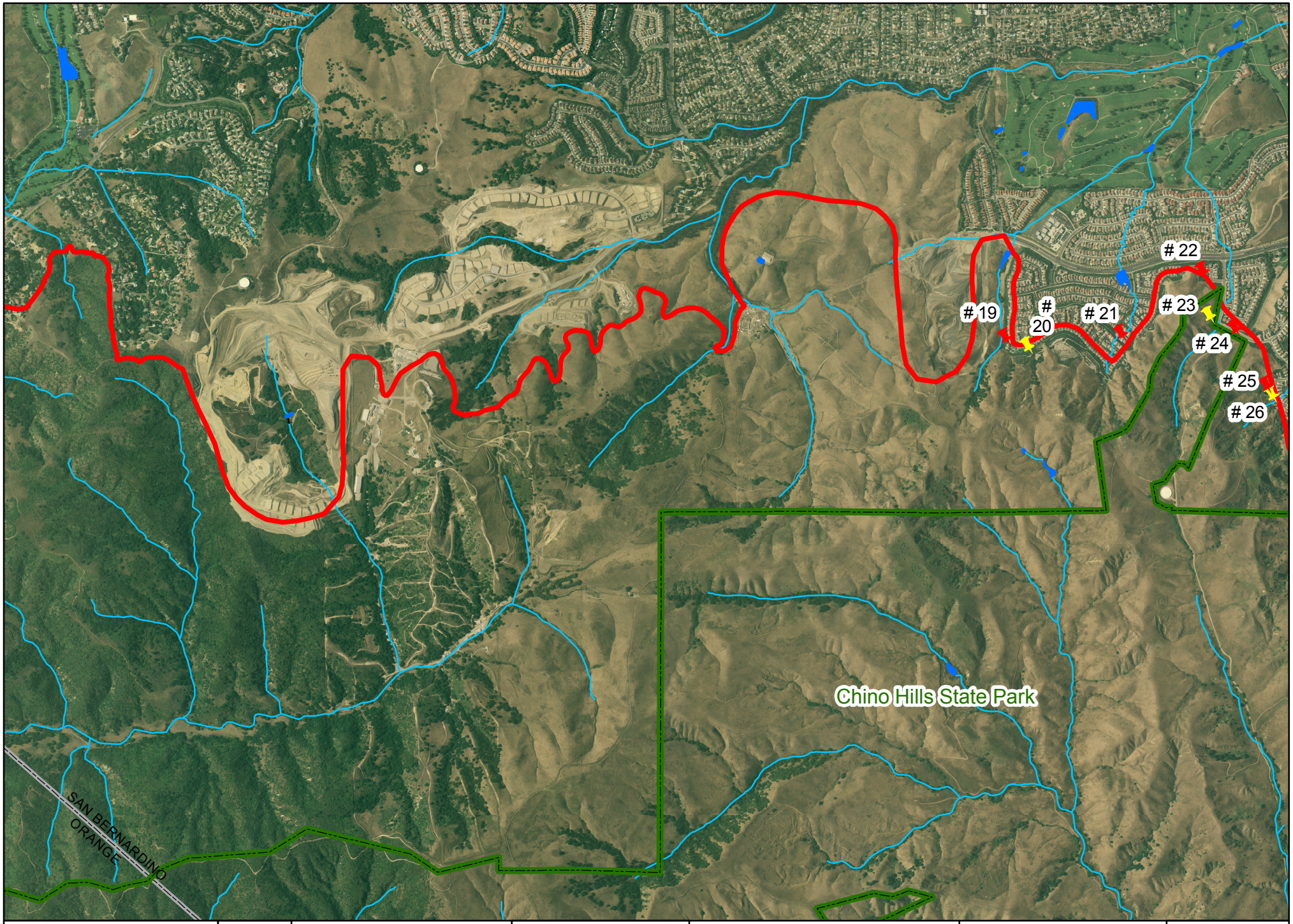
Freeway Complex	Burned Area Recovery Team	Assets at Risk	Liklihood of Occurence: High, Moderate	Freeway Complex Perimeter	0 0.1 0.2 0.3 0.4 0.5 Miles, N	Detail Map #A-02



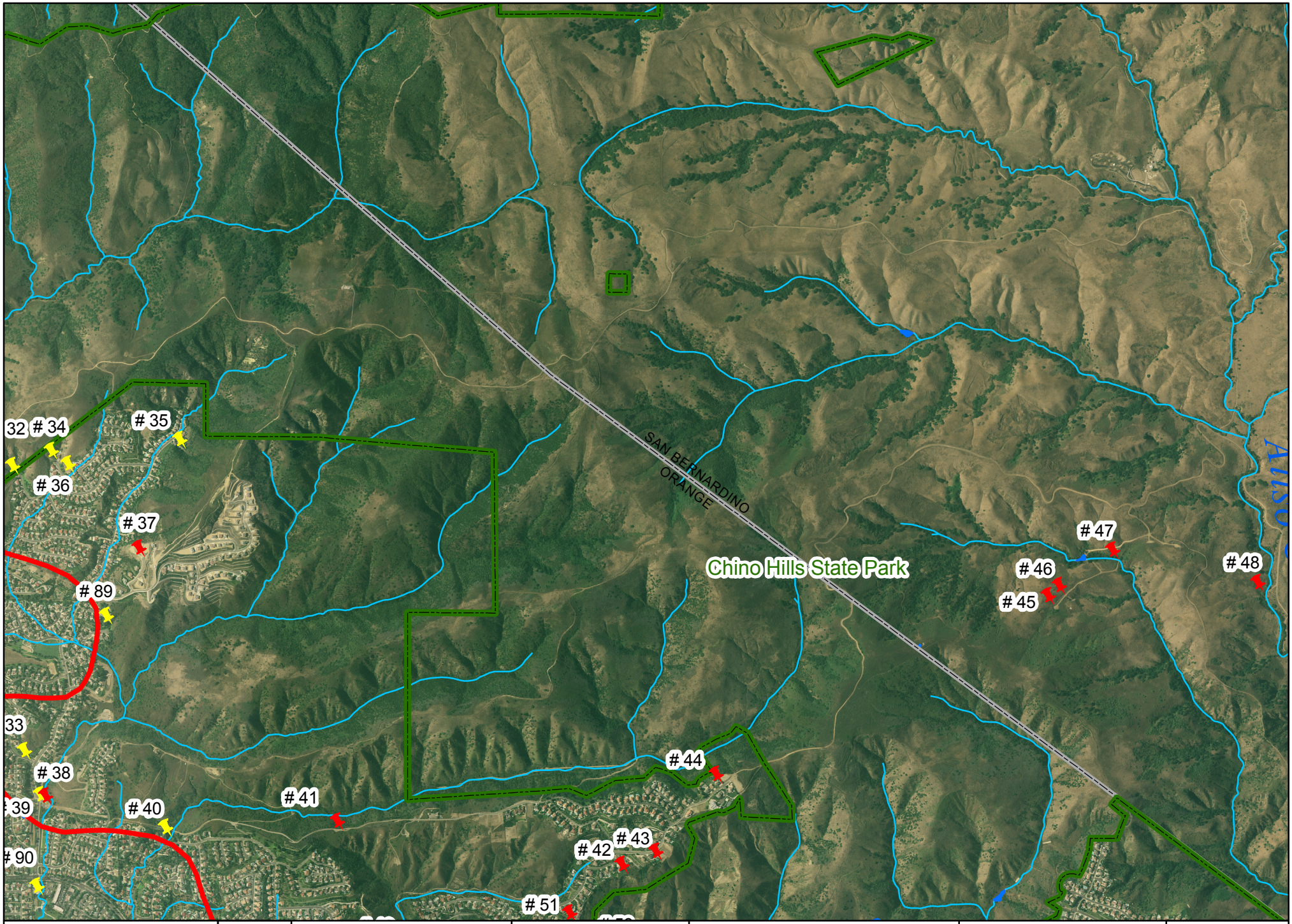
Freeway Complex	Burned Area Recovery Team	Assets at Risk	Liklihood of Occurence: High, Moderate	Freeway Complex Perimeter	0 0.1 0.2 0.3 0.4 0.5 Miles, N	Detail Map #B-01



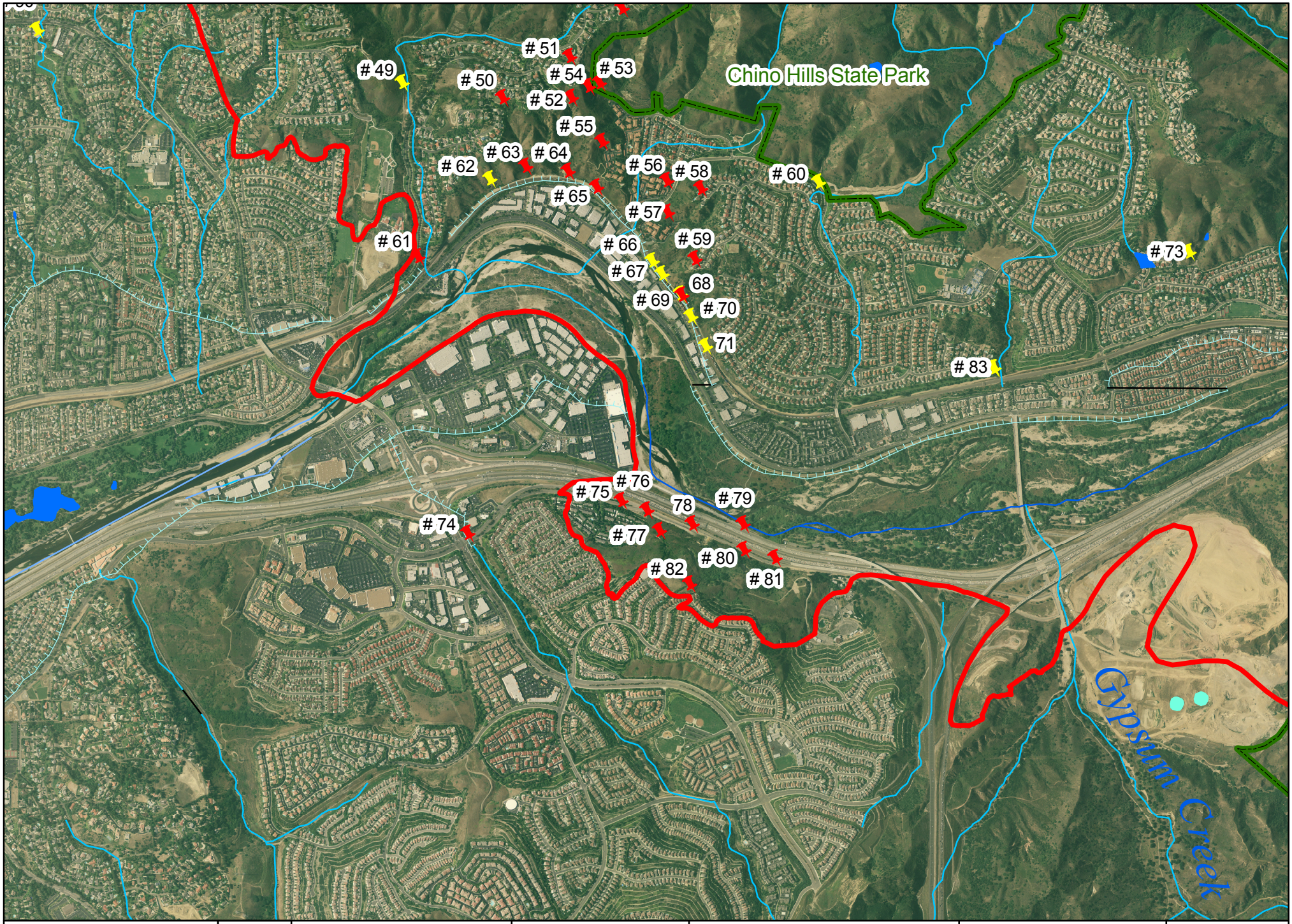
Freeway Complex	Burned Area Recovery Team	Assets at Risk	Liklihood of Occurence: High, Moderate	Freeway Complex Perimeter	0 0.1 0.2 0.3 0.4 0.5 Miles, N	Detail Map #B-02



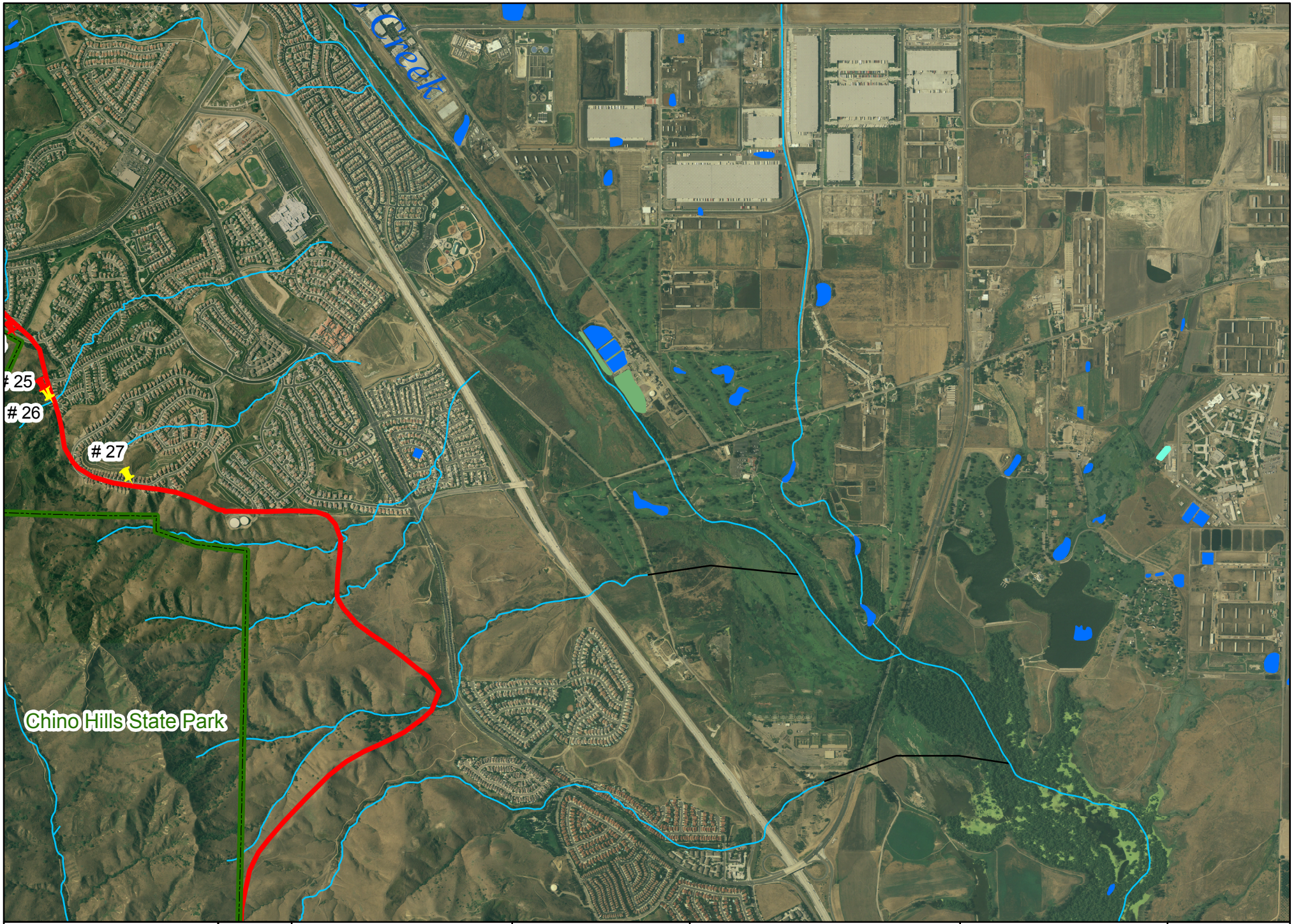
Freeway Complex	Burned Area Recovery Team	Assets at Risk	Liklihood of Occurence: High, Moderate	Freeway Complex Perimeter	0 0.1 0.2 0.3 0.4 0.5 Miles; N	Detail Map #C-01



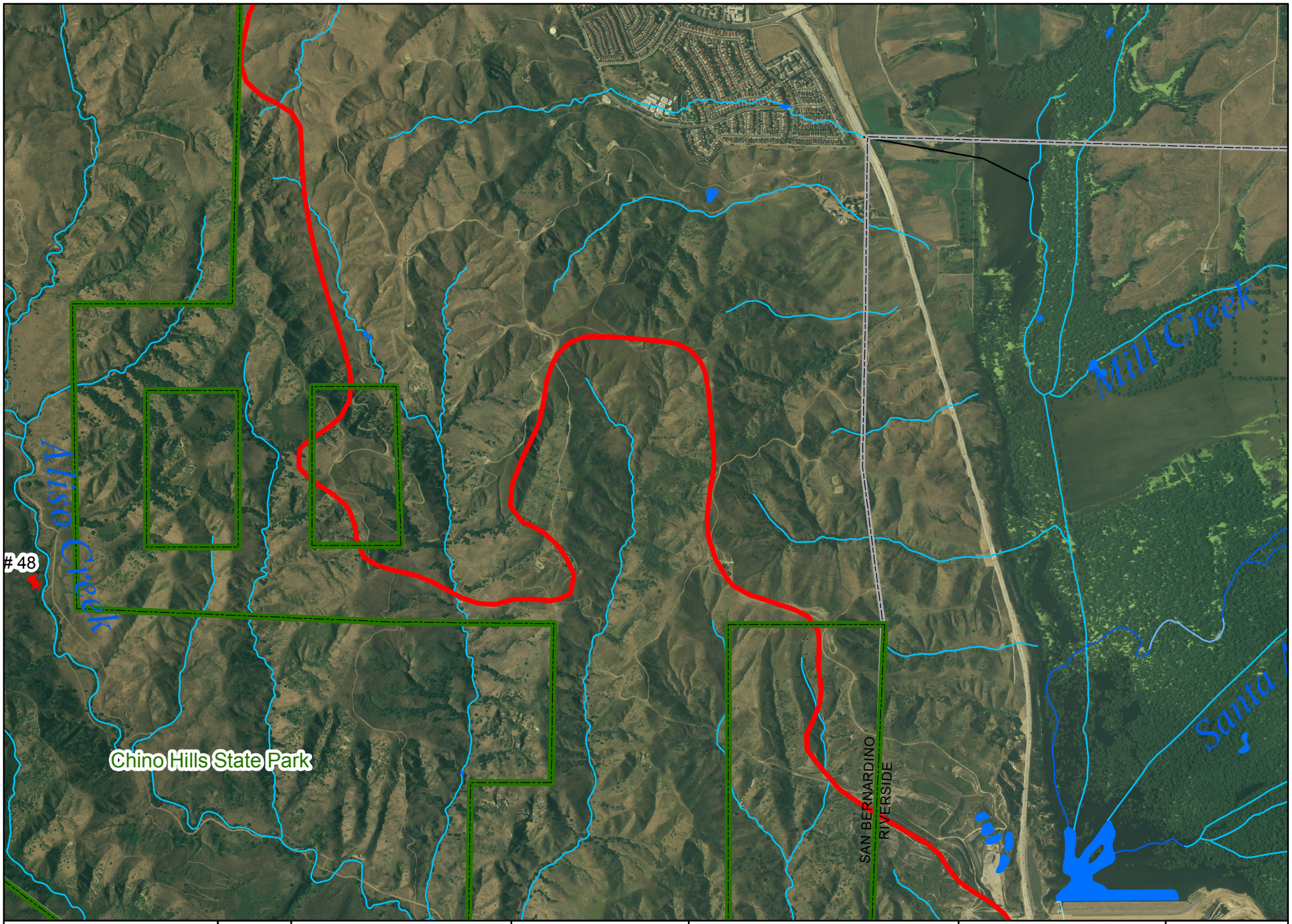
Freeway Complex	Burned Area Recovery Team	Assets at Risk	Liklihood of Occurence: High, Moderate	Freeway Complex Perimeter	0 0.1 0.2 0.3 0.4 0.5 Miles; N	Detail Map #C-02



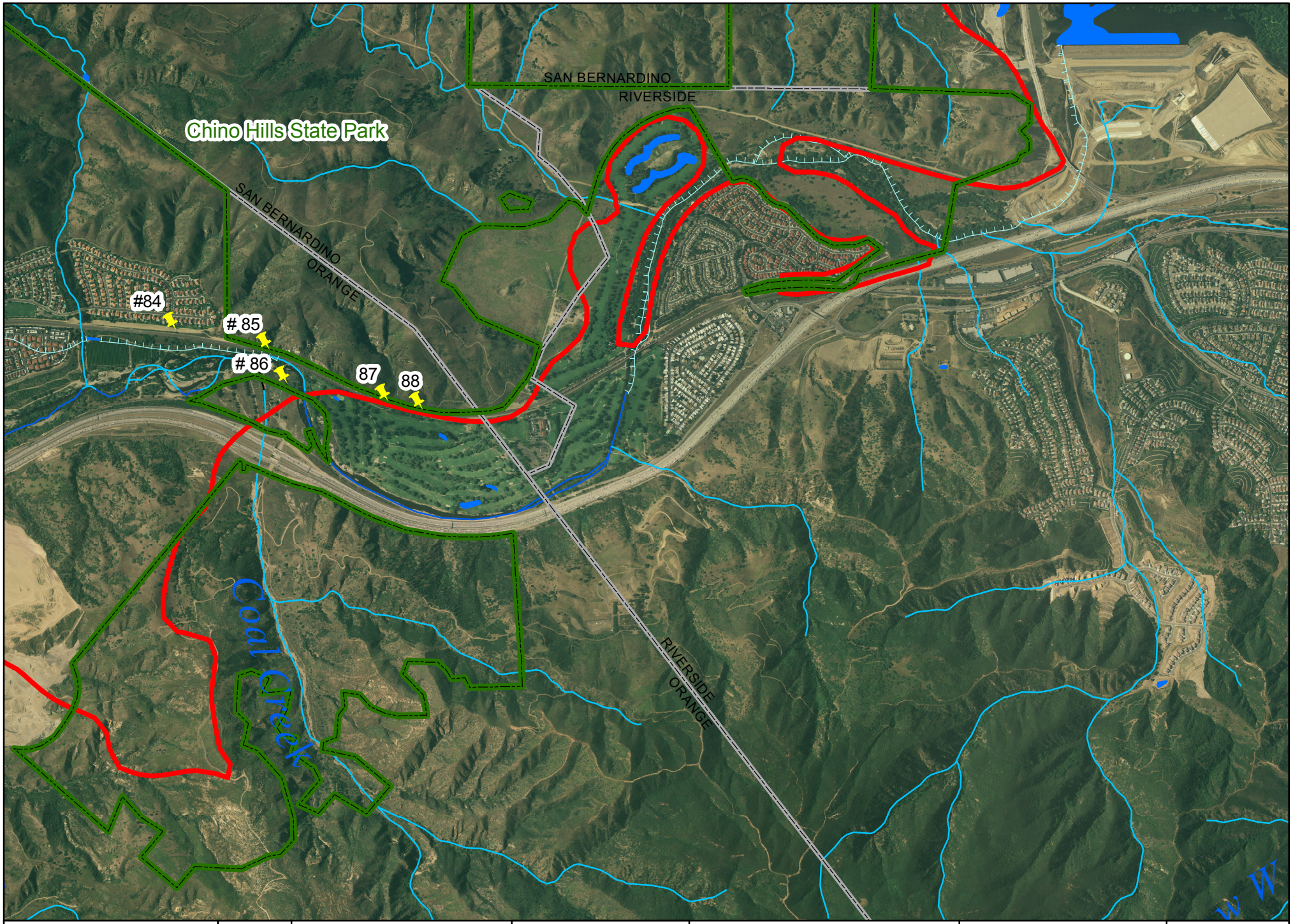
Freeway Complex	Burned Area Recovery Team	Assets at Risk	Liklihood of Occurence: High, Moderate	Freeway Complex Perimeter	0 0.1 0.2 0.3 0.4 0.5 Miles, N	Detail Map #C-03



Freeway Complex	Burned Area Recovery Team	Assets at Risk	Liklihood of Occurence: High, Moderate	Freeway Complex Perimeter	0 0.1 0.2 0.3 0.4 0.5 Miles, N	Detail Map #D-01



Freeway Complex	Burned Area Recovery Team	Assets at Risk	Liklihood of Occurence: High, Moderate	Freeway Complex Perimeter	0 0.1 0.2 0.3 0.4 0.5 Miles, N	Detail Map #D-02



Freeway Complex	Burned Area Recovery Team	Assets at Risk	Liklihood of Occurence: High, Moderate	Freeway Complex Perimeter	0 0.1 0.2 0.3 0.4 0.5 Miles, N	Detail Map #D-03